EXHIBIT D

INTERIM VAPOR INTRUSION PLAN
July 6, 2007

developed by Arrow Environmental for the West of 4th Avenue PLP Group[1]

ECOLOGY'S APPROVAL OF THE INTERIM VAPOR INTRUSION PLAN
July 25, 2007

[1] which at that time included: Art Brass Plating, Blaser Die Casting, Capital Industries, and Philip Services Corporation

July 20, 2007

Via Electronic Mail and U.S. Mail

Mr. Ed Jones
Environmental Engineer
Hazardous Waste and Toxics Reduction
Washington Department of Ecology
Northwest Regional Office
3190 – 160th Avenue Southeast
Bellevue, Washington 98008

Re: West of 4th Avenue South Investigation Area
Draft Interim Vapor Intrusion Plan

Dear Mr. Jones:

Enclosed please find one original and one copy of the revised Interim Vapor Intrusion Plan. The enclosed revised Interim Vapor Intrusion (VI) Plan (the "Plan") was prepared on behalf of the Philip Services Corporation (PSC), Art Brass Plating (ABP), Blaser Die Casting (Blaser) and Capital Industries (Capital) in response to the Washington State Department of Ecology's (Ecology's) e-mail request dated March 9, 2007 and Ecology correspondence dated June 4, 2007.

Upon approval of the Interim VI Plan, the lead businesses for the locations identified in the Ecology e-mail dated March 9, 2007 will begin implementation. If you have questions or comments regarding this submittal please contact the undersigned.

Sincerely,

Doug Hillman (email authorization)
Doug Hillman
Aspect Consulting, LLC for
for ABP

Janet Knox (email authorization)
Janet Knox
Pacific Groundwater Group for
for Blaser Die Casting

Peter Jewett (email authorization)
Peter Jewett
Farallon Consulting, LLC
for Capital Industries, Inc.

William Carroll (Lead Author)
Arrow Environmental, LLC
for PSC

cc: Jim Schwartz, Washington Assistant Attorney General
William Beck (PSC)
Marlys Palumbo (Van Ness Feldman)
William Joyce (Salter Joyce Ziker)
William Chapman (K & L Gates)
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INTERIM VAPOR INTRUSION PLAN

WEST OF 4TH AVENUE SOUTH INVESTIGATION AREA
SEATTLE, WASHINGTON

July 20, 2007

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

1.0 INTRODUCTION

The following Interim Vapor Intrusion (VI) Plan was prepared on behalf of Philip Services Corporation (PSC), Art Brass Plating (ABP), Blaser Die Casting (Blaser) and Capital Industries (Capital) in response to the Washington State Department of Ecology's (Ecology's) e-mail request dated March 9, 2007 and revised on the basis of comments from Ecology provided in correspondence dated June 4, 2007. The objective of this Interim VI Plan is to establish a consistent interim process for the West of 4th Avenue South (W4) Investigation Area to assess and mitigate potential VI of contaminants of potential concern (COPCs) at the locations identified by Ecology in e-mail correspondence dated March 9, 2007 and to present a framework for developing a comprehensive VI Assessment and Mitigation (VIAM) Plan for the W4 Investigation Area that will be incorporated as a component of the RI/FS Work Plan. In order to achieve this objective, this Interim VI Plan will:

- Summarize the interim VI measures implemented by PSC, ABP, Blaser and Capital in the W4 Investigation Area to date and the proposed source control measures that have the potential to influence VI in the area;
- Propose an interim approach for PSC, ABP, Blaser and Capital to independently implement VI measures at the locations identified by Ecology in a consistent fashion until the comprehensive VIAM Plan can be approved and implemented;
- Summarize the comprehensive VIAM Plan elements for inclusion in the RI/FS Work Plan.

2.0 BACKGROUND

Subsurface investigation activities have identified areas where COPCs, primarily halogenated volatile organic compounds (HVOC), have affected shallow groundwater in the Water-table Zone[1] located within the W4 Investigation Area. The chemical properties of HVOCs and the geologic and hydrogeologic characteristics of the W4 Investigation Area are conducive to the volatilization of HVOCs from the Water-Table Zone groundwater into soil gas and migration of soil gas into indoor air. Laboratory analysis of indoor air samples collected inside several buildings in the W4 Investigation Area has detected concentrations of HVOCs in excess of indoor air screening levels established by Ecology for the PSC site and concurrently measured background (ambient) air samples. At these locations, Ecology has required the installation of interim measures to mitigate the potential for further VI.

2.1 INTERIM MEASURES

PSC, ABP, Blaser and Capital have conducted interim VI measures within the W4 Investigation Area on the basis of the elevated concentrations COPCs detected in groundwater and/or indoor air samples. A summary of the interim measures conducted by each PLP and recent requirements by Ecology is provided in the following sections.

2.1.1 PSC

In 2002, PSC developed and began implementing an Inhalation Pathway Interim Measure (IPIM) Program to assess and mitigate VI of COPCs associated with releases at the former PSC Georgetown Facility, located at 734 S. Lucile Street, in accordance with the corrective action requirements of PSC's RCRA Permit. The PSC IPIM Program is presented in the Revised IPIM Work Plan dated August 12, 2002. A detailed summary of the IPIM Program prepared by Pioneer Technologies, Inc. (Pioneer) is provided in Appendix A and the key components of the IPIM Program are summarized below:

- Groundwater to Indoor Air Volatilization Factor (GIVF) Study – The GIVF Study resulted in development of groundwater and indoor air screening levels [Inhalation Pathway Interim Measure Action Levels (IPIMALs)] that could be used to evaluate investigation results and assess potential VI concerns at residential and commercial building locations.

- The PSC IPIM approach integrates evaluating laboratory analytical results of groundwater and indoor air samples to determine, through the use of a tiered decision process (IPIM Decision Tree), if a building warrants further investigation or action through an interim measure. The IPIM Decision Tree is organized into four tiers to allow progressive evaluation of groundwater data and incorporation of site-specific information. The tiered decision process is summarized below:

[1] For the purposes of characterizing the concentrations of COPCs in affected groundwater, the shallow unconfined aquifer was partitioned into three separate zones in the PSC RI Report: the Water-Table Zone located between the first encountered groundwater and approximately 20-feet below ground surface (bgs); the Shallow Zone, located below the Water-Table Zone between 20-feet bgs and 40-ft bgs; and the Intermediate Zone, located below the Shallow Zone between 40-feet bgs and the top of the silt aquitard. Only VOCs at the top of the water table interval have the potential to migrate into the unsaturated soil gas and subsequently into indoor air. Therefore, VOC concentrations in the Shallow and Intermediate Zones are not evaluated against VI screening levels.

- Tier 1 and Tier 2 – Laboratory analytical results of groundwater samples collected from monitoring wells on a quarterly basis by PSC and from recent direct push borings completed by PSC are compared to residential-based groundwater IPIMALs (Tier 1) or commercial-based groundwater IPIMALs (Tier 2) on a well-by-well/point-by-point basis. Concentrations that exceed the risk benchmarks established by Ecology are contoured to show areas of potential VI concern. Residential and commercial locations that fall within the respective areas of potential VI concern are identified for further evaluation under Tier 3 of the IPIM Decision Tree.
- Tier 3 – The residential and commercial/industrial locations identified in Tier 1 or Tier 2 for review under Tier 3 are evaluated to determine if site-specific data collection (i.e., analyzing co-located indoor air, ambient air, sub-slab soil gas, and groundwater samples for VI COPCs) is warranted or if the location should move directly to Tier 4. The determination to move directly to Tier 4 may be based on a cost-benefit analysis of the relative costs for sampling vs. mitigation or another technical basis. If the location does not proceed directly to Tier 4, then Tier 3 samples are collected, analyzed, and the results evaluated. Upon completion of the Tier 3 activities, a report is developed summarizing the data, risks, and the recommended course of action (i.e., the building is recommended for Tier 4 if Ecology's cancer or non-cancer health benchmarks are exceeded. Otherwise, the site returns to Tier 1/Tier 2 monitoring process).
- Tier 4 – Residential and commercial/industrial locations that move to Tier 4 have interim measures installed in order to eliminate or mitigate the potential for VI from groundwater to indoor air.

- Long-Term Monitoring – Interim measures installed under Tier 4 are monitored to ensure that the measures function as designed. Long-term monitoring and maintenance of the interim measures are performed by conducting annual inspections, periodic verification of negative pressure field checks and, in some cases, analyzing co-located indoor air, ambient air, sub-slab soil gas, and groundwater for VI COPCs.

Between 2002 and 2006, PSC conducted the following activities in accordance with the IPIM Process:

- Tier 1 and Tier 2 analysis of area-wide groundwater data on a quarterly basis;
- Tier 3 sampling at 25 locations;
- Tier 3 resample or revisit sampling events,
- Installation and operation of subslab and/or submembrane depressurization (SSD or SMD) systems at 30 locations;
- Annual inspections at buildings with SSD or SMD systems; and,
- Long term monitoring activities at locations with existing SSD or SMD systems.

During the implementation of the IPIM Process and in order to finalize the PSC Georgetown Facility RI, PSC conducted subsurface investigation activities to characterize the nature and extent of groundwater with concentrations of COPCs associated with releases from the former PSC Georgetown Facility. The results of the investigation activities indicated the presence of at

least three non-PSC source areas located west of 4th Avenue South. In 2004, PSC implemented a Hydraulic Control Interim Measure (HCIM) to minimize the potential for migration of groundwater with concentrations of COPCs beyond the PSC source areas.

2.1.2 ABP Facility – 5516 3rd Avenue South

In 2005 and 2006, ABP conducted subsurface investigation activities in accordance with the Model Toxics Control Act (WAC 173-340) regulations and under Ecology oversight within the Voluntary Cleanup Program. The results of the investigation activities identified source areas in the vicinity of former vapor degreasers where releases of TCE occurred and resulted in concentrations of COPCs in soil and groundwater in excess of potentially-applicable screening levels. On the basis of the results of the subsurface investigation activities, ABP replaced PSC as the lead business for interim VI measures for certain properties that are listed in Table 1. To date, ABP's interim VI measures have included: conducting location specific sampling at 215/217 S. Findlay St. and 220 S. Findlay St.; performing a facility evaluation at 301/313 S. Findlay St.; and, evaluating source control measures at their facility that are designed to reduce source area concentrations and mitigate the potential for VI impacts. ABP is currently proposing to install a soil vapor extraction and air sparging system at the ABP Facility and adjacent to the building at 220 S. Orcas St. as an interim source control measure.

2.1.3 Blaser Die Casting – 5700 3rd Ave. S

In 2006, Blaser conducted subsurface investigation activities in accordance with the MTCA regulations as part of an independent cleanup action and submitted the results to Ecology. The results of the investigation activities identified a source area located near the southwest corner of the Blaser building where a release of chemicals occurred and resulted in concentrations of COPCs in soil and in groundwater in excess of the potentially-applicable cleanup screening levels. Blaser replaced PSC as the lead business for interim VI measures for certain properties that are listed in Table 1. The Blaser interim VI measures conducted to date have included: installing and operating a subslab depressurization VI mitigation system at their facility and collecting post-installation indoor air samples. Blaser submitted to Ecology a source control action plan utilizing soil source excavation.

2.1.4 Capital Industries – 5801 2nd Avenue South

The Capital Facility consists of several large industrial buildings located between 4th Avenue South and 1st Avenue South and between S. Mead St. and S. Fidalgo St. In January 2004, a fire destroyed one of the Capital buildings (Plant #2). During the subsequent Plant #2 reconstruction activities, Capital collected soil samples and sub-slab soil gas samples for laboratory analysis of VOCs. Capital used the analytical results as the basis for determining that VI issues were not of concern at the new Plant #2 building. Between 2004 and 2006, Capital conducted subsurface investigation activities as part of an independent cleanup action in accordance with the MTCA regulations without direct Ecology oversight. The results of the investigation activities identified two source areas (one located at Plant #2 and one located at Plant #4) where releases occurred and resulted in concentrations of COPCs in soil and in the groundwater above potential applicable screening levels. Capital has replaced PSC as the lead business for interim VI measures for certain properties that are listed in Table 1.

2.1.5 Regulatory Agency Requirements

On October 9, 2006 and March 1, 2007, Ecology sponsored meetings to initiate a process for addressing the W4 Investigation Area. The meetings included the representatives of ABP, Blaser, Capital, and PSC. During the meeting, VI issues were discussed and the principle that individual businesses would address VI issues within allocated sub-areas of the W4 Investigation Area was affirmed.

In correspondence from Ecology to PSC dated October 23, 2006 and in subsequent e-mail correspondence from Ecology to ABP, Blaser, Capital and PSC representatives dated March 9, 2007, Ecology identified approximately 24 locations in the W4 Investigation Area that require further monitoring of potential VI of COPCs or mitigation of previously identified VI impacts, and 7 locations that require performance monitoring for existing VI mitigation systems. The locations that Ecology identified are listed in Table 2 and illustrated on Figure 1. Differences in the lead businesses listed in Table 1 compared to Table 2 are the result of negotiations between the lead businesses after Ecology's e-mail correspondence dated March 9, 2007.

3.0 PROPOSED INTERIM VI APPROACH

ABP, Blaser, Capital and PSC have agreed that interim VI measures will be implemented by individual businesses for the Ecology-identified locations. The lead businesses for addressing the locations identified by Ecology and the proposed interim VI measures are summarized in Table 2. The basis for selecting the lead businesses for specific locations is the spatial correlation between the specific location and the location of elevated concentrations of COPCs in Water-Table Zone groundwater associated with releases at the respective businesses facility. The lead business for a location may change as new information becomes available or conditions in the subsurface change.

ABP, Blaser, Capital and PSC were unable to reach consensus selecting a lead business for 1 location identified by Ecology. The technical position of ABP, Blaser, Capital and PSC regarding the location is summarized in Table 3. The results of source control measure monitoring and further investigation activities proposed by ABP, Blaser, and Capital will be used during the interim period to further assess VI concerns and the results presented in the pre-RI/FS Scoping Document will be used to select a lead business for addressing VI concerns at disputed location.

The Ecology approved methodologies of PSC's IPIM Program (Attachment A) that apply[2] to the lead businesses will be adopted by the lead businesses within the W4 Investigation Area until a comprehensive VIAM Plan is approved by Ecology. The scope and schedule of activities conducted in accordance with this Interim VI Plan will be developed by the applicable lead business and submitted to Ecology within 60-day of approval of the Interim VI Plan. The comprehensive VIAM Plan will be formally described within the W4 Investigation Area RI/FS Work Plan.

[2] Some elements of the PSC IPIM Program may not be applicable to the lead businesses because the Interim Plan will only be valid during the interim period of time before the comprehensive VI Plan is adopted during the W4 Remedial Investigation.

4.0 COMPREHENSIVE VIAM PLAN COMPONENTS

Components of the comprehensive VIAM Plan that will be included in the W4 Investigation Area RI/FS Work Plan include:

- Identification of GIVFs to establish groundwater screening levels. Available data from the W4 Area will be evaluated to determine if GIVFs specific to the W4 Area should be developed or whether the GIVFs established by PSC are appropriate;

- Calculation of action levels based on GIVF data;

- Development of Level 1[3] and Level 2 methodologies to compare groundwater monitoring results to VI action levels and selection of decision points for implementation of further site-specific sampling and implementation of interim measures;

- Development of Level 3 QA/QC procedures and methodologies for indoor and ambient air, soil gas and groundwater sampling and for evaluating the results of site-specific sampling to assess the potential for VI; and,

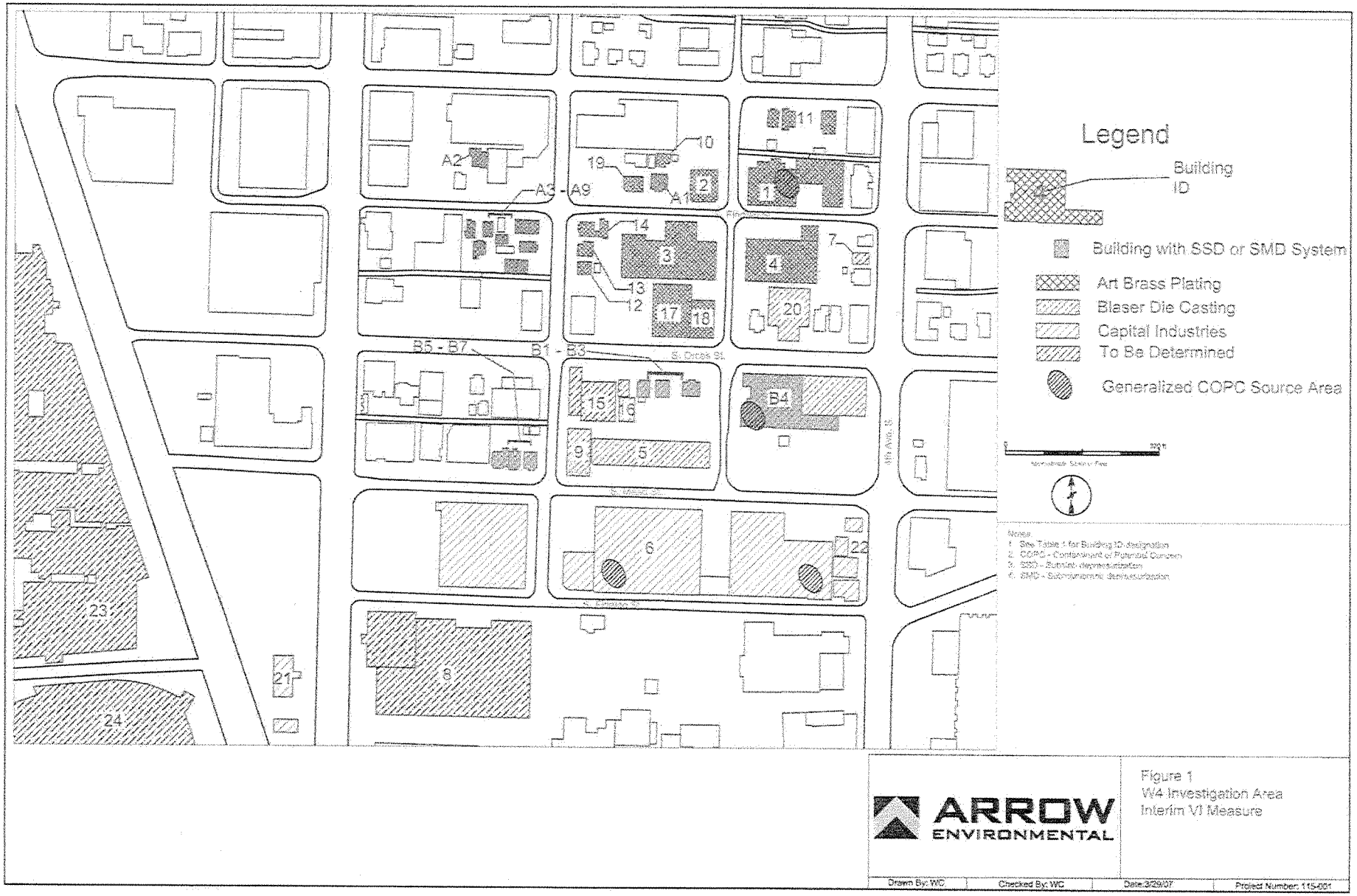
- Development of Level 4 methodologies for designing, installing, operating, monitoring and shutting down VI interim measures.

The PSC IPIM approach will be used where applicable to minimize duplication of effort and to build upon a previously approved approach. Upon approval of the comprehensive VIAM Plan by Ecology, the Level 1 and Level 2 procedures will be implemented using the combined database of available groundwater analytical data collected from the W4 Investigation Area businesses and developed as part of the W4 Investigation Area Scoping Document.

[3] Separate terminology for the individual tiers of the VI process has been used to differentiate the W4 Investigation Area interim VI activities from the PSC IPIM activities.

FIGURES

INTERIM VAPOR INTRUSION PLAN
WEST OF 4TH AVENUE SOUTH INVESTIGATION AREA



Notes:
1. See Table 1 for Building ID designation
2. COPC - Contaminant of Potential Concern
3. SSD - Subslab depressurization
4. SMD - Submembrane depressurization

ARROW ENVIRONMENTAL

Figure 1
W4 Investigation Area
Interim VI Measure

Drawn By: WC	Checked By: WC	Date: 3/29/07	Project Number: 115-001

TABLES

INTERIM VAPOR INTRUSION PLAN
WEST OF 4TH AVENUE SOUTH INVESTIGATION AREA

Table 1
W4 Investigation Area
Background Lead Business Status

Lead Business	Address
Art Brass Plating	ABP Facility at 5516 3rd Ave. S
	215/217 S. Findlay St.
	301/313 S. Findlay St.;
	220 S. Findlay St.
	5602 2nd Ave. S.
	5606 2nd Ave. S.
	5610 2nd Ave. S.
	222 S. Orcas St.
	226 S. Orcas St.
	214 S. Findlay St.
	218 S. Findlay St.
	317 S. Lucile St., and other houses on the south side of Lucile between 4th and 3rd
	218 ½ S. Findlay St
Blaser Die Casting	5700 3rd Ave. S.
	202 - 228 Mead
Capital Industries	5801 2nd Ave. S.
	5900 1st Ave. S. (Olympic Medical)[1]

Note: 1. In 2006, Capital Industries prepared a work plan for assessment and mitigation of vapor intrusion issues at Olympic Medical. See Table 3 for current status of this location

Table 2
W4 Investigation Area
Summary of Proposed Interim VI Measures at Ecology Identified Locations

Location ID	Address	Ecology Comments	Lead Business	VI Scope[1]
1	5516 3rd Ave. S. (Art Brass Plating)	Industrial building in an area where VOC concentrations at the WT pose a potential VI threat. ABP has assumed responsibility for ensuring that indoor air is not being unacceptably impacted by VI.	Art Brass Plating (ABP)	SVE proposed as element of ICAP. Implementation of SVE at this location will result in subslab depressurization and mitigation of potential vapor intrusion. Further VI monitoring proposed in ABP ICAP.
2	220 S. Findlay St.	Commercial building in an area where VOC concentrations at the WT pose a potential VI threat. ABP has assumed responsibility for ensuring that indoor air is not being unacceptably impacted by VI.	ABP	SVE proposed as element of ICAP. Implementation of SVE at this location will result in subslab depressurization and mitigation of potential vapor intrusion. Further VI monitoring proposed in ABP ICAP.
3	215/217 S. Findlay St.	Commercial/industrial building in an area where VOC concentrations at the WT pose a potential VI threat. ABP conducted a Tier 3 evaluation here during the late fall of 2005 and determined that indoor air was not being unacceptably impacted by VI. If VOC concentrations at the WT continue to pose a potential VI threat, indoor air sampling should be conducted again in the future. Sampling should be scheduled during the heating season and be completed before the end of Winter 2010.	ABP	VIAM Program consisting of ongoing monitoring and re-sampling, if necessary will be incorporated into W4 RI/FS Workplan. Indoor air resampling will be assessed prior to 2010 under the W4 VIAM Program. ABP's ICA activities include system performance monitoring to ensure that the AS/SVE system is not increasing the potential for off-site VI impacts.
4	301/313 S. Findlay St.	Industrial building in an area where VOC concentrations at the WT pose a potential VI threat. ABP met with the building owner and determined that TCE was being used in the manufacturing process. No indoor air sampling was conducted, and ABP does not intend to collect indoor samples as long as the tenant continues to use significant quantities of TCE.	ABP	TCE used by tenant. Evaluation of VI is not feasible as long as TCE continues to be used by the tenant. ABP's ICA activities include system performance monitoring to ensure that the AS/SVE system is not increasing the potential for off-site VI impacts.
5	202-228 S. Mead St.	Commercial building in an area where VOC concentrations at the WT pose a potential VI threat. PSC conducted a Tier 3 evaluation here during November 2003 and determined that indoor air was not being unacceptably impacted by VI. However, soil gas concentrations were elevated. Ecology understands that the building owner wants a mitigation system, and the Department agrees that the pathway should either be mitigated or indoor air quality should be routinely monitored.	Blaser Die Casting (Blaser)	Blaser is implementing source control measures at their facility located up-gradient of the 202-228 Building. Blaser will collect additional groundwater monitoring data during implementation of source control actions. On the basis of the results of the additional monitoring, Blaser will evaluate the potential VI threat. If agreed to by the property owner Blaser will conduct further indoor air sampling in the 2007/2008 heating season (Fall 2007).
6	5801 2nd Ave. S. (Capital Industries)	Industrial buildings in an area where VOC concentrations at the WT pose a potential VI threat. No Tier 3 evaluation has been conducted. CI collected soil gas samples in 2004 which indicated a low potential for unacceptable VI-caused indoor air impacts.CI will evaluate Plant 2 by using the JEM. If JEM results suggest the potential for unacceptable indoor impacts, air sampling will be proposed.	Capital Industries (CI)	In a letter dated December 2005, the Washington State Department of Ecology stated that no further assessment of vapor intrusion is necessary at Plant 4 based on the building's architecture, current use of the plant, and concentrations of volatile organic compounds (VOCs). Based on conversations with Ecology, CI believes that no further assessment of vapor intrusion is necessary at Plant 2 based on architecture, plant use, concentrations of sub-slab VOCs, and vapor transport modeling using the Johnson Ettinger Model for Subsurface Vapor Intrusion into Buildings
7	5507 4th Ave. S.	Residence in an area where VOC concentrations at the WT pose a potential VI threat. No Tier 3 has been performed. Access has been an issue in the past.	Not Established	The Comprehensive VIAM Program will evaluate shallow groundwater monitoring data from all PLPs to assess potentially vulnerable buildings. The current groundwater monitoring data does not indicate that this building is located in an area where VOC concentrations pose a potential VI threat. If the monitoring results change to indicate a potential VI threat, a lead business will be selected according to the processes developed within the Comprehensive VIAM Program.
8	5900 1st Ave. S.	Industrial building in an area where VOC concentrations at the WT pose a potential VI threat. PSC conducted Tier 3 evaluations here during the fall of 2004 and the summer of 2005. Indoor air quality was unacceptable in some building areas. Sub-slab soil gas concentrations were low, however, and Ecology asked that the sampling be repeated. The building tenant wants a mitigation system; Ecology agrees that the pathway should be mitigated if soil gas TCE/VC concentrations are found to be elevated.	See Table 3	See Table 3

Table 2
W4 Investigation Area
Summary of Proposed Interim VI Measures at Ecology Identified Locations

Location ID	Address	Ecology Comments	Lead Business	VI Scope[1]
9	5706 2nd Ave. S.	Commercial building in a general area where VOC concentrations at the WT pose a potential VI threat. PSC performed a Tier 3 during the fall of 2003 and determined that indoor air was not being unacceptably impacted by VI. If VOC concentrations at the WT continue to pose a potential VI threat, indoor air sampling should be conducted again. Sampling should be scheduled during the heating season and be completed before the end of Winter 2007/8.	Blaser	This property is not directly down-gradient of the Blaser source area, but because of geographical proximity, Blaser will assume lead business for the interim VI measures at this property. VIAM Program consisting of ongoing monitoring and re-sampling, if necessary, will be incorporated into W4 RI/FS Workplan. The need for indoor air resampling will be assessed prior to 2007/2008 under the W4 VIAM Program. If sampling or monitoring indicates no VI threat to the property, no further VI measures beyond those required in the W4 VIAM Program will be taken. If sampling or monitoring indicates that Blaser is not the source of the VI threat, lead business status for this property will be re-assigned to the appropriate lead business in accordance with the W4 VIAM Program procedures.
10	218 ½ S. Findlay St.	Residence in a general area where VOC concentrations at the WT pose a potential VI threat. This is a small house in the backyard of a larger house that has already been mitigated. The building has a sizable crawlspace, and Ecology agreed with PSC in 2003 that VI was unlikely to be a concern. However, at that time we did not realize there was a local source of TCE contamination. A Tier 3 evaluation is recommended here if VOC concentrations at the WT, beneath the house, pose a potential VI threat.	ABP	VIAM Program consisting of ongoing monitoring and re-sampling, if necessary will be incorporated into W4 RI/FS Workplan. Indoor air resampling will be assessed under the W4 VIAM Program. ABP's ICA activities include system performance monitoring to ensure that the AS/SVE system is not increasing the potential for off-site VI impacts.
11	317 S. Lucile St., and other houses on the south side of Lucile between 4th and 3rd	Residence in a general area where VOC concentrations at the WT pose a potential VI threat. PSC offered the owner a mitigation system but he refused. He also refused to allow indoor air sampling. Three years have now passed. As long as VOC concentrations at the WT, beneath this house, pose a potential VI threat, permission should be solicited (at least bi-annually) for conducting indoor air sampling or installing a mitigation system.Besides the house at 317 Lucile there are two other older homes on this block. It is not clear if they are occupied. If they are, and if local VOC concentrations at the WT pose a potential VI threat, permission should be solicited for either conducting indoor air sampling or installing mitigation systems.If VOC concentrations at the WT increase and pose a potential VI threat, a Tier 3 evaluation should be conducted again, this time during the heating season.	ABP	VIAM Program consisting of ongoing monitoring and re-sampling, if necessary will be incorporated into W4 RI/FS Workplan. Indoor air resampling will be assessed under the W4 VIAM Program. ABP's ICA activities include system performance monitoring to ensure that the AS/SVE system is not increasing the potential for off-site VI impacts.
12	5610 2nd Ave. S.	Residence in a general area where VOC concentrations at the WT pose a potential VI threat. PSC performed a Tier 3 evaluation here in May 2005 and determined that indoor air was not being unacceptably impacted by VI. DP-sampling during the Tier 3 detected TCE, but at a low level (0.2 ug/l). If VOC concentrations at the WT increase and pose a potential VI threat, a Tier 3 evaluation should be conducted again, this time during the heating season.	ABP	VIAM Program consisting of ongoing monitoring and re-sampling, if necessary will be incorporated into W4 RI/FS Workplan. Indoor air resampling will be assessed under the W4 VIAM Program. ABP's ICA activities include system performance monitoring to ensure that the AS/SVE system is not increasing the potential for off-site VI impacts.
13	5605 2nd Ave. S.	Residence in a general area where VOC concentrations at the WT pose a potential VI threat. PSC performed a Tier 3 evaluation here in May 2005 and determined that indoor air was not being unacceptably impacted by VI. DP-sampling during the Tier 3 detected TCE, but at a low level (0.2 ug/l). If VOC concentrations at the WT increase and pose a potential VI threat, a Tier 3 evaluation should be conducted again, this time during the heating season.	ABP	VIAM Program consisting of ongoing monitoring and re-sampling, if necessary will be incorporated into W4 RI/FS Workplan. Indoor air resampling will be assessed under the W4 VIAM Program. ABP's ICA activities include system performance monitoring to ensure that the AS/SVE system is not increasing the potential for off-site VI impacts.
14	5602 2nd Ave. S.	Residence used commercially, located in a general area where VOC concentrations at the WT pose a potential VI threat. PSC performed a Tier 3 evaluation here in May 2005 and determined that indoor air was not being unacceptably impacted by VI. DP-sampling during the Tier 3 was unable to detect TCE (DL = 0.02 ug/l). If VOC concentrations at the WT increase and pose a potential VI threat, a Tier 3 evaluation should be conducted again, this time during the heating season.	ABP	VIAM Program consisting of ongoing monitoring and re-sampling, if necessary will be incorporated into W4 RI/FS Workplan. Indoor air resampling will be assessed under the W4 VIAM Program. ABP's ICA activities include system performance monitoring to ensure that the AS/SVE system is not increasing the potential for off-site VI impacts.
15	203 S. Orcas	Commercial/industrial building in a general area where VOC concentrations at the WT pose a potential VI threat. PSC DP-sampling near the building in October 2005 detected very low VOC concentrations (TCE = 0.007J, VC = 0.012J ug/l). There is no need to sample indoor air quality as long as shallow groundwater VOC concentrations are monitored and remain low.	Not Established	Comprehensive VIAM Program consisting of ongoing monitoring and re-sampling, if necessary, will be incorporated into W4 RI/FS Workplan. ABP and Blaser have proposed installing additional monitoring wells upgradient of this location to further characterize the nature and extent of COCs in shallow groundwater. The results of the further investigation will be assessed in the Comprehensive VIAM Program. If the monitoring results change to indicate a potential VI threat, a lead business will be selected according to the processes developed within the Comprehensive VIAM Program.

Table 2
W4 Investigation Area
Summary of Proposed Interim VI Measures at Ecology Identified Locations

Location ID	Address	Ecology Comments	Lead Business	VI Scope[1]
16	211 S. Orcas	Residence and shop in a general area where VOC concentrations at the WT pose a potential VI threat. PSC DP-sampling near the building in October 2005 detected very low VOC concentrations (TCE = 0.007J; VC = 0.012J ug/l). There is no need to sample indoor air quality as long as shallow groundwater VOC concentrations are monitored and remain low.	Blaser	VIAM Program consisting of ongoing monitoring and re-sampling, if necessary, will be incorporated into W4 RI/FS Workplan. Blaser has proposed installing additional monitoring wells to further characterize the nature and extent of COCs in shallow groundwater. The results of the further investigation will be assessed in the VIAM Program.
17	222 S. Orcas	Commercial/industrial building in a general area where VOC concentrations at the WT pose a potential VI threat. PSC DP-sampling near the building in October 2004 detected very low VOC concentrations (TCE: ND; VC = 0.094 ug/l). There is no need to sample indoor air quality as long as shallow groundwater VOC concentrations are monitored and remain low.	ABP	VIAM Program consisting of ongoing monitoring and re-sampling, if necessary, will be incorporated into W4 RI/FS Workplan. ABP has proposed installing additional monitoring wells to further characterize the nature and extent of COCs in shallow groundwater. The results of the further investigation will be assessed in the VIAM Program.
18	226 S. Orcas	Commercial/industrial building in a general area where VOC concentrations at the WT pose a potential VI threat. PSC DP-sampling near the building in October 2005 detected very low VOC concentrations (TCE = 0.043J; VC = 0.015J). There is no need to sample indoor air quality as long as shallow groundwater VOC concentrations are monitored and remain low.	ABP	VIAM Program consisting of ongoing monitoring and re-sampling, if necessary will be incorporated into W4 RI/FS Workplan. ABP and Blaser have proposed installing additional monitoring wells to further characterize the nature and extent of COCs in shallow groundwater. The results of the further investigation will be assessed in the VIAM Program
19	214 S. Findlay St.	Residence in a general area where VOC concentrations at the WT pose a potential VI threat. PSC DP-sampled the WT near this house in May 2005. No VOCs were detected. There is no need to sample indoor air quality here as long as shallow groundwater VOC concentrations are monitored and remain low.	ABP	VIAM Program consisting of ongoing monitoring and re-sampling, if necessary will be incorporated into W4 RI/FS Workplan. Indoor air resampling will be assessed under the W4 VIAM Program. ABP's ICA activities include system performance monitoring to ensure that the AS/SVE system is not increasing the potential for off-site VI impacts.
20	308 S. Orcas	Commercial/industrial building in a general area where VOC concentrations at the WT pose a potential VI threat. PSC performed a Tier 3 in November 2003 and determined that indoor air was not being unacceptably impacted by VI. DP-sampling during the Tier 3 indicated that VOC concentrations in shallow groundwater were very low (TCE and VC were ND). There is no need to re-sample indoor air quality as long as shallow groundwater VOC concentrations are monitored and remain low.	Blaser	VIAM Program consisting of ongoing monitoring and re-sampling, if necessary will be incorporated into W4 RI/FS Workplan. Additional characterization conducted since 2003 confirm that VOC concentrations in groundwater at the WT do not pose a VI threat. The results of further investigation activities by ABP, PSC and Blaser will be assessed in the VIAM Program.
	POTENTIAL T3 ADDRESSES	**COMMENTS**		
21	Buildings between Mead and the confluence of 1st and East Marginal Way S., from 1st to EMW	Commercial buildings presently exist in this area (Jack-in-the-Box and a Chevron gas station). VOC concentrations at the WT are currently very low, and do not appear to pose a potential VI threat.	CI	Groundwater data from PSC direct-push borings advanced down-gradient of CI and along 1st Avenue South do not contain concentrations of COPCs above laboratory reporting limits and/or applicable screening levels in the Water Table Zone. If additional groundwater investigation down-gradient of CI is necessary it will be conducted as part of the W4 RI/FS.
22	Buildings between Mead and Fidalgo along the west side of 4th Ave. S.	Commercial/industrial buildings presently exist in this area (a restaurant at 5801 4th; "Tim's Kitchen" at 5807 4th; several companies at 5815 4th). VOC concentrations at the WT do not currently appear to pose a potential VI threat to the northern-most buildings, but concentrations near 5815 may be problematic. No Tier 3 evaluations have been conducted.	CI	Groundwater data from PSC and CI direct-push borings advanced upgradient of CI and along 4th Avenue South do not contain concentrations of COPCs above laboratory reporting limits and/or applicable screening levels in the Water Table Zone. If additional groundwater investigation is necessary it will be conducted as part of the W4 RI/FS.
23	5801 East Marginal Way S. (St. Gobain Containers)	Buildings are in an area where VOC concentrations at the WT do not currently appear to pose a potential VI threat. No Tier 3 evaluation has been conducted.	To Be Determined	Assessment of VI at the St. Gobain Facility is beyond the scope of this Interim VI Plan.
24	5901 East Marginal Way S. (Longview Fibre)	Buildings are in an area where VOC concentrations at the WT do not currently appear to pose a potential VI threat. No Tier 3 evaluation has been conducted.	To Be Determined	Assessment of VI at the Longview Fibre Facility is beyond the scope of this Interim VI Plan.
	LONG TERM MONITORING ADDRESSES	**COMMENTS**		
A1	218 S. Findlay	Building with existing subslab depressurization system (SSD). Scheduled for long term monitoring in 2007.	ABP	Negative pressure field testing only.
A2	122 S. Findlay	Building with existing submembrane (SMD) system. Not scheduled for long term monitoring in 2007.	ABP	Annual inspection by Lead Business selected in Pre-RI Scoping Document
A3	121 S. Findlay	Building with existing SMD system. Not scheduled for long term monitoring in 2007.	ABP	Annual inspection by Lead Business selected in Pre-RI Scoping Document
A4	123 S. Findlay	Building with existing SMD system. Not scheduled for long term monitoring in 2007.	ABP	Annual inspection by Lead Business selected in Pre-RI Scoping Document

Table 2
W4 Investigation Area
Summary of Proposed Interim VI Measures at Ecology Identified Locations

Location ID	Address	Ecology Comments	Lead Business	VI Scope[1]
A5	125 S. Findlay	Building with existing SMD system. Scheduled for long term monitoring in 2007	ABP	Groundwater sampling and analysis for VI COPCs by Lead Business selected in Pre-RI Scoping Document
A6	5601 2nd Ave. S.	Building with existing SMD system. Not scheduled for long term monitoring in 2007.	ABP	Annual inspection by Lead Business selected in Pre-RI Scoping Document
A7	5607 2nd Ave. S.	Building with existing SMD system. Scheduled for long term monitoring in 2007	ABP	Tier 3 sampling during the heating season (Winter 2007) by Lead Business Selected in Pre-RI Scoping Document
A8	5607 1/2 2nd Ave. S.	Building with existing SMD system. Not scheduled for long term monitoring in 2007.	ABP	Annual inspection by Lead Business selected in Pre-RI Scoping Document
A9	5609 2nd Ave. S.	Building with existing SMD system. Not scheduled for long term monitoring in 2007.	ABP	Annual inspection by Lead Business selected in Pre-RI Scoping Document
B1	215 S. Orcas	Building with existing SSD system. Scheduled for long term monitoring in 2007	Blaser	Negative pressure field testing
B2	217 S. Orcas	Building with existing subslab/submembrane depressurization system that is scheduled for long term monitoring in 2007	Blaser	Negative pressure field testing and Tier 3 sampling during the heating season (Winter 2007)
B3	227 S. Orcas	Building with existing SSD system that is scheduled for long term monitoring in 2007	Blaser	Negative pressure field testing
B4	5700 3rd Ave. S.	Blaser Facility with SSD system installed to address office area.	Blaser	Source control measures proposed near southwest corner of building that include excavation and ISCO.
B5	128 S. Mead	Building with existing SMD system. Scheduled for long term monitoring in 2007	Blaser	This property is not directly down-gradient of the Blaser source area, but because of geographical proximity, Blaser will assume lead business for the interim VI measures at this property. If long-term monitoring or inspections indicate no VI threat to the property, VI measures will be discontinued in accordance with the W4 VIAM Program Level 4 shutdown procedures. If long-term monitoring or inspections indicate that Blaser is not the source of the VI threat, lead business status for this property will be re-assigned to the appropriate lead business in accordance with the W4 VIAM Program procedures.
B6	132 S. Mead	Building with existing SMD system. Not scheduled for long term monitoring in 2007.	Blaser	This property is not directly down-gradient of the Blaser source area, but because of geographical proximity, Blaser will assume lead business for the interim VI measures at this property. If long-term monitoring or inspections indicate no VI threat to the property, VI measures will be discontinued in accordance with the W4 VIAM Program Level 4 shutdown procedures. If long-term monitoring or inspections indicate that Blaser is not the source of the VI threat, lead business status for this property will be re-assigned to the appropriate lead business in accordance with the W4 VIAM Program procedures.
B7	134 S. Mead	Building with existing SMD system. Not scheduled for long term monitoring in 2007.	Blaser	This property is not directly down-gradient of the Blaser source area, but because of geographical proximity, Blaser will assume lead business for the interim VI measures at this property. If long-term monitoring or inspections indicate no VI threat to the property, VI measures will be discontinued in accordance with the W4 VIAM Program Level 4 shutdown procedures. If long-term monitoring or inspections indicate that Blaser is not the source of the VI threat, lead business status for this property will be re-assigned to the appropriate lead business in accordance with the W4 VIAM Program procedures.

Note:
1. The scope of VI activities is based on the PSC IPIM Process and may change on the basis of specific workplans submitted by the lead business.

Table 3
Wil Investigation Area
Summary of Locations where Lead Business has not been Established

Location ID	Address	Ecology Comments	Lead Business	Art Brass Plating	Blaser Die Casting	Capital Industries	PSC	Interim VI Scope
6	5900-1st Ave. S. (Olympic Medical)	Industrial building in an area where VOC concentrations at the WT pose a potential VI threat. PSC conducted Tier 3 evaluations here during the fall of 2004 and the summer of 2005. Indoor air quality was unacceptable in some building areas. Sub-slab soil gas concentrations were low, however, and Ecology asked that the sampling be repeated. The building tenant wants a mitigation system. Ecology agrees that the pathway should be mitigated if soil gas TCE/VC concentrations are found to be elevated.	To be established in the Pre-RI Scoping Document.	The current groundwater monitoring data do not indicate that this building is located in an area where VOC concentrations associated with releases at the ABF Facility pose a potential VI threat.	Blaser believes that Capital Industries is appropriate lead role for Olympic Medical. Capital Industries is both tenant and immediate upgradient from Olympic Medical.	The existing groundwater quality data for the distribution of TCE in groundwater and the results of groundwater modeling clearly indicate that the confirmed release of TCE at the Blaser facility is responsible, in part, for TCE-contaminated groundwater at the Olympic Medical Warehouse property. The releases of TCE to groundwater at both the Capital and Blaser facilities have contributed to TCE-contaminated groundwater at the Olympic Medical Warehouse property in exceedance of the indoor air exposure pathway groundwater action level. Groundwater modeling using BIOCHLOR simulated the fate and transport of TCE from the source area at the Blaser facility in the Water Table Aquifer over a 10-year period. The results of the BIOCHLOR model indicate that TCE released to groundwater at the Blaser facility has migrated approximately 650 feet to extend beneath Capital Plant 2 and the Olympic Medical Warehouse building at concentrations that exceed indoor air inhalation pathway action levels. Therefore, the IRM at the Olympic Medical Warehouse building is the responsibility of both Blaser and	The current groundwater monitoring data do not indicate that this building is located in an area where VOC concentrations associated with releases at the PSC Facility pose a potential VI threat.	In 2005, CI prepared a work plan for assessment and mitigation of vapor intrusion issues at Olympic Medical. CI submitted a copy of the plan to Blaser as part of negotiations with Blaser regarding scope and cost allocations issues associated with the plan. Implementation of the work plan will be conducted by the (Lead Businesses) selected in the Pre-RI Scoping Document.

APPENDIX A

SUMMARY OF IPIM APPROACH

INTERIM VAPOR INTRUSION PLAN
WEST OF 4TH AVENUE SOUTH INVESTIGATION AREA

Summary of IPIM Approach

Summary of the IPIM Approach

This section summarizes the IPIM approach that PSC has used in the Georgetown Community proximate to the Facility since 2002 to assess the potential for VI at commercial and residential buildings to determine whether or not installations of VI mitigation systems are required. This section also summarizes the technical basis for developing groundwater-to-indoor-air volatilization factors (GIVFs) and constituent specific IPIM actions levels (IPIMALs) for groundwater and indoor air. The IPIM approach is an integrated approach for evaluating groundwater and indoor air data to determine, through the use of the IPIM Decision Tree, if a building warrants further investigation or action through an IM. The IPIM Decision Tree (see Figure 2-1) is organized into four tiers to allow progressive evaluation of groundwater data and incorporation of site-specific information. The IPIM Decision Tree (described in the Revised IPIM Work Plan [PSC, 2002]) is also intended to be flexible so that at any time a decision can be made to proceed directly to consult with the Ecology regarding the need to implement an IM. The technical basis for developing IPIMALs and the IPIM Decision Tree is described below.

Technical Basis for Developing IPIMALs

Migration of Soil Gas from Groundwater to Indoor Air

Groundwater in the shallow aquifer in the area of the Georgetown facility is primarily migrating in a west-southwest direction. Under some conditions, VOCs dissolved in the groundwater may partition into soil gas and migrate with soil gas through the soil into nearby basements, buildings, and other enclosed spaces[4]. The basic factors that influence the amount of VOCs that migrate from groundwater into soil gas and then into indoor air include the following:

- Volatilization from groundwater to soil gas at the water table (i.e., at the groundwater/soil interface).
- Migration of the soil gas via diffusion upward toward buildings and ground surface through the partially saturated soils directly above the water table and through the unsaturated zone (vadose zone).
- Attenuation of constituents of potential concern (COPCs) in soil gas within the vadose zone due to abiotic, aerobic or anaerobic degradation.
- Migration of soil gas vertically through the building foundation via diffusion and advection through cracks or other openings that may serve as entry points for soil gas. The degree of migration through the foundation depends on many factors, including soil type and moisture content directly beneath the structure, building construction type (e.g., basement or slab-on-grade), structural integrity of the building, pressure gradients associated with seasonal effects, the building ventilation system, and the operation of

[4] People may also be exposed to contaminated soil gases if they are excavating soils in areas where the groundwater is contaminated with VOCs.

household appliances. Advection is made possible by continuous airflow paths associated with open or incompletely sealed doors and windows, chimneys and other intake/exhaust ports.

- Mixing of indoor air inside the enclosed space with ambient air that is drawn into the building. The degree of mixing depends on the amount of mechanical or forced ventilation, natural ventilation, and infiltration from ambient air.

Development of GIVFs and Groundwater IPIMALs

PSC developed GIVFs and IPIMALs in order to evaluate the inhalation pathway following the procedures outlined in the Revised IPIM Work Plan (PSC, 2002), which are presented on Figure 2-2.

Development of GIVFs

The GIVFs were developed in August 2002 based on multi-media sampling performed by PSC at 10 building locations within a mixed residential/industrial neighborhood that is hydraulically downgradient of the Georgetown facility and is most likely impacted by facility-related COPCs[5]. Samples were collected in accordance with the Revised IPIM Work Plan (PSC, 2002). Building-specific GIVFs were developed using sets of data collected from multiple locations using the approach outlined in the Revised IPIM Work Plan (PSC, 2002) and IPIM Tech Memo 1 (PSC, 2003a).

Development of Groundwater IPIMALs

The IPIMALs for groundwater were calculated using conservative risk-based indoor air action levels and the COPC-specific GIVFs.

The IPIMALs are based on the action levels for indoor air developed in the Draft HHERA (PSC, 2001). Exposure parameters used to develop these IPIMALs are presented in Table 2-1 for restricted (commercial/industrial) and unrestricted (residential) scenarios. These action levels were developed such that the maximum indoor air concentrations of each COPC are health protective action levels based on a COPC-specific carcinogenic risk goal of 1E-06 and a hazard quotient of 0.1 for noncarcinogens for both residential and commercial/industrial workers. Table 2-2 presents the indoor air action levels for residential and commercial receptors and the specific exposure assumptions on which these action levels are based. IPIMALs for indoor air were calculated by using the final toxicity values approved by Ecology for use in the RI (PIONEER, 2005).

IPIMALs for groundwater were calculated using the IPIMALs for indoor air and the GIVFs, using the following equation:

[5] The COPCs for the site were identified in the Draft Human Health and Ecological Risk Assessment (Draft HHERA) (PSC, 2001).

$$IPIMAL\ Groundwater\ (\mu g/L) = \frac{IPIMAL\ IndoorAir\ (\mu g/m^3)}{GIVF\ \frac{(\mu g/m^3)}{(\mu g/L)}}$$

Table 2-2 also shows the residential and commercial groundwater IPIMALs for each COPC that are used to evaluate quarterly groundwater monitoring results by following the IPIM Decision Tree.

Pre-Corrective Action Groundwater Monitoring

PSC conducts routine groundwater monitoring on a quarterly basis to assess trends in the groundwater flow direction and gradient and to assess fluctuations in the concentrations of the COPCs detected in groundwater samples collected from the network of wells installed between Airport Way (located east of the Facility) and the Duwamish Waterway. The groundwater monitoring activities include measuring the depth to groundwater, monitoring groundwater stabilization parameters during low-flow well purging activities, collecting groundwater samples for laboratory analysis and documenting the groundwater monitoring activities and results in quarterly progress reports that are submitted to Ecology. The groundwater monitoring activities are conducted in accordance with the Pre-Corrective Action Monitoring Plan (PCAMP) (PSC, 2004).

IPIM Decision Tree

The IPIM Decision Tree (see Figure 2-1) is organized into four tiers to allow progressive evaluation of groundwater data and incorporation of site-specific information. Validated data from each quarterly groundwater monitoring event are compiled and evaluated for purposes of calculating IM cancer cumulative exceedance factors (CCEFs) and noncancer cumulative exceedance factors (NCCEFs) as follows:

- All groundwater data collected by PSC from the areas identified in Figure 2-3 are included in the evaluation; and
- Censored data (i.e., non-detected results) are assigned one-half the reporting limit for comparison purposes, in accordance with the Revised IPIM Work Plan (PSC, 2002).

Residential buildings are evaluated in Tier 1. Commercial/industrial locations are evaluated in Tier 2. The determination of whether or not a building is a residential use-type versus commercial use-type is based on preliminary field verifications by PSC and PIONEER personnel. Additional field verifications may be conducted prior to making a final determination of building use-types and follow-up actions.

Tier 1 – Determination of Potential Impacts to Residential Buildings

The first tier in the IPIM Decision Tree is to compare groundwater monitoring data to residential-based groundwater IPIMALs on a well-by-well basis.

Residential-based and commercial-based groundwater IPIMALs developed in IPIM Tech Memo 1 are presented in Table 2-2. COPC-specific exceedance factors (EFs) for each location are calculated using the following equation:

$$EF = \frac{C_{groundwater}}{\text{Residential}_{IPIMAL}}$$

where:

Parameter	Description
$C_{groundwater}$	Concentration in each groundwater well (ug/L).
$\text{Residential}_{IPIMAL}$	Residential-based IPIMAL for groundwater (ug/L), based on a carcinogenic risk of 1E-06 and a hazard quotient (HQ) of 0.1.
EF	Exceedance Factor.

Under Tier 1, residential CCEFs and NCCEFs for each monitoring well in the IPIM area are calculated by summing the EFs for individual cancer and noncancer COPCs, respectively. A CCEF and NCCEF of 10 indicate that exposure to indoor air concentrations associated with volatilization from groundwater near the sample station could potentially result in a cumulative risk of 1E-05 or a hazard index (HI) of 1[6], respectively.

Residential CCEFs and NCCEFs for COPCs detected at each monitoring well or direct push station are contoured using the Inverse Distance Weighting (IDW) interpolation method. IDW is used to create a grid of nodes (250-foot radius upgradient/downgradient of each well and 100-foot cross gradient from each well) where the value of each node is determined by interpolating values from known sample results. With IDW, data are weighted during interpolation such that the influence of one point relative to another declines with distance from the grid node. For example, areas closer to the measured data point are given more weight than more distant areas. As a result, there is much more confidence in contours generated for areas with higher sample density versus areas (e.g., west of 6th Avenue) where there are fewer samples. The IDW input parameters are summarized in Table 2-3.

A key advantage of applying the IDW is the ability to incorporate anisotropy into the interpolation. Many physical processes, such as groundwater flow, have preferred orientations (i.e., anisotropy). For example, groundwater in the PSC Area presented in Figure 2-3 generally flows in a west-southwest direction. This preferred flow direction is incorporated into the IDW model by setting an appropriate anisotropy angle. During the gridding process, points oriented in the direction of flow are weighted more heavily than other points, thus reducing the uncertainty associated with the interpolation algorithm used to estimate the area of influence.

[6] Per WAC 173-340-700(5)(b)(c), PSC may elect to evaluate the COPC-specific toxicity information to determine if it is appropriate to segregate the hazard quotients (HQs) (if the CEF for noncarcinogens is greater than 10). If the toxicity information indicates that it is appropriate to segregate the HQs, the decision rules for evaluating the segregated HIs are as follows: if any of the segregated HIs are greater than 1, the building will be proposed for Tier 4. If all of the segregated HIs are less than 1, the building will not be evaluated further until the next round of groundwater sampling. Segregation of HIs will be done with the COPC-specific prior approval of Ecology.

Residential locations that fall within the contours representing CCEFs or NCCEFs for COPCs detected in groundwater exceeding 10 are proposed for further evaluation under Tier 3 of the IPIM Decision Tree (see Figure 2-1). These locations have a potential cumulative inhalation cancer risk due to VI of 1E-05 or greater and/or a HI of 1 or greater. All locations are re-evaluated after the next quarterly groundwater monitoring event.

Tier 2 – Determination of Potential Impacts to Commercial Buildings

The approach for developing commercial-based IPIMALs is identical to the approach used to develop the residential-based IPIMALs except that the commercial exposure assumptions are used instead of residential exposure assumptions. Commercial/industrial locations are evaluated under Tier 2 by comparing COPCs detected in groundwater to commercial-based IPIMALs as presented in Table 2-2. Commercial/industrial locations that fall within the contours representing CCEFs or NCCEFs for COPCs detected in groundwater exceeding 10 are proposed for further evaluation under Tier 3 of the IPIM Decision Tree (see Figure 2-1). These locations have a potential cumulative inhalation cancer risk due to VI of 1E-05 or greater and/or a HI of 1 or greater. All locations are re-evaluated after the next quarterly groundwater monitoring event.

Tier 3 – Site-Specific Sampling

Residential and commercial/industrial locations identified in Tier 1 or Tier 2 for review under Tier 3 are evaluated to determine if site-specific data collection is warranted or if the location should move directly to Tier 4. Each location is evaluated independently. Site-specific, co-located, and contemporaneous groundwater, sub-slab, soil gas, indoor air, and ambient air samples are collected at buildings identified as Tier 3 locations in Tier 1 and Tier 2.

All sampling and analysis should been conducted in accordance with the Revised IPIM Work Plan (PSC, 2002). The data are then compiled and evaluated to determine if the location should proceed to Tier 4, as follows:

1. One-half of the reporting limit is assumed for non-detected results in indoor air. For comparison purposes, all data are presented in three ways: CCEFs and NCCEFs calculated for all data, CCEFs and NCCEFs calculated using just non-detected data, and CCEFs and NCCEFs calculated using just detected data.
2. Per the Revised IPIM Work Plan (PSC, 2002), indoor air concentrations are corrected by subtracting the maximum detected ambient air concentration from the maximum detected indoor air concentration, to account for the contribution of ambient air to the measured indoor air concentrations[7].

Noncancer exceedance factors (NCEFs) are calculated by dividing the corrected indoor air concentrations by noncancer-based indoor air IPIMALs. Cancer exceedance factors (CEFs) are calculated by dividing the corrected indoor air concentrations by cancer-based indoor air

[7] Literature values for background indoor air sources (i.e., potential contributions from non-VI related indoor air sources) were originally proposed to be used to "correct" measured indoor air concentrations in addition to ambient air. However, Ecology ultimately did not agree to this adjustment (see March 3, 2003 letter from Ed Jones [Ecology] to Carolyn Mayer [PSC])) (Ecology, 2003).

IPIMALs. The individual NCEFs and CEFs are summed to provide the NCCEF and CCEF. CEFs are calculated using the same relationship as used for Tier 1 and Tier 2, but indoor air data are compared to indoor air IPIMALs, as follows:

$$EF = \frac{C_{Indoor\ air\_Corr}}{\text{Residential or Commercial}_{IPIMAL}}$$

where:

Parameter	Description
$C_{Indoor\ air\_Corr}$	Corrected maximum indoor air at location (µg/m^3). These concentrations are determined by subtracting the maximum measured ambient (outdoor) air concentration from the maximum indoor air concentration.
Residential or Commercial$_{IPIMAL}$	Residential-based or commercial-based IPIMAL for indoor air (µg/m^3), based on a carcinogenic risk of 1E-06 and HQ of 0.1.
EF	Exceedance Factor.

The CCEFs and NCCEFs for each location are calculated by summing the EFs for individual cancer and noncancer COPCs. A CCEF/NCCEF of 10 indicates that exposure to indoor air concentrations could potentially lead to a cumulative risk of 1E-05 or an HI of 1.

The NCCEF and CCEF for each location is compared to Ecology's noncancer and cancer benchmark of 10. Locations with a NCCEF and/or CCEF greater than 10 are recommended for further evaluation to determine if the location should proceed to Tier 4. All other buildings are re-evaluated when the next round of groundwater sampling is performed.

Tier 4 – Inhalation Pathway Interim Measures

Locations proposed for evaluation under Tier 4 of the IPIM Decision Tree are selected based on the results of the Tier 3 analysis and discussions with Ecology[8]. Tier 3 sampling is conducted on a subset of buildings having exceedances of groundwater CCEFs and NCCEFs. When Tier 3 sampling indicates that a Tier 4 IPIM is warranted, those buildings in close proximity (where Tier 3 sampling was not conducted) are also identified for Tier 4 IPIM installations.

Prior to installation of a Tier 4 VI mitigation system, PSC has negotiated access agreements with the property owners at each location. These access agreements define the responsibilities of PSC and the property owners as follows:

- PSC:
  - Install and provide maintenance of the system; and
  - Monitor the performance of the system.
- Property Owner:
  - Allow PSC and its contractors access to the property to perform maintenance of the systems;

[8] It may be decided that some buildings should proceed directly to Tier 4 following the Tier 1 or Tier 2 evaluation.

- Receive instruction on how to monitor the system to ensure it is operating properly; and
- Contact PSC if the system is not operating properly.

The notification and coordination process implemented between PSC and the property owners is a critical component of the effective operation of the Tier 4 systems.

Depressurization System Installation

The *Depressurization Design Document: A Supplemental Inhalation Pathway Interim Measures Work Plan* (Depressurization Design Document) was submitted to Ecology in May 2003 (PSC, 2003b). This document describes how IPIMs are implemented at buildings that have moved to Tier 4. The IPIMs implemented at each property consist of either a sub-slab depressurization system (SSDS) and/or a sub-membrane depressurization system (SMDS), which are designed to be consistent with the American Society for Testing Materials (ASTM) E2121 (ASTM, 2003) and the USEPA's Radon Mitigation Standards (USEPA, 1993; USEPA, 1994).

The purpose of subsurface ventilation is to depressurize the ground immediately below the slab, which is achieved by using exhaust fans designed to generate sufficient pressure to prevent the flux of air from the soil, through the slab, and into the building. This type of system has been designed for a wide variety of VOCs that migrate through soil, largely through diffusion.

The SSDS decreases the pressure below the building slab so that pressure inside the building is higher, thus, any flow of air and any VOCs between the building and the slab are forced downward out of the building and into the slab. A fan pulls the air/VOCs from the subsurface, and vents them to the ambient air.

For buildings with crawl spaces, VOCs are removed as air is drawn into perforated pipe positioned beneath a vapor barrier (i.e., SMDS). The perforated pipe is attached to an exhaust fan that creates a pressure differential sufficient to direct air into the pipe, where it is eventually vented to the ambient air.

Prior to installation, diagnostic testing is performed to determine the size of the depressurization system (i.e., how many fans and associated exhaust systems) that is required for each building. Once complete, a site-specific design document is developed according to the *Supplemental IPIM Work Plan Depressurization System Design Document* (PSC, 2003c).

Confirmation of VI Mitigation System Effectiveness

System verification is performed in accordance with the Depressurization Design Document and the Verification of Depressurization System Effectiveness and Long Term Operations and Maintenance Plan for Inhalation Pathway Interim Measure (Long-Term O&M Plan), submitted to Ecology in April 2005 (PSC, 2003b, 2005). System verification is performed after installation of the SSDS at the locations with basements or slab-on-grade construction to ensure that a negative pressure differential of at least one Pascal (Pa) is achieved across the extent of the

slab[9]. Once the pressure field is confirmed following system start-up, monitoring of the in-line pressure gauge (manometer) is considered an adequate indicator of satisfactory system operation (MADEP, 1995).

For crawl space SMDS, it is not possible to measure the extent of the negative-pressure field. However, additional perforated pipe beneath the membrane serves to extend the suction field beneath the liner, and to increase airflow and movement of VOCs into the pipes and out of the subsurface. The primary way to measure the effectiveness of an SMDS is through inspection of the manometer installed on the exhaust pipe. At installation, manometer readings taken right above the sub-membrane systems should range from 220 to 360 Pa, which is within the guidelines for radon mitigation (USEPA, 1993). The large volume of air being exhausted from under the membranes (110 to 180 cubic feet per minute [cfm]) provides further indication that crawl space areas are being sufficiently ventilated.

To provide additional verification that the established pressure differential is adequate for VOC mitigation, VOC sampling is performed in representative buildings with basement/slab-on-grade construction. At each building, one basement or ground floor indoor air, ambient air and groundwater sample is collected to compare post-installation VOC concentrations with pre-SSDS installation concentrations. Samples are collected according to the methodology specified in the Revised IPIM Work Plan (PSC, 2002) and site-specific Tier 3 Sampling and Analysis Plans.

Note: Pre- and post-mitigation sampling of VOCs is limited by the influence of background/ambient air concentrations that may mask concentrations of VOCs emanating from soil gas and make it difficult to show decreasing trends in response to the IPIM. Therefore, no specific analytical "criteria" are presented in the Long-Term O & M Plan (PSC, 2005) to assess the effectiveness of the depressurization systems.

Long-Term O & M Plan

The purpose of Long-Term O & M Plan (PSC, 2005) is to determine whether or not the IPIM depressurization systems are still functioning as designed. Long-term monitoring and maintenance of the IPIMs are performed using annual inspections and a long-term monitoring program including periodic pressure field checks and/or VOC sampling. Additional evaluations may be performed if a substantial change in conditions indicates a potential impact to system performance.

Annual Inspections

Annual inspections take place during the second quarter and fourth quarter of each year, depending on the accessibility of each building. If the annual inspection indicates that a change in conditions has occurred, additional steps may be performed to determine whether or not the IPIM is still working effectively or is in need of modifications. The criteria for determining

[9] This pressure differential has been shown to be effective in radon mitigation projects, and is below the five Pa pressure differential that, according to EPA (USEPA, 1994), can lead to backdrafting.

whether or not an SSDS or SMDS needs to be re-evaluated to confirm system effectiveness, includes the following:

- A significant structural change in the building (e.g., remodeling that can introduce additional pathways of vapor migration);
- A significant increase in groundwater concentrations (e.g., 10 fold increase in the cumulative inhalation risk/hazard) in the vicinity of the building as indicated by the quarterly groundwater sampling performed by PSC;
- Changes in the mitigation system from the previous reporting period; and/or
- Problems associated with a system's operation and maintenance.

Additional steps that may be taken to evaluate the impact of a change in conditions are discussed in the Long-Term O & M Plan (PSC, 2005) and may include:

- Pressure field extension measurements for SSDS to confirm whether or not a negative pressure field still extends under the entire slab and meets the minimum performance standards at the most distal points (at least one Pa). Results are compared with post-installation IPIM measurements. Results that are within ±20 percent of the post-installation measurements indicate that the system is working effectively (PIONEER, 2004);
- Smoke flow visualization tests to qualitatively establish that an adequate suction field has been established at the perimeter of the slab; and/or
- Crawl space or basement/ground floor indoor air and ambient air sampling to compare VOC concentrations with pre- and/or post-IPIM concentrations.

Long-Term Monitoring Program

The long-term monitoring program consists of periodic measurements of the negative pressure field extension and/or VOC sampling. The IPIM sampling groups, proposed sampling locations, sampling timeframe, and type of sampling to be conducted are presented in the Long-Term O & M Plan (PSC, 2005). The general sampling approach is the following:

- Collect IPIM VOC samples annually at locations in close proximity and downgradient of the Georgetown facility.
- Collect negative pressure-field extension readings biennially at all SSDS locations.
- Collect VOC samples periodically at SMDS locations[10].

VOC sampling may be conducted as part of annual inspections or as part of long-term monitoring. The data obtained during the annual inspections or long-term monitoring are compared with pre- and post-IPIM SSDS/SMDS installation VOC sampling results and IPIMALs.

[10] In lieu of sampling crawl space air for VOCs at some SMDS locations, the PLP may instead collect a direct push groundwater sample in the immediate vicinity of the building.

If the resulting cumulative inhalation risk/hazard is greater than 10 times the previous SSDS/SMDS VOC sampling results, or the IPIM risk/hazard threshold is exceeded, then the PLP makes a preliminary determination as to whether or not the SSDS/SMDS installation needs to be modified (e.g., installing additional fan(s), sealing cracks in the slab, et cetera) to ensure that it is reducing indoor air concentrations of VOCs associated with VI from groundwater below Ecology's health risk benchmarks. Results of VOC sampling and a draft determination will be presented in a brief technical memo to Ecology for review prior to finalizing a follow up course of action. This memo is provided to Ecology within 30 days of receiving the validated analytical results.

The results of each annual inspection are presented in the second and fourth Quarterly Groundwater Monitoring Reports for that year.

IPIM Implementation Program Results

The results of implementation of the IPIM are presented below:

- **Tier 1 and Tier 2** – Every quarter, CCEFs and NCCEFs are calculated for each well[11]. The results for each well are presented in a table format and compared to Tier 1 (residential) and Tier 2 (commercial/industrial) screening levels. Figures illustrate contours of the CCEF and NCCEF values and provide a comparison of residential and commercial CCEFs >10 for recent monitoring results with previous monitoring results.
- **Tier 3 and Tier 4** – Buildings that fall within the contours illustrated on the figures developed in Tier 1 and Tier 2 are considered to be of potential concern and move into the Tier 3 evaluation. In the Tier 3 evaluation, a subset of the buildings of concern is sampled for groundwater, sub-slab and/or soil gas, indoor air, and ambient (outdoor) air. Results of this evaluation are used to identify those buildings requiring installation of a VI mitigation system under Tier 4 of the IPIM program. Because many of the residences are in close proximity to each other and are represented by the same groundwater monitoring well(s), Tier 3 results from a few representative locations are used to identify the broader range of buildings that require installation of a VI mitigation system. VI mitigation system installation has been completed in those buildings where groundwater and/or indoor air IPIMALS were exceeded, or based on the results of Tier 3 sampling in adjacent buildings. Those buildings where VI mitigation systems have been installed are included in the Long-Term O & M Plan, and are inspected annually, which includes periodic air sampling at some locations.

IPIM Program Summary

The key components of the IPIM Program are summarized below:

[11] For the monitoring wells not sampled during a quarterly monitoring event, groundwater monitoring results are used from the most recent round of sampling at each of these wells for the interpolation.

- **GIVF Study** – The GIVF study resulted in development of groundwater and indoor air concentrations (IPIMALs) that could be used to screen for locations of potential concern for VI.
- **Tier 1** – Quarterly monitoring well and recent direct push sample groundwater monitoring data are compared to residential-based groundwater IPIMALs on a well-by-well/point-by-point basis. Concentrations that exceed risk benchmarks established by Ecology are contoured to show areas of impact. Residential locations that fall within the areas of impact are identified for further evaluation under Tier 3 of the IPIM Decision Tree.
- **Tier 2** – Commercial/industrial locations are evaluated further under Tier 2 by comparing groundwater monitoring data to commercial-based groundwater IPIMALs on a well-by-well basis. Concentrations that exceed risk benchmarks established by Ecology are contoured to show areas of impact. Commercial/industrial locations that fall within the areas of impact are identified for further evaluation under Tier 3 of the IPIM Decision Tree
- **Tier 3** – Residential and commercial/industrial locations identified in Tier 1 or Tier 2 for review under Tier 3 are evaluated to determine if site-specific data collection (i.e., co-located indoor air, ambient air, sub-slab soil gas, and groundwater) is warranted or if the location should move directly to Tier 4. If the site does not proceed directly to Tier 4, then Tier 3 samples are collected and evaluated, and a Tier 3 Report is developed summarizing the data, risks, and the recommended course of action (i.e., the site is recommended for Tier 4 if Ecology's cancer or noncancer health benchmarks are exceeded. Otherwise, the site returns to Tier 1/Tier 2).
- **Tier 4** – Residential and commercial/industrial locations that move to Tier 4 have VI mitigation systems installed in order to eliminate or mitigate VI from groundwater and/or soil.
- **Long-Term Monitoring** – Long-term monitoring is performed ensure that depressurization systems are still functioning as designed. Long-term monitoring and maintenance of the IPIMs are performed using annual inspections and a long-term monitoring program including periodic pressure field checks and, in some cases, VOC sampling.

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Table 2-1 – Exposure Parameters Used to Calculate IPIMALs

Parameter	Abbreviation	Units	Restricted – Industrial/Commercial Scenario[1]				Unrestricted – Residential Scenario[1]					
			NonCarcinogen		Carcinogen		NonCarcinogen		Carcinogen			
			Value	Source	Value	Source	Value	Source	Child Value	Source	Adult Value	Source
Air inhalation intake rate	BR	m^3/hr	1.5	USEPA	1.5	USEPA	0.417	Eq. 750-1	0.417	Eq. 750-1	0.833	Eq. 750-2
Exposure time	ET	hr/day	10	USEPA	10	USEPA	24	Eq. 750-1	24	Eq. 750-1	24	Eq. 750-2
Exposure frequency	EXF	day/yr	250	USEPA	250	USEPA	365	Eq. 750-1	365	Eq. 750-2	365	Eq. 750-2
Exposure duration	ED	yr	25	Eq. 745-1	25	Eq. 745-2	6	Eq. 750-1	6	USEPA	24	USEPA
Average body weight	ABW	kg	70	Eq. 745-1	70	Eq. 745-2	16	Eq. 750-1	16	Eq. 750-1	70	Eq. 750-2
Averaging time	AT	day	9125	Eq. 745-1	27375	Eq. 745-2	2190	Eq. 750-1	27375	Eq. 750-2	27375	Eq. 750-2
Unit conversion factor	UCF	ug/mg	1000	–	1000	USEPA	1000	–	1000	–	1000	–
Target risk[2]	Risk	unitless	–	–	1.00E-06	SSRLG	n/a	–	1.00E-06	SSRLG	1.00E-06	SSRLG
Target hazard quotient[2]	THQ	unitless	0.1	SSRLG	–	–	0.1	SSRLG	0.1	–	0.1	–

Notes:

– = Not applicable.

USEPA = USEPA. 1991. Use of standard default exposure factors. Memo from P. Cirone to Risk Assessors. EPA Region 10, Seattle, WA. April 18, 1991.

Eq. 745-1, Eq. 745-2, Eq. 750-1, and Eq. 750-2 are Equations and Input Parameters defined in MTCA.

MTCA = Model Toxics Control Act Cleanup Regulation Chapter 173-340 WAC Amended February 12, 2001.

SSRLG = Site-Specific Remediation Level Goal.

[1] Exposure parameters defined in Draft HHERA (PSC, 2001). Residential cancer-based IPIMALs were calculated for a child and adult using the following age-integrated equation:

IPIMAL (ug/m^3) = {Risk/((((adultBR*adultEF)/adultBW)*adultED) + ((((childBR*childEF)/childBW)*childED))/AT)*UCF)/ Cancer Slope Factor

[2] Target hazard quotient of 0.1 and target risk of 1E-06 used for used for both scenarios in developing IPIMALs.

Table 2-2 – Indoor Air and Groundwater IPIMALs for Residential and Commercial Scenarios

COPC	Residential Air IPIMAL (ug/m^3) Cancer	Residential Air IPIMAL (ug/m^3) Noncancer	Commercial Air IPIMAL (ug/m^3) Cancer	Commercial Air IPIMAL (ug/m^3) Noncancer	Residential Groundwater[1] IPIMAL (ug/L) Cancer	Residential Groundwater[1] IPIMAL (ug/L) Noncancer	Commercial Groundwater[1] IPIMAL (ug/L) Cancer	Commercial Groundwater[1] IPIMAL (ug/L) Noncancer	Inhalation Reference Dose (mg/kg-day)		Inhalation Slope Factor $(mg/kg-day)^{-1}$	
1,1,1-trichloroethane	–	1.0E+02	–	4.3E+02	–	1.1E+03	–	4.7E+03	6.3E-01	4	–	9
1,1-dichloroethane	–	2.3E+01	–	9.7E+01	–	7.5E+02	–	3.2E+03	1.4E-01	2	–	9
1,1-dichloroethylene	–	9.1E+00	–	3.9E+01	–	5.3E+01	–	2.3E+02	5.7E-02	3	–	8
1,2,4-trimethylbenzene	–	2.7E-01	–	1.2E+00	–	1.3E+01	–	5.5E+01	1.7E-03	4	–	9
1,2-dichloroethane	7.8E-02	2.2E-01	2.2E-01	9.5E-01	1.0E+01	3.0E+01	3.0E+01	1.3E+02	1.4E-03	4	9.1E-02	3
1,3,5-trimethylbenzene	–	2.7E-01	–	1.2E+00	–	9.8E+00	–	4.2E+01	1.7E-03	4	–	9
2-hexanone	–	8.0E-01	–	3.4E+00	–	6.1E+02	–	2.6E+03	5.0E-03	4	–	9
Benzene	2.6E-01	1.4E+00	7.5E-01	5.8E+00	7.8E+00	4.1E+01	2.2E+01	1.7E+02	8.6E-03	3	2.7E-02	3
Chloroethane	–	4.6E+02	–	1.9E+03	–	5.4E+03	–	2.3E+04	2.9E+00	3	–	9
Chloroform	8.8E-02	2.2E+00	2.5E-01	9.5E+00	3.3E+00	8.5E+01	9.6E+00	3.6E+02	1.4E-02	5	8.1E-02	3
Cis-1,2-dichloroethylene	–	1.6E+00	–	6.8E+00	–	7.3E+01	–	3.1E+02	1.0E-02	6	–	9
Ethylbenzene	–	4.6E+01	–	1.9E+02	–	1.3E+03	–	5.4E+03	2.9E-01	3	–	9
Naphthalene	–	1.4E-01	–	5.8E-01	–	5.9E+01	–	2.5E+02	8.6E-04	3	–	9
P-isopropyltoluene	–	1.8E+01	–	7.8E+01	–	7.5E+01	–	3.2E+02	1.1E-01	6	–	9
Propylbenzene	–	1.6E+00	–	6.8E+00	–	2.7E+01	–	1.1E+02	1.0E-02	6	–	9
Sec-butylbenzene	–	1.6E+00	–	6.8E+00	–	2.3E+01	–	9.9E+01	1.0E-02	6	–	9
Tetrachloroethylene	3.4E-01	2.7E+01	9.7E-01	1.2E+02	4.0E+00	3.3E+02	1.2E+01	1.4E+03	1.7E-01	4	2.1E-02	7
Toluene	–	1.8E+01	–	7.8E+01	–	5.0E+02	–	2.1E+03	1.1E-01	3	–	9
Trans-1,2-dichloroethylene	–	3.2E+00	–	1.4E+01	–	6.5E+01	–	2.8E+02	2.0E-02	6	–	9
Trichloroethylene	2.0E-02	1.6E+00	5.0E-02	6.8E+00	4.0E-01	3.0E+01	9.0E-01	1.3E+02	1.0E-02	4	4.0E-01	4
Vinyl Chloride	2.3E-01	4.6E+00	6.6E-01	1.9E+01	1.0E+00	2.1E+01	3.0E+00	8.8E+01	2.9E-02	3	3.1E-02	3

Notes:
– = No toxicity value was available. Therefore, an IPIMAL could not be calculated.
The IPIMALs presented in this table are based on the Preliminary Remedial Action Levels (PRALs) presented in the HHERA (PSC, 2001) and do not take into account multipathway or multiconstituent exposures, impacts to ecological receptors, migration from soil to groundwater, or background concentrations of COPCs.
The HHERA PRALs were developed using the following target risk goals for individual COPCs:
Cancer Risk (CR) = 1E-06
Hazard Quotient (HQ) = 0.1
COPC – Constituent of Potential Concern
IPIMAL – Inhalation Pathway Interim Measure Action Level.
[1] Calculated using the Maximum GIVF for 1,1-DCE per IPIM Tech Memo 1.
[2] HEAST2 (Table 2), 1997.
[3] IRIS (1st Quarter), 2005.
[4] NCEA.
[5] NCEA value provided by Marcia Bailey.
[6] NTV - IPIMAL Surrogate Toxicity Value.
[7] Email from M.Bailey of USEPA 06/17/03.
[8] Email from M.Bailey of USEPA 09/18/02.
[9] No Value on IRIS 05, HEAST 97, or NCEA.

Table 2-3 – IDW Input Parameters

IDW Parameter	Parameters Used in Interpolation of CEFs	Description
Power	4	As the power increases, the grid node being interpolated is influenced more by points located closer than points located further away. The default value in many software applications (e.g., Surfer) is 2. For this analysis, a power of 4 was assumed which results in contours that are less smooth but are heavily influenced by points located closer to the grid node being interpolated. The power parameter must be greater than 0 and less than 20.
Smoothing	0	Smoothing was not incorporated into the contours. Normally, IDW behaves as an exact interpolator. When calculating a grid node, the weights assigned to the data points are fractions, and the sums of all the weights are equal to 1.0. When a particular observation is coincident with a grid node, the distance between that observation and the grid node is 0.0, and that observation is given a weight of 1.0, while all other observations are given weights of 0.0. Thus, the grid node is assigned the value of the coincident observation. The smoothing parameter buffers this behavior. If a non-zero smoothing parameter is used, no point is given an overwhelming weight (i.e., no point is given a weighting factor equal to 1.0).
Radius 1	250[a] feet	The radius of the search ellipse in the X direction (east-west: parallel to groundwater flow).
Radius 2	100[a] feet	The radius of the search ellipse in the Y direction (north-south: perpendicular to groundwater flow).
Search Sectors	4	The search ellipse was divided into 4 search sectors of equal size.
Anisotropy Angle	5°	The anisotropy angle is the offset of the search ellipse in the X direction. An anisotropy angle of 5 ° results in an orientation of the X coordinate of the search ellipse parallel to the groundwater flow located hydraulically down gradient of the Georgetown Facility.
Cell Spacing	2 feet	The cell spacing is the size of the node that will be assigned the interpolated value. Smaller cell spacing results in a smoother interpolation because more nodes are interpolated.

Figure 2-1 – IPIM Decision Tree

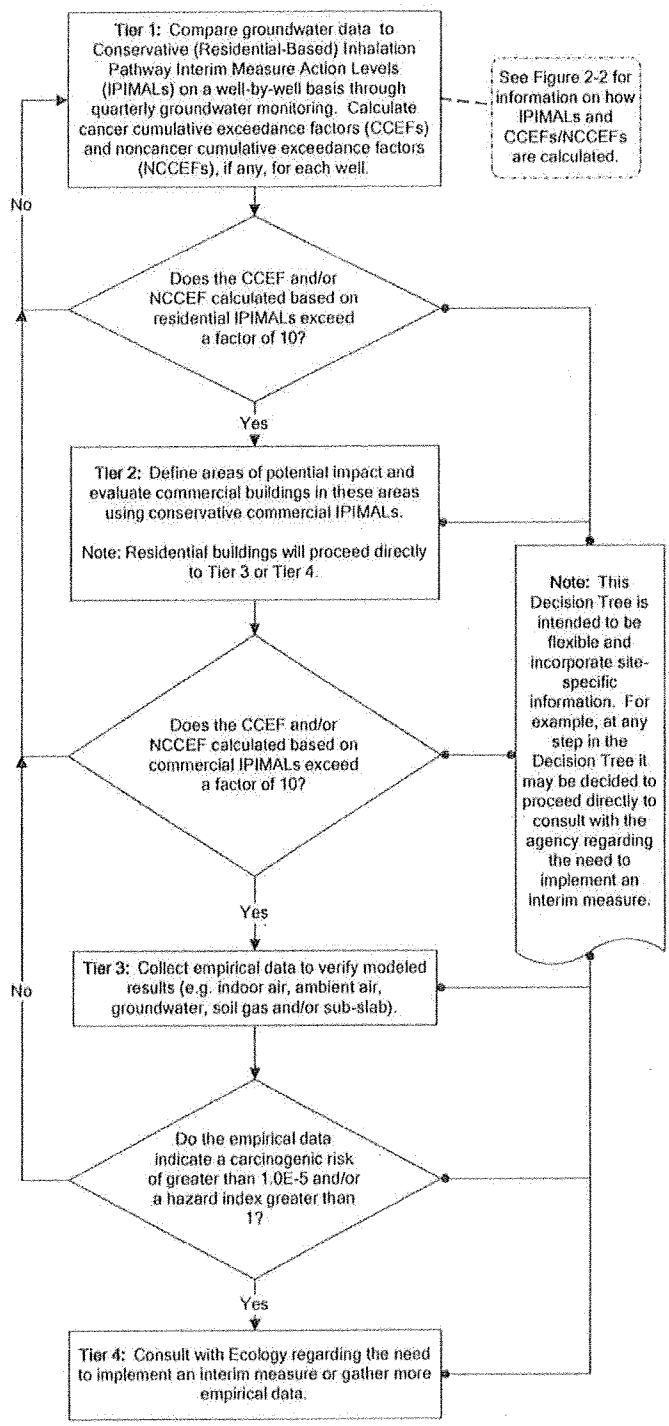
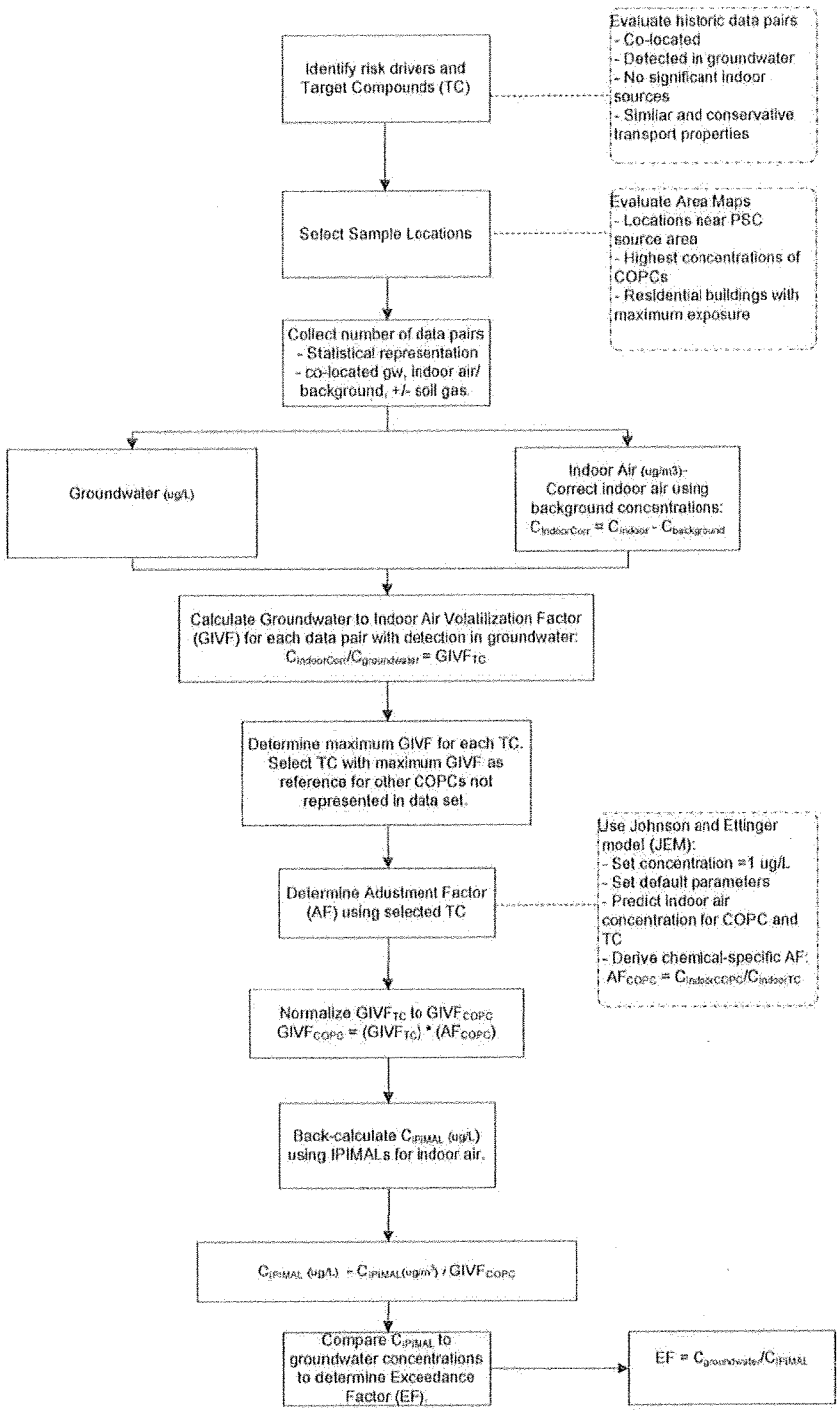
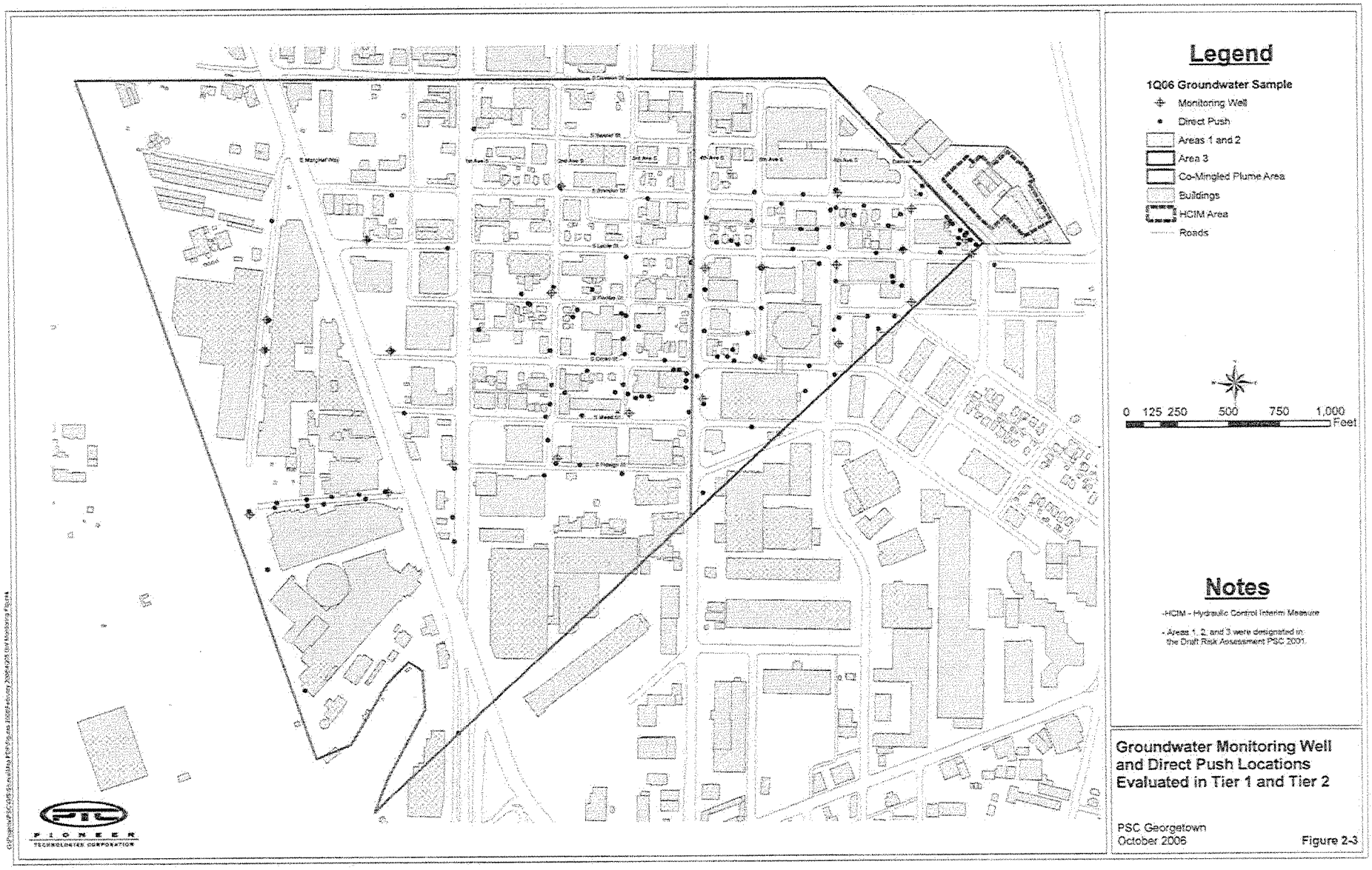


Figure 2-2 – Approach for Developing GIVFs and Groundwater IPIMALs





Groundwater Monitoring Well and Direct Push Locations Evaluated in Tier 1 and Tier 2

PSC Georgetown
October 2006

Figure 2-3