APPENDIX 9.6

Charles Church (Wales) Limited

NEW RESIDENTIAL DEVELOPMENT GLEBELANDS, NEWPORT

Summary Report with Proposals for Land Remediation/Reclamation Works

9579/RB/07/REV A

Intégral Géotechnique

CLIENT:	**Charles Church (Wales) Limited**
PROJECT:	**New Residential Development, Glebelands, Newport**
TITLE:	**Summary Report with Proposals for Land Remediation/Reclamation Works**
JOB NO:	**9579**
DOCUMENT REF:	**9579/RB/07/REV A**

Revision	Purpose Description	Originated	Reviewed	Authorised	Date
0	Final	RB	HP	VZ	Mar 07
A	Final	RB	HP	VZ	May 07

Geotechnical Engineers:

Intégral Géotechnique (Wales) Limited
50 Cathedral Road
Cardiff
CF11 9LL

Tel: 029 2022 0462
Fax: 029 2034 0789

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EXECUTIVE SUMMARY

Intégral Géotechnique (Wales) Limited have been instructed by Charles Church (Wales) Limited as Geotechnical Engineers to oversee the remediation and reclamation of a residential development in Newport.

Previous site investigations have been carried out across the site by White Young Green, who submitted a Planning Support Statement – Proposed School and Residential Development, Land at Glebelands, Newport Report ref: EV808/GO/PS Summary/DEC060V2.

The planning support document in conjunction with a number of method statements have been accepted in partial discharge of Condition No. 6 of the planning consent, subject to the successful implementation of the method statements.

Intégral Géotechnique have reviewed all available site investigation information and produced a summary report.

The site is located to the north of Newport, between a railway line and the eastern bank of the River Usk, approximately 200m south of the M4 motorway and occupies an area of approximately 8.1hectares.

A detailed human health risk assessment was completed by White Young Green. Intégral Géotechnique are in broad agreement with the risk assessment and the conceptual site model. The model was completed in 2003 and since then considerable refinement of a number of input parameters in line with current UK guidelines has taken place. The risk assessment has therefore been reviewed and the site specific target levels (SSTL's) updated in accordance with CLEA and current UK guidelines. These newly derived SSTL's will be used as remediation targets and for site validation/certification purposes.

The groundwater risk assessment completed by White Young Green has been reviewed and agreed with. There is not considered to be a significant risk to the River Usk.

A detailed ground gas risk assessment has been undertaken by White Young Green. The results of the risk assessment showed some elevated concentrations of methane and carbon dioxide and it was recommended that a clay cap was placed across the site to act as both a barrier for gas and to raise site levels. The practicality of maintaining the required thickness of clay cap is considered unfeasible and can not be guaranteed. It is therefore proposed that the clay cap is omitted and replaced by excess fill materials present in the northern part of the site. This will be subject to further gas monitoring. Flux box testing is proposed and is currently programmed to be carried out across the site. Flux box testing allows a more accurate assessment of actual surface gas conditions present at the site. It is anticipated that the flux box testing will demonstrate that the clay cap is not required. However, should this not be the case, and unacceptable concentrations are detected, further risk assessment will be carried out and suitable engineering measures incorporated.

PCB's have been identified in the northern part of the site, and in the proposed school site to the north. The PCB affected materials and any associated drums are to be excavated and removed from site. These works will be supervised and validated accordingly.

The site needs to be raised in order to meet flood protection requirements. Since the site is underlain by alluvial clay, settlement is the main geotechnical consideration. The ground will therefore be surcharged in phases by placing a thickness of material on top of the ground and allowing it to settle. The process of settlement will be speeded up by the installation of a series of band drains across the site. The phasing of the required works is provided on a series of drawings appended to this report.

Further monitoring in the form of both geo-environmental and geotechnical is required across the site, both during and after completion of the required works. This includes sampling and testing of groundwater, gas monitoring, testing and validation of garden capping materials and settlement monitoring in the form of piezometers, extensometers and plated settlement monitoring.

1.0 INTRODUCTION

Charles Church (Wales) Limited are proposing to develop approximately 8.1 hectares of land located to the north of Newport, between a railway line and the eastern bank of the River Usk, approximately 200m south of the M4 motorway.

The site is located at an approximate National Grid reference of ST 317 896.

Intégral Géotechnique (Wales) Limited have been appointed as the Geotechnical Engineers to oversee the remediation and reclamation of this residential development site.

Many previous site investigations have been carried out by White Young Green regarding the environmental considerations which required detailed assessment under the discharge of Planning Condition No. 6 applied to Planning Consent Application No. 00/0768/DC.

In conclusion of the White Young Green investigation, White Young Green compiled and submitted a Planning Support Statement – Proposed School and Residential Development Land at Glebelands, Newport Report, ref EV808/GO/PS Summary/DEC060V2. The document included Appendices A to H.

The Planning Support document, in conjunction with method statements for the removal of PCB contaminated materials, capping of the northern area, enabling and filling works in the southern area and installation of vertical band drains has been accepted in partial discharge of Condition No. 6, subject to the successful implementation of the method statements.

Intégral Géotechnique (Wales) Limited have reviewed all the environmental and geotechnical data produced to date and have produced this summary report with proposals for land remediation and reclamation works.

2.0 AVAILABLE SITE INVESTIGATION INFORMATION

Intégral Géotechnique (Wales) Limited have been forwarded site investigation reports and drawings which date back to June 2000. The reports have been prepared by Intégral Géotechnique (Wales) Limited in conjunction with Gwent Consultancy, Atkins, Norwest Holst, W S Atkins, White Young Green and Terra Dat.

A detailed schedule of the site investigation data reviewed by ourselves is presented in Appendix A.

3.0 EXISTING PLANNING CONDITIONS & METHOD STATEMENTS

A Planning Consent, Application No. 00/0768/DC has been granted for the development of the residential site in conjunction with the school site to the north. The greater scheme, referred to as Durham Road Schools PFI project was subject to a Contamination Remediation Condition.

This Condition, No. 6A and B has been partially discharged subject to the implementation of various method statements. The method statements submitted under the Planning Application are as follows:

- Method statement for the removal of PCB contaminated material Revision A
- Method statement for the capping of the northern area Revision A
- Method statement for enabling and filling works in the southern area Revision A
- Method statement for installation of the vertical band drains Revision A

Intégral Géotechnique (Wales) Limited have reviewed the content of these method statements. Our comments regarding proposed addendum to the existing Planning Conditions and method statements are further discussed in Section 4.6 of this report.

4.0 ASSESSMENT OF THE AVAILABLE DATA & RECOMMENDATIONS

4.1 SUMMARY OF HUMAN HEALTH RISK ASSESSMENT

We have reviewed the content of the Planning Support Statement provided by White Young Green. With regard to the human health risk assessment, we have paid particular attention to Appendix D, Quantitative Risk Assessment for Ground Conditions recorded during 2003 investigations and Appendix G, Planning Support – Enhanced Ground Contamination Risk Assessment and Remediation Strategy V1 of May 2005.

We are in broad agreement with the conceptual site model, risk assessment methodology and the RBCA Risk Assessment Model that has been used to calculate the site specific target levels (SSTLs) which are reviewed in these reports. However, we note that the risk assessments were carried out in 2003. Since the time of publication of the risk assessments, considerable refinement of the input parameters in line with CLEA guidance and UK legislation has taken place.

We note that several contaminants of concern recorded at the site are identified by the White Young Green reports at US_{95} concentrations above the calculated SSTL values within the Planning Support Statement.

The identified contaminants of concern above the SSTL are as follows:

- Benzo(a)anthracene
- Benzo(a)pyrene
- Dibenzo (a,h) anthracene
- Arsenic
- Nickel
- Benzene
- TPH Band C5-C7
- PCB Congener 28
- PBC Congener 52
- PCB Congener 101
- PCB Congener 138
- PCB Congener 153
- PCB Congener 180

Details of the US_{95} values for these contaminants of concern are presented in Table 6.6 of the Planning Support – Enhanced Ground Contamination Risk Assessment and Remediation Strategy Report.

4.1 SUMMARY OF HUMAN HEALTH RISK ASSESSMENT (CONTINUED)

With regard to the PCB contamination, no revision of the published SSTLs and associated remediation strategy is proposed.

It is proposed that the PCB contamination is excavated and removed in line with the method statements, with the areas of excavation being defined more accurately by cross reference to the Terra Dat Geophysical Report identifying metallic anomalies in the ground reflective of the PCB drums. The excavations will be tested and validated in accordance with the site specific target levels as published by White Young Green and submitted under the planning process.

With regard to the remaining elements and compounds, we have produced revised calculations for the site specific target levels using the RBCA Toolkit for Chemical Releases. The model has been used by utilising the existing conceptual site model previously proposed by White Young and Green, however, several input parameters have been revised in line with current guidance and best practice. The model has not been run to include the inhalation of vapours via the indoor air pathway since all buildings will benefit from gas protective membranes.

The results of the revised risk assessment and a summary of the SSTLs are given in Appendix B.

The revised SSTLs will be used as remedial targets during validation of the proposed remediation/reclamation works.

4.2 SUMMARY OF GROUNDWATER QUALITY RISK ASSESSMENT

We have reviewed the content of the White Young Green Planning Support – Enhanced Ground Contamination Risk Assessment and Remediation Strategy. We are in agreement with the conclusions of the R & D P20 quantitative risk assessments prepared for the site. It is concluded in line with the White Young Green report that there is no significant risk to the River Usk from the groundwater beneath the site.

Proposals for further monitoring and testing of groundwater quality are given below in Section 4.5.1.

4.3 SUMMARY OF GROUND GAS RISK ASSESSMENT (CONTINUED)

All buildings will benefit from gas protective membranes and passively vented sub floor voids. These protection measures meet the requirements of classification Amber 1.

Measurements from boreholes can result in unrealistic gas readings since the borehole provides a preferential flow path for gas migration and a void in which gas can accumulate. In order to more accurately demonstrate the actual gas regime at the site, a number of flux box tests are proposed and are currently programmed across the site, and focusing in particular on the area of the two boreholes that detected elevated methane. Flux box tests allow an assessment of gas conditions at the ground surface.

It is anticipated that the flux box tests will demonstrate that the 650mm thick clay cap proposed by White Young and Green is not required. Should the flux box tests indicate unacceptable concentrations of methane or carbon dioxide at the ground surface then further risk assessment will be carried out and suitable engineering measures incorporated.

From experience of similar gas/ground conditions in other areas of Newport and in Cardiff, the gas regime of a site can change significantly following reclamation works and piling operations. Hence, it is proposed to carry out further flux box gas monitoring, post piling/reclamation, at the head of driven piles, to demonstrate more accurately the existing gas regime.

4.4 GEOTECHNICAL CONSIDERATIONS

Site levels are to be raised in order to provide a development plateau in line with the flood protection requirements for the site. It is anticipated that finished ground level for the development will be set at no lower than 8.87m AOD.

The materials required for raising the existing ground levels should be clean, inert acceptable materials. Allowance should be made for the stripping of topsoil materials and removal of hedgerows and remnant structures at the site. Additionally, the bases of existing reens should be fully cleaned out.

Any existing services will need to be removed or protected and diverted from beneath the development areas. It is anticipated that the water course to be culverted will be constructed in accordance with a specific method statement allowing for concreting of the invert of an oversized pipe, post settlement in order to retain flow capacity.

4.4 GEOTECHNICAL CONSIDERATIONS (CONTINUED)

The works will be carried out in accordance with the method statement for enabling and filling works to the southern areas as prepared by Norwest Holst Limited.

It is proposed, however, to vary the method statement at point 6.15 requiring the placement of a 650mm thick clay barrier being placed on top of the drainage layer.

In line with the gas risk assessment presented in Section 4.3 of this report, it has been demonstrated that the need for a 450mm thick clay barrier acting as an inground gas barrier has been superseded by the risk assessment recommending the installation of gas protection measures and ventilation of sub-floor voids within the building structures only, subject to substantiating flux box gas test results. This point is further discussed in Section 4.7.

A minor variation to the previously proposed earthworks will be carried out as follows. On completion and validation of the PCB removal, the northern area will be reduced in level by approximately 0.5m below existing ground level. These materials will be tested and screened against the calculated SSTL concentrations including pcb concentrations and if satisfactory, placed as part of the greater fill to the southern areas of the site. Any material above SSTL levels will be reworked from site to a licensed tip. This work is being undertaken to reduce ground levels in the northern areas to approximately 0.6m below finished ground level since this area is currently raised above the flood protection requirement. Upon replacement of 600m of clean capping materials in line with our revised RBCA SSTL levels, this area will be stabilised and will not be subject to further settlement.

The phasing of the construction works for the southern housing areas of the site are outlined on the W S Atkins Consultants Drawing Nos. 5041855/AA/400/1000 to 1007 inclusive. The Drawings are presented in Appendix C. Additionally, a cross section of the Earthworks planned are illustrated in Figures 1 and 2.

In summary, the works outlined in the Drawings contained within Appendix C are broadly as follows:

- Japanese Knotweed will be removed and disposed of off site
- The existing bases to the south of the site will be grubbed out
- A temporary haul road will be formed running north to south across the central reaches of the site

4.4 GEOTECHNICAL CONSIDERATIONS (CONTINUED)

- A 1200mm diameter culvert falling to head wall at the River Usk will be constructed controlling the existing reen at the site
- Overhead electric cables will be grounded
- The residential area underlying the main spine road and to the west of the main spine road will be raised in level to 8.7m AOD. Imported surcharge materials will be placed over and above 8.7m to 10.7m for a 24 month period
- Remove PCB contamination in line with method statements after geophysical survey
- Reduce northern area 500mm and re-use fill to southern area of site
- Install band drains to the southern and eastern areas of the site, install Terram protected 300mm thick granular free draining blanket. The granular drainage blanket and terrain geotextile layers will be placed over the entire southern low lying area
- Spread and level materials stockpiled from earlier phases and import granular quarry shale to fill materials to 8.7m AOD
- Surcharging materials will be moved around the site in a phased manner in accordance with the plans contained within Appendix C.

The primary geotechnical consideration is the settlement of the land form upon placement of the fill materials. Rigorous quantitative monitoring will be undertaken in order to control and assess the settlement of the proposed remediation/reclamation scheme. Further details of the proposed monitoring are laid out in Section 4.5.

4.5 PROPOSED MONITORING

4.5.1 Geo-environmental

Groundwater and ground gas monitoring wells are to be installed and existing wells retained and extended during the course of the site filling works. These wells will be monitored on a 6 weekly basis until an assessment of the groundwater data confirms that equilibrium conditions are present. It is not anticipated that any problematic variations to the existing data will be encountered as all materials to be imported to the site will be certified as clean and inert and would not present a source of contaminants so as to detrimentally affect the groundwater regime at the site.

However, it is considered prudent that further groundwater monitoring is carried out to confirm this assumption. Upon the raising of the site levels, within each phase a further validatory round of flux box gas monitoring will be undertaken to confirm that the baseline gas risk assessments anticipated at the site are reflective in the remediated plateau.

4.5 PROPOSED MONITORING (CONTINUED)

Upon completion of placement of the fill materials to 8.7m AOD, a series of grid samples on a 40m grid will be taken of the imported fill materials at around 8.7m AOD and cross-referenced with the importation materials validation chemical results in order to demonstrate that placed materials have not become compromised by the civil engineering activities at the site.

All materials provided as garden capping within the final 600mm of fill will be clean and inert in accordance with SGV guidelines for residential properties with plant uptake. Routine monitoring of capping thickness and chemical composition of garden soils to a depth of 600mm will be undertaken as the various phases of the development proceed. Sampling of imported materials will be in line with Norwest Holst Limited method statement for enabling and filling works to the southern area.

4.5.2 Geotechnical

A series of piezometers, extensometers and plated settlement monitoring points will be installed across site areas to be raised in level. Upon placement of the proposed phased surcharge areas, settlement monitoring will commence until the predicted final settlement for materials raised to 8.7m AOD is reached. Upon establishing that settlement has been controlled to the full extent of the requirements of the proposed plateau finished levels, surcharging may be removed from the phase and reinstalled upon the subsequent area to be surcharged.

In this phased fashion, the need to remove large quantities of surcharged materials from the site after final site levels have been stabilised should not be necessary.

4.6 PROPOSED ADDENDUM TO THE EXISTING PLANNING CONDITIONS

The recommendations given in the method statements for site works submitted in discharge of Planning Condition No. 6 are largely to be upheld by the proposed remediation and reclamation scheme.

In line with the summary of ground gas assessment presented in Section 4.3 of this report, it is proposed to omit the 450mm thick clay barrier as required by the original White Young Green gas risk assessment.

APPENDIX A

SCHEDULE OF AVAILABLE SITE INVESTIGATION DATA

DURHAM ROAD, GLEBELANDS
PERSIMMON HOMES

SCHEDULE OF RECEIVED 3RD PARTY DOCUMENTS

Previous IG/Gwent Consultancy Reports

- Newport Brownfield Sites Appraisal prepared by
  Intégral Géotechnique (Wales) Limited and Gwent Consultancy
  Review of Remediation Costs for WDA and Newport County Borough Council. March 2001
  Report Ref. 73231 Rep 2D and February 2001 (and draft of August 2006)

- Newport Brownfield Sites Appraisal. Review of Cost Estimates for Geotechnical and Environmental Constraints by Intégral Géotechnique (Wales) Limited and Gwent Consultancy of January 2001.
  Report No. 73231 Rep 2B

- Gwent Consultancy. Durham Road Schools PFI Project, Newport.
  Contamination Investigation, Interpretative Report June 2000 Report No. GT/72615

Atkins Reports

- Atkins – Durham Road School and Residential Development.
  Planning Noise Impact assessment Report No. 5041855

Norwest Holst Soil Engineering Reports

- Report on a Ground Investigation at Durham Road, Newport.
  Volume One and Volume Two Document Ref. JH/ND/F13041

W.S. Atkins Consultants Limited – Drawings

- Durham Road School – Constraints Drawing
  No. 5041855/GEO/200/2840P2; and
  No. 5041855/GEO/200/2841P1

White Young Green Reports

- WYG – Planning Support Statement – Proposed School & Residential Development
  Land at Glebelands, Newport (Application No. 00/0768) for
  Norwest Holst. Ref. E3808/GO/PS Summary/Dec060V2

  Inc:

  Appendix A — Ground Conditions Desk Top Study Assessment
  (WYG ref. E3803/PG/Aug 03/GC1Av2. Aug 03)

  Appendix B — Report on Ground Investigation at Durham Road, Newport.
  Factual S.I. Report from Norwest Holst Soil Engineering.
  Three Volumes. October 2003

  Appendix C — Site Investigation Interpretative Report
  (WYG ref. E3808/CBP/GIR/Oct 2003/V1)

Appendix D	Quantitative Risk Assessment of Ground Conditions recorded during 2000 and 2003 investigations. (WYG ref. E3808/JV/SP/Oct 03/QRA/V1) October 2003
Appendix E	Site Investigation Factual Report V1 (WYG ref. E3808/AE/CBP/SIFactualRep/Jan05/V1) April 2005
Appendix F	Interpretative Geotechnical Report V1 (WYG ref. E3803/MC/IntGeo/Feb05/V1) April 2005
Appendix G	Planning Support – Enhanced ground contamination risk assessment and remediation strategy V1 (WYG ref. E3808/GO/PSS-RemStrat/MAY05/V1) May 2005
Appendix H	Planning Support – Land gas monitoring and risk assessment report V1 (WYG ref. E3808/JC/LANDGAS/PLANNINGSUPPORT/MAY05/V1) May 2005

- WYG (Draft) – Planning Support- Enhanced Ground Contamination Risk Assessment and Remediation Strategy Site. Land at Glebelands, Newport. App No. 00/0768 for Norwest Holst (Ref E3808/GO/PSS-REMSTRAT/MAY05/V1)

- WYG – Outline Remediation Strategy, Newport for Vinci Investments Limited Ref. E3808/PDG/REMSTRAT/Oct 03/V1

- WYG – Noise Vibration Assessment Doc Ref. E3982/NM/Oct03/V1

- WYG Phase 1 Habitat and Protected Species Survey Report Durham Road Schools PFI., Glebelands, Newport Ref. E0808/EMT/Oct 03/P1 HS & PSS/V1

Terra Dat Report

- Geophysical Survey Report Location of Suspected Buried Drums for WYG Report Ref. 1251

APPENDIX B

REVISED RBCA MODEL AND SUMMARY SSTL'S

SSTL Summary
New Residential Development
Glebelands
Newport

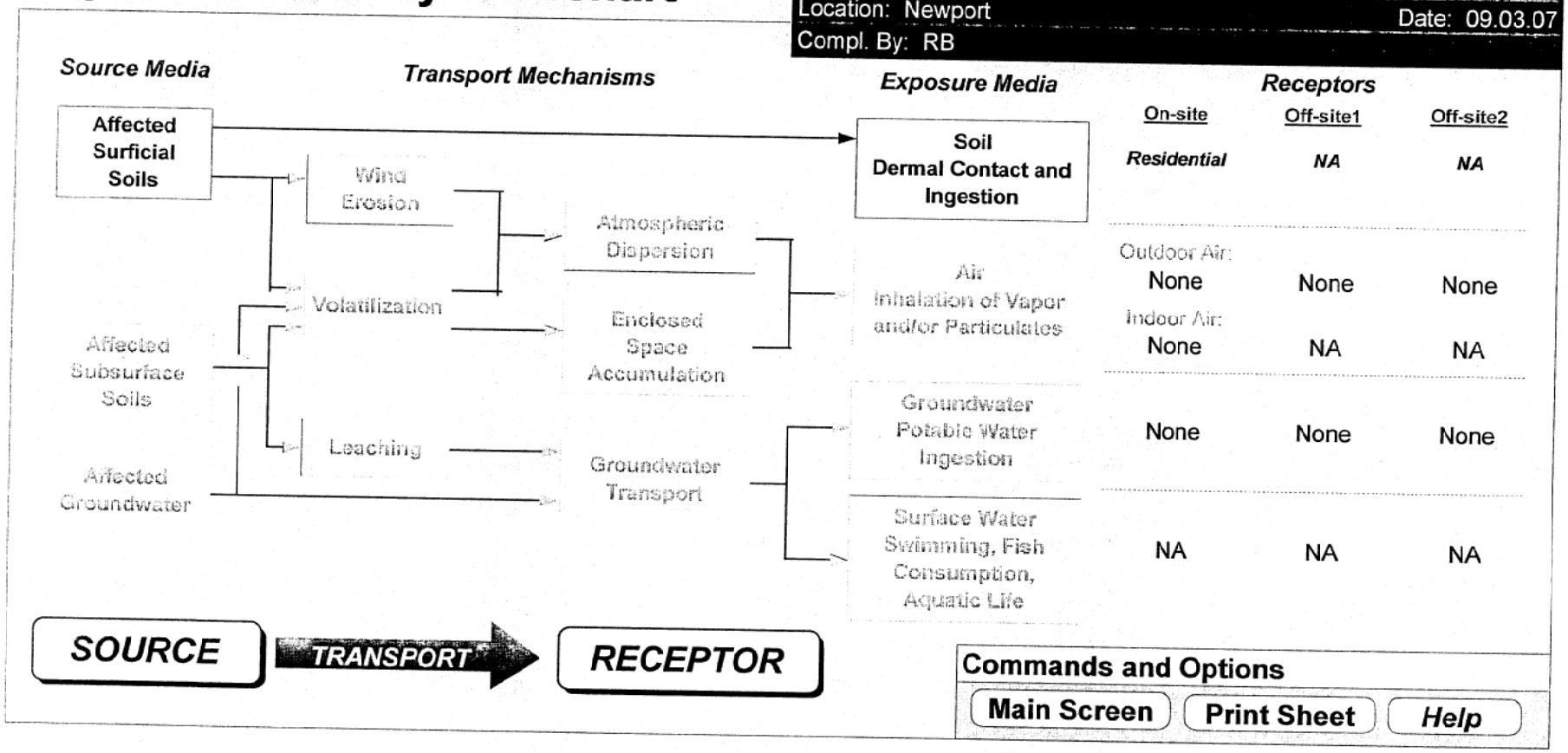
Determinand	Pathway			SSTL
	Dermal Contact & Ingestion	Inhalation		
		Outdoor Air	Indoor Air	
	mg/kg	mg/kg	mg/kg	mg/kg
Arsenic	184.8	374,892.0	N/A	184.8
Cadmium	308.0	898,550.7	N/A	308.0
Chromium (VI)	1,847.8	134,782.6	N/A	1,847.8
Copper	24,637.5	NC	N/A	24,637.5
Mercury	184.8	0.8	N/A	8.0*
Nickel	615.9	3,369,565.2	N/A	615.9
Phenol	75,080.4	>1.5E+5	N/A	75,080.4
Selenium	3,079.7	NC	N/A	3,079.7
Zinc	184,781.3	NC	N/A	184,781.3
Acenaphthene	26,461.0	>1.7E+3	N/A	26,461.0
Acenaphthylene	1,764.1	>2.4E+3	N/A	1,764.1
Anthracene	132,305.2	>3.9E+1	N/A	132,305.2
Benzo(a)Anthracene	60.4	>4.8E+2	N/A	60.4
Benzo(a)Pyrene	9.1	>1.0E+2	N/A	9.1
Benzo(b)Fluoranthene	60.4	>4.9E+2	N/A	60.4
Benzo(g,h,i)Perylene	13,230.5	>6.8E+1	N/A	13,230.5
Benzo(k)Fluoranthene	604.1	>1.4E+2	N/A	604.1
Chrysene	38.3	>2.2E+1	N/A	38.3
Dibenzo(a,h)Anthracene	6.0	>2.3E+1	N/A	6.0
Fluoranthene	17,640.7	>4.8E+2	N/A	17,640.7
Fluorene	17,640.7	>7.5E+2	N/A	17,640.7
Indeno(1,2,3,c,d)Pyrene	60.4	>1.3E+5	N/A	60.4
Naphthalene	12,079.2	>3.8E+3	N/A	12,079.2
Phenanthrene	13,230.5	>1.4E+3	N/A	13,230.5
Pyrene	13,230.5	>3.7E+2	N/A	13,230.5
TPH - Aliph >C05-C06	679,842.7	>2.0E+3	N/A	679,842.7
TPH - Aliph >C06-C08	679,842.7	>1.4E+3	N/A	679,842.7
TPH - Aliph >C08-C10	13,596.9	694.6	N/A	694.6
TPH - Aliph >C10-C12	13,596.9	>5.2E+2	N/A	13,596.9
TPH - Aliph >C12-C16	13,596.9	>2.3E+2	N/A	13,596.9
TPH - Aliph >C16-C21	910,476.7	>9.6E+1	N/A	910,476.7
TPH - Aliph >C21-C34	910,476.7	>9.6E+1	N/A	910,476.7
TPH - Arom >C05-C07	407.9	4.1	N/A	4.1
TPH - Arom >C07-C08	27,193.7	277.8	N/A	277.8
TPH - Arom >C08-C10	5,438.7	282.8	N/A	282.8
TPH - Arom >C10-C12	5,438.7	1,589.1	N/A	1,589.1
TPH - Arom >C12-C16	5,438.7	>1.8E+3	N/A	5,438.7
TPH - Arom >C16-C21	13,657.2	>6.3E+2	N/A	13,657.2
TPH - Arom >C21-C35	13,657.2	>5.1E+1	N/A	13,657.2

* - SGV for mercury used as SSTL

N/A - Pathway inactive - Gas protective barriers incorporated in all buildings

Exposure Pathway Flowchart

Site Name: New Residential Development, Glebelands Job ID: 9579
Location: Newport Date: 09.03.07
Compl. By: RB



Receptors	On-site	Off-site1	Off-site2
	Residential	*NA*	*NA*
Outdoor Air:	None	None	None
Indoor Air:	None	NA	NA
Groundwater Potable Water Ingestion	None	None	None
Surface Water Swimming, Fish Consumption, Aquatic Life	NA	NA	NA

Commands and Options

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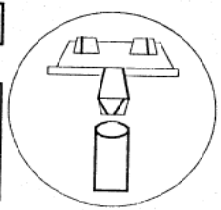
Exposure Factors and Target Risk Limits

Site Name: New Residential Development, Glebelands
Location: Newport
Compl. By: RB
Job ID: 9579 Date: 09.03.07

1. Exposure Parameters

		Residential			Commercial	
Age Adjustment?		Adult	(Age 0-6)	(Age 0-16)	Chronic	Construc.
Averaging time, carcinogens (yr)		6				
Averaging time, non-carcinogens (yr)		6			25	1
Body weight (kg)		13.5	13.5	13.5	70	
Exposure duration (yr)		6	6	6	25	1
Exposure frequency (days/yr)		80			250	180
Dermal exposure frequency (days/yr)		80			250	
Skin surface area, soil contact (cm^2)	☑	706		706	5800	5800
Soil dermal adherence factor ($mg/cm^2/day$)		1				
Water ingestion rate (L/day)		2			1	
Soil ingestion rate (mg/day)	☑	100	100		50	100
Swimming exposure time (hr/event)		3				
Swimming event frequency (events/yr)		12	12	12		
Swimming water ingestion rate (L/hr)	☐	0.05	0.5			
Skin surface area, swimming (cm^2)	☐	23000		8100		
Fish consumption rate (kg/day)		0.025				
Contaminated fish fraction (unitless)		1				



2. Risk Goal Calculation Options

- ○ Individual Constituent Risk Goals Only
- ◉ Individual and Cumulative Risk Goals

3. Target Health Risk Limits

	Individual	Cumulative
Target Risk (Class A/B carcins.)	1.0E-4	1.0E-4
Target Risk (Class C carcinogens)	1.0E-4	
Target Hazard Quotient	1.0E+0	
Target Hazard Index		1.0E+0

4. Commands and Options

Return to Exposure Pathways

Use Default Values

Print Sheet

Help

RBCA SITE ASSESSMENT

Input Parameter Summary

Site Name: New Residential Development, Giebelands
Site Location: Newport

Completed By: RB
Date Completed: 09.03.07

Job ID: 9579

Exposure Parameters		Residential			Commercial/Industrial	
		Adult	(1-6yrs)	(1-16 yrs)	Chronic	Construc.
AT_c	Averaging time for carcinogens (yr)	6			25	1
AT_n	Averaging time for non-carcinogens (yr)	6			25	1
BW	Body weight (kg)	13.5	13.5	13.5	70	
ED	Exposure duration (yr)	6	6	6	25	1
τ	Averaging time for vapor flux (yr)	6			25	1
EF	Exposure frequency (days/yr)	80			250	180
EF_D	Exposure frequency for dermal exposure	80			250	
IR_w	Ingestion rate of water (L/day)	2			1	
IR_s	Ingestion rate of soil (mg/day)	100	100		50	100
SA	Skin surface area (dermal) (cm^2)	706		706	5800	5800
M	Soil to skin adherence factor	1				
ET_{swim}	Swimming exposure time (hr/event)	3				
EV_{swim}	Swimming event frequency (events/yr)	12	12	12		
IR_{swim}	Water ingestion while swimming (L/hr)	0.05	0.5			
SA_{swim}	Skin surface area for swimming (cm^2)	23000		8100		
IR_{fish}	Ingestion rate of fish (kg/yr)	0.025				
FI_{fish}	Contaminated fish fraction (unitless)	1				

Complete Exposure Pathways and Receptors	On-site	Off-site 1	Off-site 2
Groundwater:			
Groundwater Ingestion	None	None	None
Soil Leaching to Groundwater Ingestion	None	None	None
Applicable Surface Water Exposure Routes:			
Swimming			NA
Fish Consumption			NA
Aquatic Life Protection			NA
Soil:			
Direct Ingestion and Dermal Contact	Residential		
Outdoor Air:			
Particulates from Surface Soils	None	None	None
Volatilization from Soils	None	None	None
Volatilization from Groundwater	None	None	None
Indoor Air:			
Volatilization from Subsurface Soils	None	NA	NA
Volatilization from Groundwater	None	NA	NA

Receptor Distance from Source Media	On-site	Off-site 1	Off-site 2	(Units)
Groundwater receptor	NA	NA	NA	(m)
Soil leaching to groundwater receptor	NA	NA	NA	(m)
Outdoor air inhalation receptor	NA	NA	NA	(m)

Target Health Risk Values		Individual	Cumulative
TR_{ab}	Target Risk (class A&B carcinogens)	1.0E-4	1.0E-4
TR_c	Target Risk (class C carcinogens)	1.0E-4	
THQ	Target Hazard Quotient (non-carcinogenic risk)	1.0E+0	1.0E+0

Modeling Options	
RBCA tier	Tier 2
Outdoor air volatilization model	NA
Indoor air volatilization model	NA
Soil leaching model	NA
Use soil attenuation model (SAM) for leachate?	NA
Air dilution factor	NA
Groundwater dilution-attenuation factor	NA

NOTE: NA = Not applicable

Surface Parameters		General	Construction	(Units)
A	Source zone area	NA	NA	(m^2)
W	Length of source-zone area parallel to wind	NA	NA	(m)
W_{gw}	Length of source-zone area parallel to GW flow	NA		(m)
U_{air}	Ambient air velocity in mixing zone	NA		(m/s)
δ_{air}	Air mixing zone height	NA		(m)
P_a	Areal particulate emission rate	NA		(g/cm^2/s)
L_{ss}	Thickness of affected surface soils	NA		(m)

Surface Soil Column Parameters		Value			(Units)
h_{cap}	Capillary zone thickness	NA			(m)
h_v	Vadose zone thickness	NA			(m)
ρ_b	Soil bulk density	NA			(g/cm^3)
f_{oc}	Fraction organic carbon	NA			(-)
θ_T	Soil total porosity	NA			(-)
K_{vs}	Vertical hydraulic conductivity	NA			(cm/d)
k_v	Vapor permeability	NA			(m^2)
L_{gw}	Depth to groundwater	NA			(m)
L_s	Depth to top of affected soils	NA			(m)
L_{base}	Depth to base of affected soils	NA			(m)
$L_{s,ce}$	Thickness of affected soils	NA			(m)
pH	Soil/groundwater pH	NA			(-)
		capillary	vadose	foundation	
θ_w	Volumetric water content	NA	NA	NA	(-)
θ_a	Volumetric air content	NA	NA	NA	(-)

Building Parameters		Residential	Commercial	(Units)
L_b	Building volume/area ratio	NA	NA	(m)
A_b	Foundation area	NA	NA	(m^2)
X_{crk}	Foundation perimeter	NA	NA	(m)
ER	Building air exchange rate	NA	NA	(1/s)
L_{crk}	Foundation thickness	NA	NA	(m)
Z_{crk}	Depth to bottom of foundation slab	NA	NA	(m)
η	Foundation crack fraction	NA	NA	(-)
dP	Indoor/outdoor differential pressure	NA	NA	(g/cm/s^2)
Q_s	Convective air flow through slab	NA	NA	(m^3/s)

Groundwater Parameters		Value	(Units)
δ_{gw}	Groundwater mixing zone depth	NA	(m)
I_f	Net groundwater infiltration rate	NA	(cm/yr)
U_{gw}	Groundwater Darcy velocity	NA	(cm/d)
V_{gw}	Groundwater seepage velocity	NA	(cm/d)
K_s	Saturated hydraulic conductivity	NA	(cm/d)
i	Groundwater gradient	NA	(-)
S_w	Width of groundwater source zone	NA	(m)
S_d	Depth of groundwater source zone	NA	(m)
θ_{eff}	Effective porosity in water-bearing unit	NA	(-)
f_{oc-sat}	Fraction organic carbon in water-bearing unit	NA	(-)
pH_{sat}	Groundwater pH	NA	(-)
	Biodegradation considered?	NA	

Transport Parameters		Off-site 1	Off-site 2	Off-site 1	Off-site 2	(Units)
Lateral Groundwater Transport		Groundwater Ingestion		Soil Leaching to GW		
α_x	Longitudinal dispersivity	NA	NA	NA	NA	(m)
α_y	Transverse dispersivity	NA	NA	NA	NA	(m)
α_z	Vertical dispersivity	NA	NA	NA	NA	(m)
Lateral Outdoor Air Transport		Soil to Outdoor Air Inhal.		GW to Outdoor Air Inhal.		
σ_y	Transverse dispersion coefficient	NA	NA	NA	NA	(m)
σ_z	Vertical dispersion coefficient	NA	NA	NA	NA	(m)
ADF	Air dispersion factor	NA	NA	NA	NA	(-)

Surface Water Parameters		Off-site 2	(Units)
Q_{sw}	Surface water flowrate	NA	(m^3/s)
W_{pl}	Width of GW plume at SW discharge	NA	(m)
δ_{pl}	Thickness of GW plume at SW discharge	NA	(m)
DF_{sw}	Groundwater-to-surface water dilution factor	NA	(-)

RBCA SITE ASSESSMENT

Site Name: New Residential Development, Glebelands
Site Location: Newport

Completed By: RB
Date Completed: 09.03.07

Job ID: 9579

SOIL (0.6 - 2.5 m) SSTL VALUES

Target Risk (Class A & B): 1.0E-6
Target Risk (Class C): 1.0E-6
Target Hazard Quotient: 1.0E+0

Groundwater DAF Option:

SSTL Results For Complete Exposure Pathways ("X" If Complete)

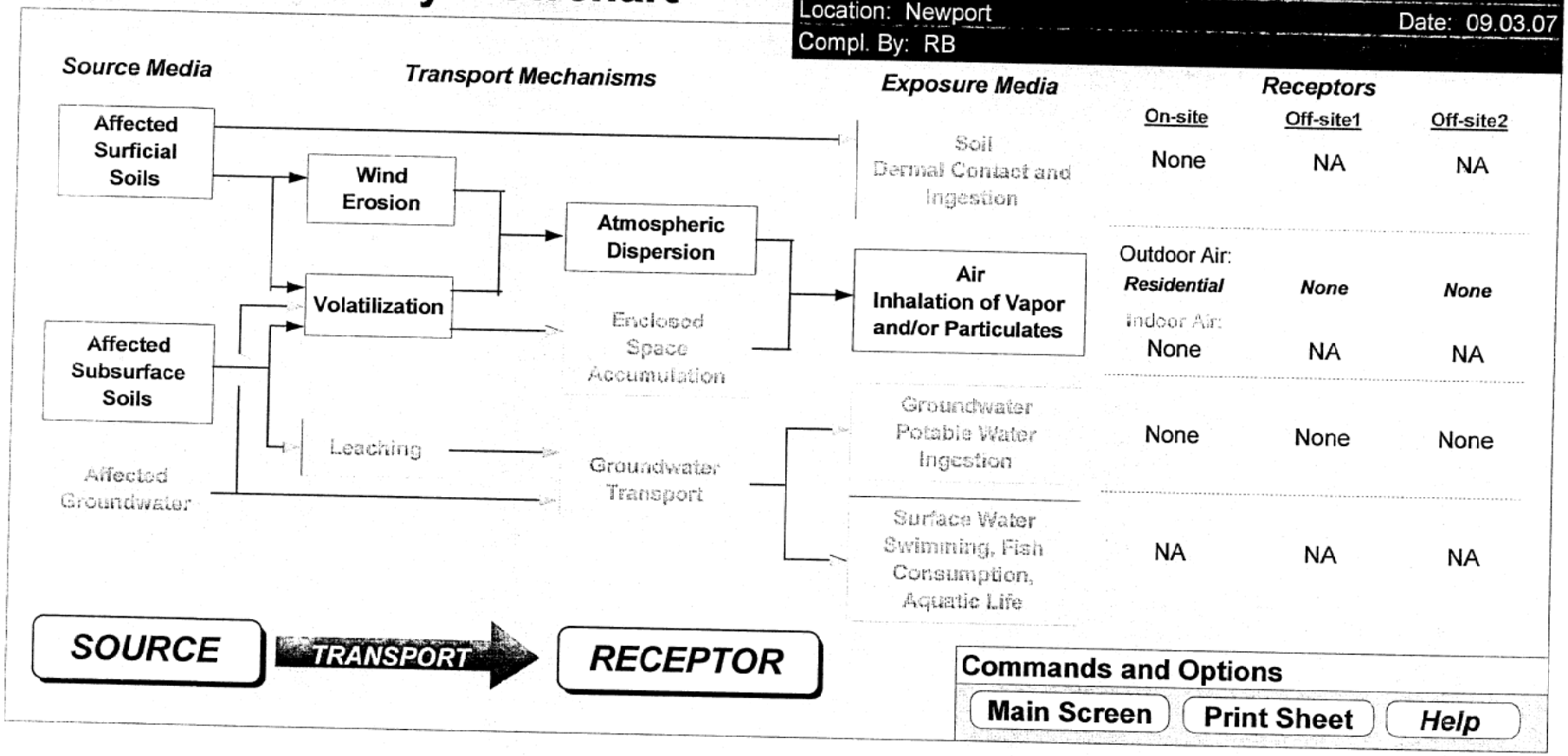
CONSTITUENTS OF CONCERN		Representative Concentration	Soil Leaching to Groundwater Ingestion / Discharge to Surface Water			Soil Vol. to Indoor Air	Soil Volatilization and Surface Soil Particulates to Outdoor Air				X	Surface Soil Ingestion and Dermal Contact		Applicable SSTL	SSTL Exceeded ?	Required CRF
			On-site (0 m)	Off-site 1 (0 m)	Off-site 2 (0 m)	On-site (0 m)	On-site (0 m)		Off-site 1 (0 m)	Off-site 2 (0 m)		On-site (0 m)				
CAS No.	Name	(mg/kg)	None	None	None	None	None	Construction Worker	None	None		Residential	Construction Worker	(mg/kg)	"is" if yes	Only if "yes" left
7440-38-2	Arsenic*		NA	NA	NA	NA	NA	NA	NA	NA		1.8E+2	NA	1.8E+2	☐	NA
7440-43-9	Cadmium		NA	NA	NA	NA	NA	NA	NA	NA		3.1E+2	NA	3.1E+2	☐	NA
18540-29-9	Chromium (VI)		NA	NA	NA	NA	NA	NA	NA	NA		1.8E+3	NA	1.8E+3	☐	NA
7440-50-8	Copper		NA	NA	NA	NA	NA	NA	NA	NA		2.5E+4	NA	2.5E+4	☐	NA
7439-97-6	Mercury		NA	NA	NA	NA	NA	NA	NA	NA		1.8E+2	NA	1.8E+2	☐	NA
7440-02-0	Nickel*		NA	NA	NA	NA	NA	NA	NA	NA		6.2E+2	NA	6.2E+2	☐	NA
108-95-2	Phenol		NA	NA	NA	NA	NA	NA	NA	NA		7.5E+4	NA	7.5E+4	☐	NA
7782-49-2	Selenium		NA	NA	NA	NA	NA	NA	NA	NA		3.1E+3	NA	3.1E+3	☐	NA
7440-66-6	Zinc		NA	NA	NA	NA	NA	NA	NA	NA		1.8E+5	NA	1.8E+5	☐	NA
83-32-9	Acenaphthene*		NA	NA	NA	NA	NA	NA	NA	NA		2.6E+4	NA	2.6E+4	☐	NA
208-96-8	Acenaphthylene*		NA	NA	NA	NA	NA	NA	NA	NA		1.8E+3	NA	1.8E+3	☐	NA
120-12-7	Anthracene*		NA	NA	NA	NA	NA	NA	NA	NA		1.3E+5	NA	1.3E+5	☐	NA
56-55-3	Benzo(a)Anthracene		NA	NA	NA	NA	NA	NA	NA	NA		6.0E+1	NA	6.0E+1	☐	NA
50-32-8	Benzo(a)Pyrene*		NA	NA	NA	NA	NA	NA	NA	NA		9.1E+0	NA	9.1E+0	☐	NA
205-99-2	Benzo(b)Fluoranthene		NA	NA	NA	NA	NA	NA	NA	NA		6.0E+1	NA	6.0E+1	☐	NA
191-24-2	Benzo(g,h,i)Perylene*		NA	NA	NA	NA	NA	NA	NA	NA		1.3E+4	NA	1.3E+4	☐	NA
207-08-9	Benzo(k)Fluoranthene		NA	NA	NA	NA	NA	NA	NA	NA		6.0E+2	NA	6.0E+2	☐	NA
218-01-9	Chrysene		NA	NA	NA	NA	NA	NA	NA	NA		3.8E+1	NA	3.8E+1	☐	NA
53-70-3	Dibenzo(a,h)Anthracene		NA	NA	NA	NA	NA	NA	NA	NA		6.0E+0	NA	6.0E+0	☐	NA
206-44-0	Fluoranthene*		NA	NA	NA	NA	NA	NA	NA	NA		1.8E+4	NA	1.8E+4	☐	NA
86-73-7	Fluorene*		NA	NA	NA	NA	NA	NA	NA	NA		1.8E+4	NA	1.8E+4	☐	NA
193-39-5	Indeno(1,2,3,c,d)Pyrene		NA	NA	NA	NA	NA	NA	NA	NA		6.0E+1	NA	6.0E+1	☐	NA
91-20-3	Naphthalene*		NA	NA	NA	NA	NA	NA	NA	NA		1.2E+4	NA	1.2E+4	☐	NA
85-01-8	Phenanthrene*		NA	NA	NA	NA	NA	NA	NA	NA		1.3E+4	NA	1.3E+4	☐	NA
129-00-0	Pyrene*		NA	NA	NA	NA	NA	NA	NA	NA		1.3E+4	NA	1.3E+4	☐	NA
0-00-0	TPH - Aliph >C05-C06		NA	NA	NA	NA	NA	NA	NA	NA		6.8E+5	NA	6.8E+5	☐	NA
0-00-0	TPH - Aliph >C06-C08		NA	NA	NA	NA	NA	NA	NA	NA		6.8E+5	NA	6.8E+5	☐	NA
0-00-0	TPH - Aliph >C08-C10		NA	NA	NA	NA	NA	NA	NA	NA		1.4E+4	NA	1.4E+4	☐	NA
0-00-0	TPH - Aliph >C10-C12		NA	NA	NA	NA	NA	NA	NA	NA		1.4E+4	NA	1.4E+4	☐	NA
0-00-0	TPH - Aliph >C12-C16		NA	NA	NA	NA	NA	NA	NA	NA		1.4E+4	NA	1.4E+4	☐	NA
0-00-0	TPH - Aliph >C16-C21*		NA	NA	NA	NA	NA	NA	NA	NA		9.1E+5	NA	9.1E+5	☐	NA
0-00-0	TPH - Aliph >C21-C34*		NA	NA	NA	NA	NA	NA	NA	NA		9.1E+5	NA	9.1E+5	☐	NA
0-00-0	TPH - Arom >C05-C07		NA	NA	NA	NA	NA	NA	NA	NA		4.1E+2	NA	4.1E+2	☐	NA
0-00-0	TPH - Arom >C07-C08		NA	NA	NA	NA	NA	NA	NA	NA		2.7E+4	NA	2.7E+4	☐	NA
0-00-0	TPH - Arom >C08-C10		NA	NA	NA	NA	NA	NA	NA	NA		5.4E+3	NA	5.4E+3	☐	NA
0-00-0	TPH - Arom >C10-C12		NA	NA	NA	NA	NA	NA	NA	NA		5.4E+3	NA	5.4E+3	☐	NA
0-00-0	TPH - Arom >C12-C16		NA	NA	NA	NA	NA	NA	NA	NA		5.4E+3	NA	5.4E+3	☐	NA
0-00-0	TPH - Arom >C16-C21*		NA	NA	NA	NA	NA	NA	NA	NA		1.4E+4	NA	1.4E+4	☐	NA
0-00-0	TPH - Arom >C21-C35*		NA	NA	NA	NA	NA	NA	NA	NA		1.4E+4	NA	1.4E+4	☐	NA

* = Chemical with user-specified data

">" indicates risk-based target concentration greater than constituent residual saturation value. NA = Not applicable. NC = Not calculated.

Exposure Pathway Flowchart

Site Name: New Residential Development, Glebelands Job ID: 9579
Location: Newport Date: 09.03.07
Compl. By: RB



Exposure Media	Receptors	On-site	Off-site1	Off-site2
Soil Dermal Contact and Ingestion		None	NA	NA
Air Inhalation of Vapor and/or Particulates	Outdoor Air: *Residential*	*None*	*None*	*None*
	Indoor Air:	None	NA	NA
Groundwater Potable Water Ingestion		None	None	None
Surface Water Swimming, Fish Consumption, Aquatic Life		NA	NA	NA

Commands and Options

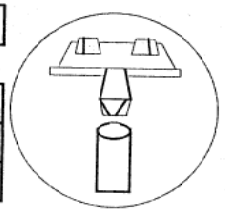
Main Screen Print Sheet Help

Exposure Factors and Target Risk Limits

Site Name: New Residential Development, Glebelands
Location: Newport
Compl. By: RB
Job ID: 9579 Date: 09.03.07

1. Exposure Parameters

		Residential			Commercial	
Age Adjustment?		Adult	(Age 0-6)	(Age 0-16)	Chronic	Construc.
Averaging time, carcinogens (yr)		6				
Averaging time, non-carcinogens (yr)		6			25	1
Body weight (kg)		13.5	13.5	13.5	70	
Exposure duration (yr)		6	6	6	25	1
Exposure frequency (days/yr)		365			250	180
Dermal exposure frequency (days/yr)		365			250	
Skin surface area, soil contact (cm^2)	☑	706		706	5800	5800
Soil dermal adherence factor ($mg/cm^2/day$)		1				
Water ingestion rate (L/day)		2			1	
Soil ingestion rate (mg/day)	☑	100	100		50	100
Swimming exposure time (hr/event)		3				
Swimming event frequency (events/yr)		12	12	12		
Swimming water ingestion rate (L/hr)	☐	0.05	0.5			
Skin surface area, swimming (cm^2)	☐	23000		8100		
Fish consumption rate (kg/day)		0.025				
Contaminated fish fraction (unitless)		1				



2. Risk Goal Calculation Options

- ○ Individual Constituent Risk Goals Only
- ◉ Individual and Cumulative Risk Goals

3. Target Health Risk Limits

	Individual	Cumulative
Target Risk (Class A/B carcins.)	1.0E-4	1.0E-4
Target Risk (Class C carcinogens)	1.0E-4	
Target Hazard Quotient	1.0E+0	
Target Hazard Index		1.0E+0

4. Commands and Options

Return to Exposure Pathways

Use Default Values

Print Sheet

Help

Site-Specific Soil Parameters

Site Name: New Residential Development, Glebelands — Job ID: 9579
Location: Newport — Date: 09.03.07
Compl. By: RB

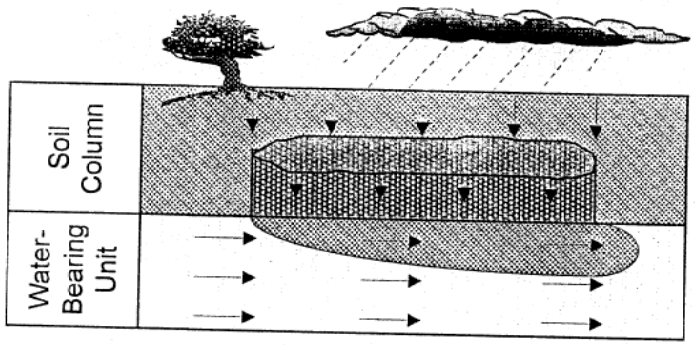
1. Soil Source Zone Characteristics

Hydrogeology

	General Case Construction	
Depth to water-bearing unit	3	(m)
Capillary zone thickness	0.05	(m)
Soil column thickness	2.95	(m)

Affected Soil Zone

Depth to top of affected soils	0.6		(m)
Depth to base of affected soils	2.5		(m)
Affected soil area	29000	29000	(m^2)
Length of affected soil parallel to assumed wind direction	250	250	(m)
Length of affected soil parallel to assumed GW flow direction			(m)



2. Surface Soil Column

	Vadose Zone	Capillary Fringe	
Predominant USCS Soil Type			
or Calculate			
Total porosity	0.46		(-)
Volumetric water content	0.15	0.369	(-)
Volumetric air content	0.31	0.091	(-)
Dry bulk density	1.6		(kg/L)
Vertical hydraulic conductivity	8.6E+2		(cm/d)
Vapor permeability	1.0E-12		(m^2)
Capillary zone thickness	5.0E-2		(m)

Net Rainfall Infiltration

Net infiltration estimate		(cm/yr)
or NA	*or*	
Average annual precipitation		(cm/yr)

Partitioning Parameters

Fraction organic carbon	0.061	(-)
Soil/water pH	7.9	(-)

3. Commands and Options

Main Screen | Use Default Values | Print Sheet
Set Units | | *Help*

Site-Specific Air Parameters

Site Name: New Residential Development, Glebelands Job ID: 9579
Location: Newport Date: 09.03.07
Compl. By: RB

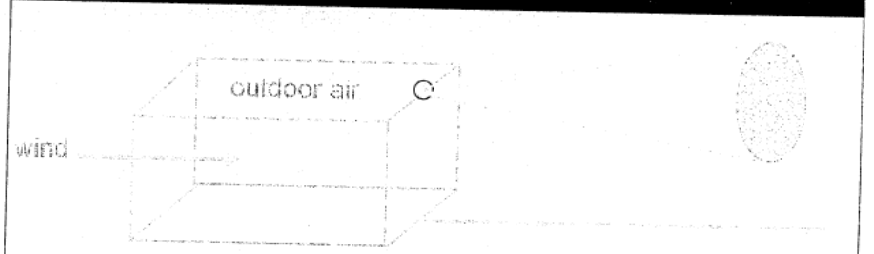
1. Outdoor Air Pathway

Dispersion in Air

	Off-site 1	Off-site 2	
Distance to offsite air receptor			(m)
or	NA	or	
Horizontal dispersivity			(m)
Vertical dispersivity			(m)

Air Source Zone

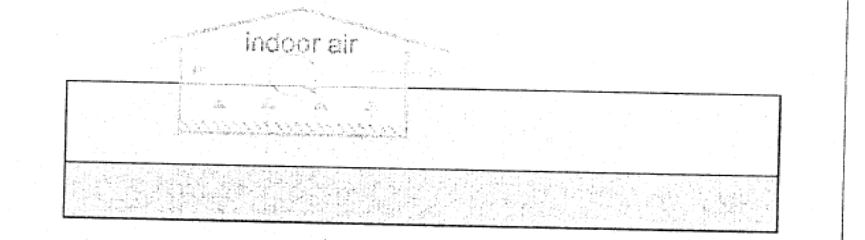
Air mixing zone height	0.93	(m)
Ambient air velocity in mixing zone	3	(m/s)
Areal particulate emission flux	6.9E-14	(g/cm^2/s)



2. Indoor Air Pathway

Building Parameters

	Residential	Commercial	
Building volume/area ratio	2	3	(m)
Foundation area	70	70	(m^2)
Foundation perimeter	34	34	(m)
Building air exchange rate	1.4E-4	2.3E-4	(1/s)
Depth to bottom of foundation slab	0.15	0.15	(m)
Convective air flow through cracks	0.0E+0	0.0E+0	(m^3/s)
Foundation thickness	0.15		(m)
Foundation crack fraction	0.01		(-)
Volumetric water content of cracks	0.12		(-)
Volumetric air content of cracks	0.26		(-)
Indoor/Outdoor differential pressure	0		(g/cm/s^2)



3. Commands and Options

Main Screen | Use Default Values | Print Sheet
Set Units | | Help

RBCA SITE ASSESSMENT

Input Parameter Summary

Site Name: New Residential Development, Glebelands
Site Location: Newport

Completed By: RB
Date Completed: 09.03.07

Job ID: 9579

Exposure Parameters		Residential			Commercial/Industrial	
		Adult	(1-6yrs)	(1-16 yrs)	Chronic	Construc.
AT_c	Averaging time for carcinogens (yr)	6				
AT_n	Averaging time for non-carcinogens (yr)	6			25	1
BW	Body weight (kg)	13.5	13.5	13.5	70	
ED	Exposure duration (yr)	6	6	6	25	1
τ	Averaging time for vapor flux (yr)	6			25	1
EF	Exposure frequency (days/yr)	365			250	180
EF_D	Exposure frequency for dermal exposure	365			250	
IR_w	Ingestion rate of water (L/day)	2			1	
IR_s	Ingestion rate of soil (mg/day)	100	100		50	100
SA	Skin surface area (dermal) (cm^2)	706		706	5800	5800
M	Soil to skin adherence factor	1				
ET_{swim}	Swimming exposure time (hr/event)	3				
EV_{swim}	Swimming event frequency (events/yr)	12	12	12		
IR_{swim}	Water ingestion while swimming (L/hr)	0.05	0.5			
SA_{swim}	Skin surface area for swimming (cm^2)	23000		8100		
IR_{fish}	Ingestion rate of fish (kg/yr)	0.025				
FI_{fish}	Contaminated fish fraction (unitless)	1				

Complete Exposure Pathways and Receptors	On-site	Off-site 1	Off-site 2
Groundwater:			
Groundwater Ingestion	None	None	None
Soil Leaching to Groundwater Ingestion	None	None	None
Applicable Surface Water Exposure Routes:			
Swimming			
Fish Consumption			NA
Aquatic Life Protection			NA
			NA
Soil:			
Direct Ingestion and Dermal Contact	None		
Outdoor Air:			
Particulates from Surface Soils	Residential	None	None
Volatilization from Soils	Residential	None	None
Volatilization from Groundwater	None	None	None
Indoor Air:			
Volatilization from Subsurface Soils	None	NA	NA
Volatilization from Groundwater	None	NA	NA

Receptor Distance from Source Media	On-site	Off-site 1	Off-site 2	(Units)
Groundwater receptor	NA	NA	NA	(m)
Soil leaching to groundwater receptor	NA	NA	NA	(m)
Outdoor air inhalation receptor	0	NA	NA	(m)

Target Health Risk Values		Individual	Cumulative
TR_{ab}	Target Risk (class A&B carcinogens)	1.0E-4	1.0E-4
TR_c	Target Risk (class C carcinogens)	1.0E-4	
THQ	Target Hazard Quotient (non-carcinogenic risk)	1.0E+0	1.0E+0

Modeling Options	
RBCA tier	Tier 2
Outdoor air volatilization model	Surface & subsurface models
Indoor air volatilization model	NA
Soil leaching model	NA
Use soil attenuation model (SAM) for leachate?	NA
Air dilution factor	NA
Groundwater dilution-attenuation factor	NA

NOTE: NA = Not applicable

Surface Parameters		General	Construction	(Units)
A	Source zone area	2.9E+4	NA	(m^2)
W	Length of source-zone area parallel to wind	2.5E+2	NA	(m)
W_{gw}	Length of source-zone area parallel to GW flow	NA		(m)
U_{air}	Ambient air velocity in mixing zone	3.0E+0		(m/s)
δ_{air}	Air mixing zone height	9.3E-1		(m)
P_a	Areal particulate emission rate	6.9E-14		(g/cm^2/s)
L_{ss}	Thickness of affected surface soils	6.0E-1		(m)

Surface Soil Column Parameters		Value			(Units)
h_{cap}	Capillary zone thickness	NA			(m)
h_v	Vadose zone thickness	NA			(m)
ρ_s	Soil bulk density	1.6E+0			(g/cm^3)
f_{oc}	Fraction organic carbon	6.1E-2			(-)
θ_T	Soil total porosity	4.6E-1			(-)
K_{vs}	Vertical hydraulic conductivity	8.6E+2			(cm/d)
k_v	Vapor permeability	1.0E-12			(m^2)
L_{gw}	Depth to groundwater	NA			(m)
L_s	Depth to top of affected soils	6.0E-1			(m)
L_{base}	Depth to base of affected soils	2.5E+0			(m)
L_{subs}	Thickness of affected soils	1.9E+0			(m)
pH	Soil/groundwater pH	7.9E+0			(-)
		capillary	vadose	foundation	
θ_w	Volumetric water content	0.369	0.15	0.12	(-)
θ_a	Volumetric air content	0.091	0.31	0.26	(-)

Building Parameters		Residential	Commercial	(Units)
L_b	Building volume/area ratio	NA	NA	(m)
A_b	Foundation area	NA	NA	(m^2)
X_{crk}	Foundation perimeter	NA	NA	(m)
ER	Building air exchange rate	NA	NA	(1/s)
L_{crk}	Foundation thickness	NA	NA	(m)
Z_{crk}	Depth to bottom of foundation slab	NA	NA	(m)
η	Foundation crack fraction	NA	NA	(-)
dP	Indoor/outdoor differential pressure	NA	NA	(g/cm/s^2)
Q_s	Convective air flow through slab	NA	NA	(m^3/s)

Groundwater Parameters		Value	(Units)
δ_{gw}	Groundwater mixing zone depth	NA	(m)
I_f	Net groundwater infiltration rate	NA	(cm/yr)
U_{gw}	Groundwater Darcy velocity	NA	(cm/d)
V_{gw}	Groundwater seepage velocity	NA	(cm/d)
K_s	Saturated hydraulic conductivity	NA	(cm/d)
i	Groundwater gradient	NA	(-)
S_w	Width of groundwater source zone	NA	(m)
S_d	Depth of groundwater source zone	NA	(m)
ϑ_{eff}	Effective porosity in water-bearing unit	NA	(-)
$f_{oc\text{-}sat}$	Fraction organic carbon in water-bearing unit	NA	(-)
pH_{sat}	Groundwater pH	NA	(-)
	Biodegradation considered?	NA	

Transport Parameters		Off-site 1	Off-site 2	Off-site 1	Off-site 2	(Units)
Lateral Groundwater Transport		Groundwater Ingestion		Soil Leaching to GW		
α_x	Longitudinal dispersivity	NA	NA	NA	NA	(m)
α_y	Transverse dispersivity	NA	NA	NA	NA	(m)
α_z	Vertical dispersivity	NA	NA	NA	NA	(m)
Lateral Outdoor Air Transport		Soil to Outdoor Air Inhal.		GW to Outdoor Air Inhal.		
σ_y	Transverse dispersion coefficient	NA	NA	NA	NA	(m)
σ_z	Vertical dispersion coefficient	NA	NA	NA	NA	(m)
ADF	Air dispersion factor	NA	NA	NA	NA	(-)

Surface Water Parameters		Off-site 2	(Units)
Q_{sw}	Surface water flowrate	NA	(m^3/s)
W_{pl}	Width of GW plume at SW discharge	NA	(m)
δ_{pl}	Thickness of GW plume at SW discharge	NA	(m)
DF_{gw}	Groundwater-to-surface water dilution factor	NA	(-)

RBCA SITE ASSESSMENT

Site Name: New Residential Development, Globelands
Site Location: Newport
Completed By: RB
Date Completed: 09.03.07
Job ID: 9579

SOIL (0.6 - 2.5 m) SSTL VALUES

Target Risk (Class A & B): 1.0E-4
Target Risk (Class C): 1.0E-4
Target Hazard Quotient: 1.0E+0
Groundwater DAF Option:

SSTL Results For Complete Exposure Pathways ("X" if Complete)

CONSTITUENTS OF CONCERN		Representative Concentration	Soil Leaching to Groundwater Ingestion / Discharge to Surface Water			Soil Vol. to Indoor Air	X Soil Volatilization and Surface Soil Particulates to Outdoor Air				Surface Soil Inhalation, Ingestion, Dermal Contact		Applicable SSTL	SSTL Exceeded ?	Required CRF
			On-site (0 m)	Off-site 1 (0 m)	Off-site 2 (0 m)	On-site (0 m)	On-site (0 m)		Off-site 1 (0 m)	Off-site 2 (0 m)	On-site (0 m)				
CAS No.	Name	(mg/kg)	None	None	None	None	Residential	Construction Worker	None	None	None	Construction Worker	(mg/kg)	"as" if yes	Only if "yes" left
7440-38-2	Arsenic*		NA	NA	NA	NA	3.7E+5	NA	NA	NA	NA	NA	3.7E+5	☐	NA
7440-43-9	Cadmium		NA	NA	NA	NA	9.0E+5	NA	NA	NA	NA	NA	9.0E+5	☐	NA
18540-29-9	Chromium (VI)		NA	NA	NA	NA	1.3E+5	NA	NA	NA	NA	NA	1.3E+5	☐	NA
7440-50-8	Copper		NA	NA	NA	NA	NC	NA	NA	NA	NA	NA	NC	☐	NA
7439-97-6	Mercury		NA	NA	NA	NA	7.7E-1	NA	NA	NA	NA	NA	7.7E-1	☐	NA
7440-02-0	Nickel*		NA	NA	NA	NA	3.4E+6	NA	NA	NA	NA	NA	3.4E+6	☐	NA
108-95-2	Phenol		NA	NA	NA	NA	>1.5E+5	NA	NA	NA	NA	NA	>1.5E+5	☐	NA
7782-49-2	Selenium		NA	NA	NA	NA	NC	NA	NA	NA	NA	NA	NC	☐	NA
7440-66-6	Zinc		NA	NA	NA	NA	NC	NA	NA	NA	NA	NA	NC	☐	NA
83-32-9	Acenaphthene*		NA	NA	NA	NA	>1.7E+3	NA	NA	NA	NA	NA	>1.7E+3	☐	NA
208-96-8	Acenaphthylene*		NA	NA	NA	NA	>2.4E+3	NA	NA	NA	NA	NA	>2.4E+3	☐	NA
120-12-7	Anthracene*		NA	NA	NA	NA	>3.9E+1	NA	NA	NA	NA	NA	>3.9E+1	☐	NA
56-55-3	Benzo(a)Anthracene		NA	NA	NA	NA	>4.8E+2	NA	NA	NA	NA	NA	>4.8E+2	☐	NA
50-32-8	Benzo(a)Pyrene*		NA	NA	NA	NA	>1.0E+2	NA	NA	NA	NA	NA	>1.0E+2	☐	NA
205-99-2	Benzo(b)Fluoranthene		NA	NA	NA	NA	>4.9E+2	NA	NA	NA	NA	NA	>4.9E+2	☐	NA
191-24-2	Benzo(g,h,i)Perylene*		NA	NA	NA	NA	>6.8E+1	NA	NA	NA	NA	NA	>6.8E+1	☐	NA
207-08-9	Benzo(k)Fluoranthene		NA	NA	NA	NA	>1.4E+2	NA	NA	NA	NA	NA	>1.4E+2	☐	NA
218-01-9	Chrysene		NA	NA	NA	NA	>2.2E+1	NA	NA	NA	NA	NA	>2.2E+1	☐	NA
53-70-3	Dibenzo(a,h)Anthracene		NA	NA	NA	NA	>2.3E+1	NA	NA	NA	NA	NA	>2.3E+1	☐	NA
206-44-0	Fluoranthene*		NA	NA	NA	NA	>4.8E+2	NA	NA	NA	NA	NA	>4.8E+2	☐	NA
86-73-7	Fluorene*		NA	NA	NA	NA	>7.5E+2	NA	NA	NA	NA	NA	>7.5E+2	☐	NA
193-39-5	Indeno(1,2,3,c,d)Pyrene		NA	NA	NA	NA	>1.3E+5	NA	NA	NA	NA	NA	>1.3E+5	☐	NA
91-20-3	Naphthalene*		NA	NA	NA	NA	>3.8E+3	NA	NA	NA	NA	NA	>3.8E+3	☐	NA
85-01-8	Phenanthrene*		NA	NA	NA	NA	>1.4E+3	NA	NA	NA	NA	NA	>1.4E+3	☐	NA
129-00-0	Pyrene*		NA	NA	NA	NA	>3.7E+2	NA	NA	NA	NA	NA	>3.7E+2	☐	NA
0-00-0	TPH - Aliph >C05-C06		NA	NA	NA	NA	>2.0E+3	NA	NA	NA	NA	NA	>2.0E+3	☐	NA
0-00-0	TPH - Aliph >C06-C08		NA	NA	NA	NA	>1.4E+3	NA	NA	NA	NA	NA	>1.4E+3	☐	NA
0-00-0	TPH - Aliph >C08-C10		NA	NA	NA	NA	6.9E+2	NA	NA	NA	NA	NA	6.9E+2	☐	NA
0-00-0	TPH - Aliph >C10-C12		NA	NA	NA	NA	>5.2E+2	NA	NA	NA	NA	NA	>5.2E+2	☐	NA
0-00-0	TPH - Aliph >C12-C16		NA	NA	NA	NA	>2.3E+2	NA	NA	NA	NA	NA	>2.3E+2	☐	NA
0-00-0	TPH - Aliph >C16-C21*		NA	NA	NA	NA	>9.5E+1	NA	NA	NA	NA	NA	>9.6E+1	☐	NA
0-00-0	TPH - Aliph >C21-C34*		NA	NA	NA	NA	>9.5E+1	NA	NA	NA	NA	NA	>9.6E+1	☐	NA
0-00-0	TPH - Arom >C05-C07		NA	NA	NA	NA	4.1E+0	NA	NA	NA	NA	NA	4.1E+0	☐	NA
0-00-0	TPH - Arom >C07-C08		NA	NA	NA	NA	2.8E+2	NA	NA	NA	NA	NA	2.8E+2	☐	NA
0-00-0	TPH - Arom >C08-C10		NA	NA	NA	NA	2.8E+2	NA	NA	NA	NA	NA	2.8E+2	☐	NA
0-00-0	TPH - Arom >C10-C12		NA	NA	NA	NA	1.6E+3	NA	NA	NA	NA	NA	1.6E+3	☐	NA
0-00-0	TPH - Arom >C12-C16		NA	NA	NA	NA	>1.8E+3	NA	NA	NA	NA	NA	>1.8E+3	☐	NA
0-00-0	TPH - Arom >C16-C21*		NA	NA	NA	NA	>6.3E+2	NA	NA	NA	NA	NA	>6.3E+2	☐	NA
0-00-0	TPH - Arom >C21-C35*		NA	NA	NA	NA	>5.1E+1	NA	NA	NA	NA	NA	>5.1E+1	☐	NA

* = Chemical with user-specified data

">" indicates risk-based target concentration greater than constituent residual saturation value. NA = Not applicable. NC = Not calculated.