PERIODIC REVIEW (FINAL DRAFT)

PASCO BULK FUEL TERMINALS SITE
(FORMERLY PORT OF PASCO SITE)
PASCO, WA

EASTERN REGIONAL OFFICE
TOXICS CLEANUP PROGRAM

JANUARY 2009

Table of Contents

LIST OF ACRONYMS

1,1-DCE – 1,1-dichloroethene
1,2-DCE – 1,2-dichloroethene
1,2-DCP – 1,2-dichloropropane
1,2,-DCA – 1,2-dichloroethane
BTEX – Benzene, Toluene, Ethylbenzene, Xylenes
CAP – Cleanup Action Plan
COE – U.S. Army Corps of Engineers
CUL – Cleanup Level
DCE - Dichloroethene
DO – Dissolved Oxygen
cPAHs – carcinogenic Polyaromatic Hydrocarbons [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(123-cd)pyrene]
EC – Equivalent Carbon
FS – Feasibility Study
IAS/SVE – In Situ Air Sparging/Soil Vapor Extraction
MDL – Method Detection Limit
mg/Kg – milligrams per Kilogram
MTCA – Model Toxics Control Act
MW – Monitoring Well
PCE – tetrachoroethene or perchloroethylene
PQL – Practical Quantitation Limit
RI – Remedial Investigation
TCE - trichloroethylene
TPH – Total Petroleum Hydrocarbons
µg/L – micrograms per Liter
VOCs – Volatile Organic Carbons [benzene, ethylbenzene, toluene, total xylenes, 1,2-DCP, chloroform, 1,1-DCE, 1,2-DCA, TCE, cis-1,2-DCE, trans-1,2-DCE]

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

This document, prepared by the State of Washington Department of Ecology (Ecology), is the first periodic review of compliance monitoring data to evaluate the effectiveness of ongoing cleanup actions at the Pasco Bulk Fuel Terminal Site (Site). This Site was formerly known as the Port of Pasco Site. Site cleanup is being conducted pursuant to the 1995 Model Toxics Control Act (MTCA), Chapter 70.105D RCW, and the January 1996 Chapter 173-340 WAC, the MTCA Cleanup Regulation. All MTCA citations in this document refer to these MTCA editions unless otherwise stated.

Cleanup actions at this Site are in accordance with the requirements of Consent Decree No. 00 2 50546 1 that was filed in Franklin County Superior Court on August 25, 2000. The Pasco Bulk Fuel Terminals Coordinating Group implemented the remedial actions in accordance with the design documents required by the Site's March 1999 Final Cleanup Action Plan (CAP) as amended in August 25, 2000.

Treatment systems to address petroleum and chlorinated solvents in soils and ground water have been installed in 3 stages for 7 remediation areas of the Site. The primary treatment systems include soil vapor extraction (SVE) and in-situ air sparging (IAS). Stage 1 IAS/SVE treatment systems construction started in 2001 and treatment systems were in full operation by February 2002. Stage 2 construction started in 2002 and was completed in January 2003. Stage 3 construction started and was completed in 2006.

Site periodic reviews are required because WAC 173-340-420 (1) provides that

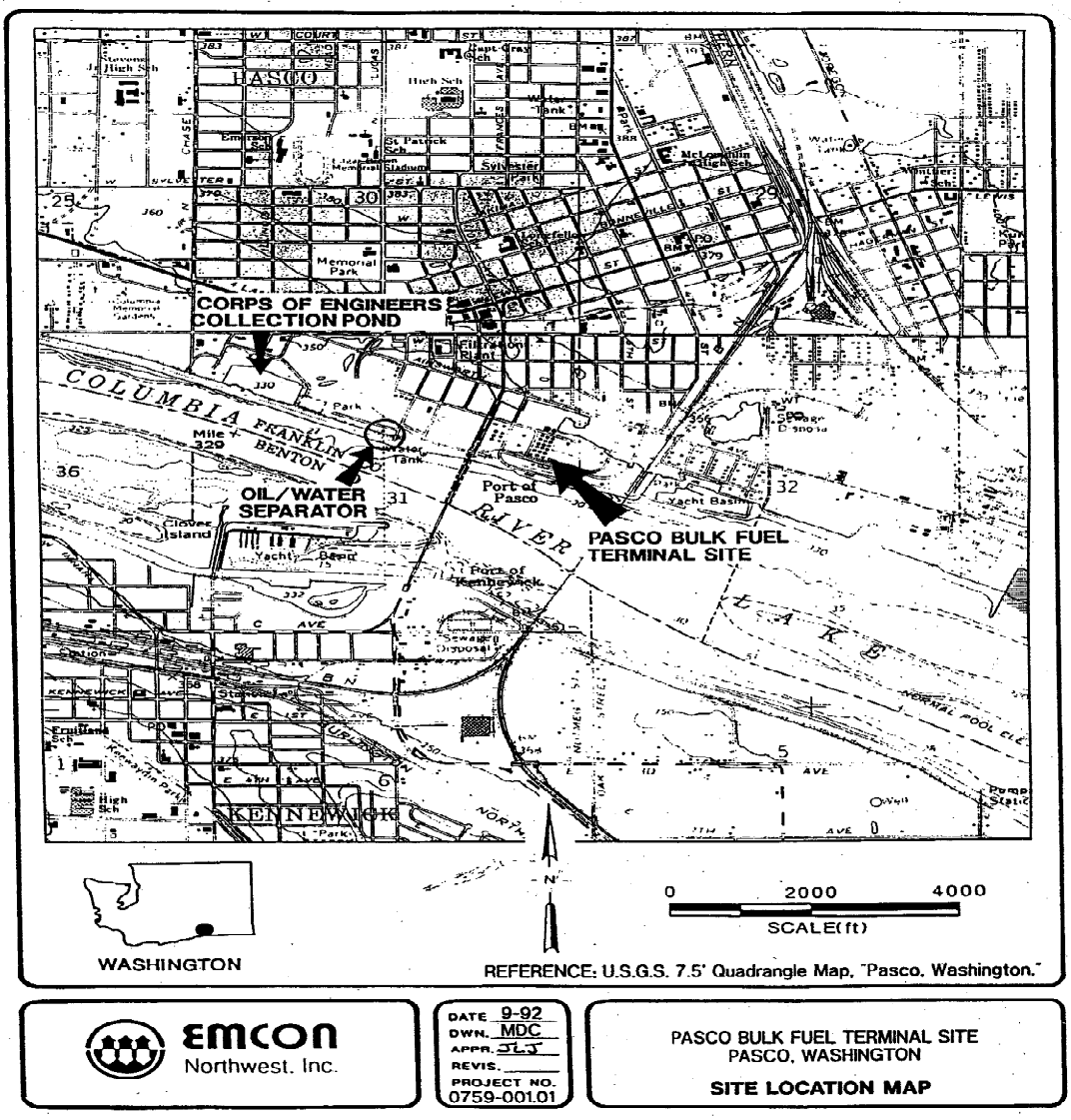
> " if the department selects or approves a cleanup action that results in hazardous substances remaining at a site at concentrations which exceed Method A or Method B cleanup levels established under WAC 173-340-700 through 173-340-760 or if conditional points of compliance have been established, the department shall review the cleanup action no less frequently than every five years after the initiation of such cleanup action to ensure that human health and the environment are being protected".

2.0 SUMMARY OF SITE CONDITIONS

2.1 SITE DESCRIPTION

The Site is located in Section 31, Township 9 North, Range 30 East, Williamette Meridian, on the north bank of the Columbia River in Pasco, Washington (See Figure 1).

FIGURE 2.1.1
SITE LOCATION MAP

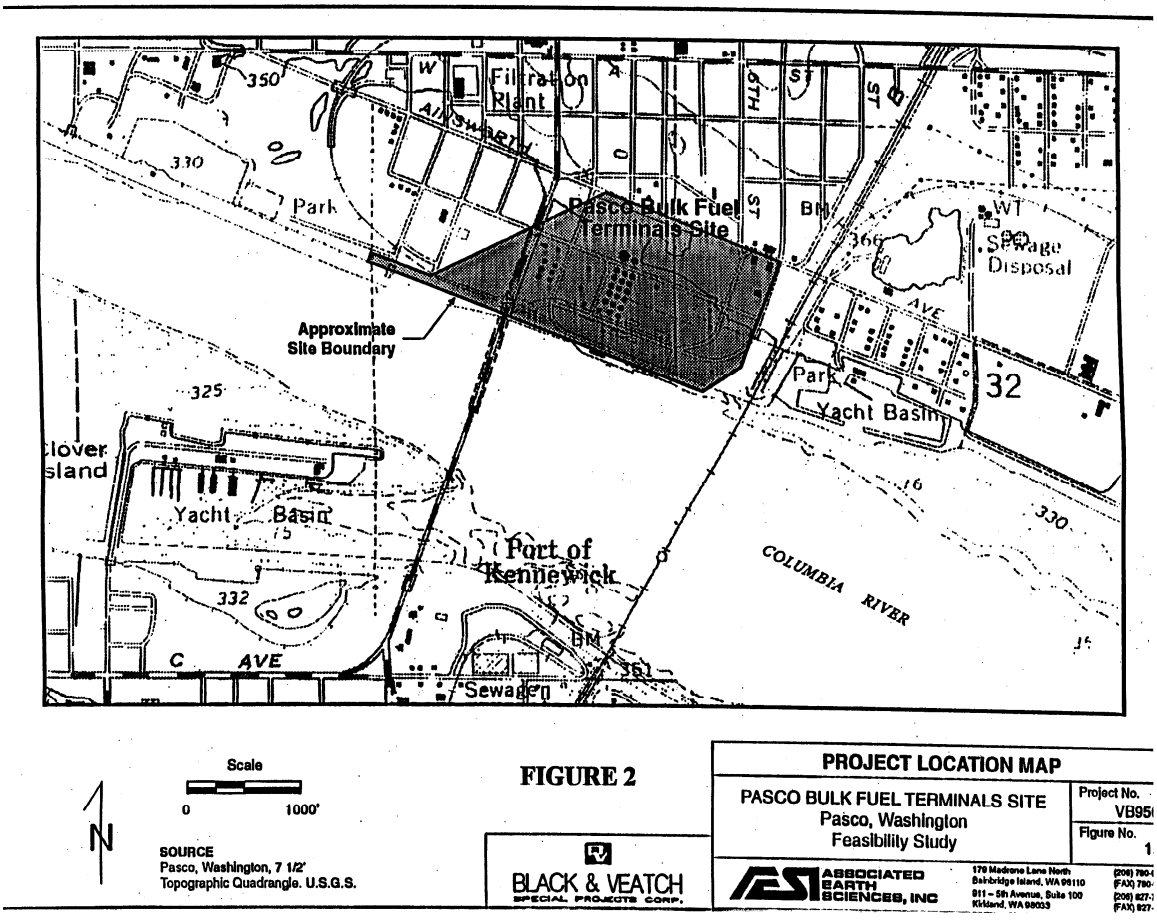


The Site is approximately 90 acres in size and its boundaries are described as follows (Figure 2):

- Ainsworth Avenue on the north.
- The U. S. Army Corps of Engineers (COE) levee on the south.
- South 5th Avenue on the east.
- A line extending from the intersection of South 9th Avenue and Ainsworth Avenue to the intersection of the COE interceptor drain and the extension of South 12th Avenue on the west.

The Site also includes a strip of land located west of South 12th Avenue that includes the COE interceptor drain, the Port of Pasco oil/water separator, and the COE drainage ditch.

FIGURE 2.1.2
SITE BOUNDARY MAP



The Site lies behind dikes maintained by the COE. The COE facilities on the Site, which were all constructed prior to 1952, include:

- An **embankment levee** that parallels the Columbia River.
- A 42-inch-diameter **interceptor drain** located beneath the southern portion of the Site. This interceptor drain was constructed to dewater the area behind the dikes. Water in the COE interceptor drain flows by gravity to an outlet located approximately 1,500 feet west of the main tank farm. Following discharge through an **oil/water separator**, the water flows through an open channel and discharges into the COE collection pond. Figure 1 shows the locations of the oil/water separator and the collection pond. The COE periodically pumps the water from the pond into the Columbia River.
- A **cutoff wall** surrounding the Continental Grain facility [designated as Area 9 in Figure 4.1] with two **dewatering wells** inside this wall. While the grain facility was in place, the area within the slurry wall was being dewatered by pumping groundwater out of these two wells. Extracted groundwater was initially discharged to the interceptor drain until 1995 when the COE installed another oil/water separator prior to discharging directly to the Columbia River. The COE ceased dewatering these wells in 2004 when the grain elevator was demolished.

2.2 SITE HISTORY

The Site had been used primarily as a petroleum storage and distribution facility since the early 1940s. Other industrial and commercial uses had also occurred at the Site. The Site once included 3 tank farms that, during peak operating periods, consisted of approximately 50 aboveground tanks. Other smaller tank farms also were operated at the Site. In addition to petroleum products, agricultural chemicals including soil fumigants, fertilizers, and solvents were stored. The Site also contained rail car and truck loading racks, railroad spurs, and underground and aboveground pipelines. In 1992, all operating storage tanks were emptied of petroleum products and agricultural chemicals, and tanks not owned by the Port of Pasco were removed from the Site. Some buildings and underground sumps associated with loading and distribution areas were also removed. In 1999, the remaining storage tanks were removed from the Site.

Oil films on the water discharging from the interceptor drain to the collection pond have been observed since the 1950s. Site investigations starting in 1969 found petroleum contamination in the form of free petroleum product on ground water as well as soils and ground water contamination. In addition, chlorinated solvents and one constituent of a fumigant were found in soils and ground water.

In 1990, Ecology conducted a Site Hazard Assessment of the Site to determine its ranking relative to other contaminated sites in the State. The Site ranked a 1 on a scale of 1 to 5, 1 being the highest risk.

The Remedial Investigation (RI) conducted from 1993 through 1995 completed the characterization of site contamination. The Feasibility Study (FS) Report, completed in

1997, described the applicable cleanup requirements for the Site, proposed cleanup standards, identified and evaluated remedial action alternatives for the Site, and recommended remedial alternatives for the Site.

Ecology issued the final CAP in March 1999. An In-situ Air Sparging/Soil Vapor Extraction (IAS/SVE) pilot test was conducted on site starting in April 1999 to evaluate the effectiveness of treating the site contaminants. The CAP was amended in August 2000 at the same time the Consent Decree, to implement the cleanup actions, was entered in Superior Court.

2.3 PHYSICAL SITE CHARACTERISTICS

2.3.1 Site Geology

Site soils are divided into four primary stratigraphic units, consisting from top to bottom: Fill, Alluvium, the Pasco Gravel, and the Ringold Formation. Fill material including sandy silt, silty sand, sand, sand with gravel, and gravel are present in the upper few feet over most of the Site, with a maximum thickness of approximately 7 feet. Alluvium at the Site consists of silt and fine sand with less extensive deposits of clayey silt and clay. In general, this alluvium is present in a wedge that thickened toward the southern portion of the Site near the banks of the Columbia River. The Pasco Gravel consists primarily of sandy gravel with cobbles and ranges from 13 to 34 feet in thickness. The Ringold Formation encountered beneath the Pasco Gravel is about 40 feet below ground surface (bgs). It consists of indurated to cemented, hard silt and clayey silt interbedded with fine sand.

2.3.2 Ground Water Hydrology

The ground water flow system consists of a shallow, unconfined aquifer within the alluvium and the underlying Pasco Gravels. Depth to ground waters across the Site ranges from roughly 4 to 10 feet below ground surface (bgs). The base of the unconfined aquifer system is the upper surface of the Ringold Formation.

Ground water flow within the unconfined aquifer is generally from east to west, but it turns south in the immediate vicinity of the COE interceptor drain. The COE interceptor drain acts as a line sink that locally lowers the ground water table and is the discharge point for COE dewatering wells. Ground water levels are generally lowest during the month of October and highest during May and June. Annual ground water level fluctuations across the Site average about one foot.

The Columbia River is located immediately south of the Site. Hydraulic interconnection between the Site and the River is minimized by the COE levee that is keyed into the Ringold Formation.

2.4 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of contamination, described in detail in the RI Report, is summarized below. Figures illustrating the extent of contamination are found in the RI Report.

2.4.1 Free-Phase Product

- Free-phase product was present at the Site in identified areas generally at a depth of 4 to 6 feet. The free product consisted of gasoline and diesel, the amounts of each varying from one plume to another. The apparent free-phase product thickness increased during periods of low ground water table elevation. Free product discharged to the COE drain and was collected in the oil/water separator.

2.4.2 Soils

- Areas of significant Total Petroleum Hydrocarbons (TPH) surface concentrations were limited to the main tank farm area. TPH concentrations were also found at the 2-4 feet depth. A much broader portion of Site soils had significant TPH concentrations at the 4-6.5 feet depth, generally associated with the water table.

- Detections of polynuclear aromatic hydrocarbons (PAHs) and benzene, toluene, ethylbenzene, and xylenes (BTEX) in soils were generally located within the areas delineated by TPH.

- Arsenic levels in soil were all within background levels. Lead levels in soils were below the most stringent cleanup criteria.

- Perchloroethylene (PCE), also known as tetrachloroethene, was detected at former PCE tank locations. Trichloroethylene (TCE) occurred only in association with PCE and is not detected above the most stringent among cleanup criteria considered protective of human health. The chemical 1,2-dichloropropane (1,2-DCP), a soil fumigant, was detected in only one soil boring.

2.4.3 Ground Water

- Dissolved gasoline and diesel in ground water were the major contaminants on Site.

- The occurrences of lead, PAHs, and BTEX were essentially within the TPH plume, consistent with the presence of these compounds in petroleum products.

- Arsenic concentrations elevated above the background concentration had the same general distribution as the TPH plume. A correlation was also noted between low dissolved oxygen (DO) and elevated arsenic levels in ground water.

- Significant PCE, TCE and dichloroethenes (DCEs), 1,2-dichloroethane (1,2-DCA) detections were found in some wells. The relative percentages of these compounds varied from well to well.

- The greatest concentration of 1,2-Dichloropropane (1,2-DCP) measured at the Site occurred near the former west tank farm. The dissolved-phase 1,2-DCP plume extended down gradient (southwest) to the COE drain. The southward extent was limited by the COE drain.

2.4.4 COE Interceptor Drain

- The occurrence of dissolved phase contaminants in the water in this drain was consistent with the nature and extent of dissolved phase contaminants identified in ground water in monitoring wells adjacent to the drain.

2.4.5 Surface Water and Sediments

- TPH, lead, and Volatile Organic Carbons (VOCs) were detected in the ditch surface water and sediments. Concentrations of PCE and lead were higher in the collection pond than at the point where the ditch water entered the pond. This suggested that there were other sources of contaminants to the pond that were not related to the Site. For this reason, the Site included the ditch but not the COE Collection Pond.

- TPH, lead, and a few VOCs were detected in the ditch sediments. Benzene, PCE, TCE, and 1,2-DCP were not detected in sediment samples. Concentrations of detected chemicals were higher in the sediments found at the head of the ditch immediately downstream of the oil/water separator.

2.5 INTERIM ACTIONS

Interim actions at the Site started in 1993. The actions included:

- The installation of a trench and a well with skimmer pumps to recover free petroleum product from ground water. More than 4,000 gallons of free product were recovered from ground water as a result of the interim action. Ten additional recovery trenches, later installed as supplemental interim action in order to recover additional free product from the ground water, did not result in a significant recovery.

- The evaluation and abatement of risks posed by the free product in utility manholes and in a basement sump of a family residence in the Site. The sump in the basement of the family residence was sealed. The Port of Pasco then purchased this property and this residence was later demolished. Utility companies had been warned of the dangers of vapors in the affected manholes.

3.0 CLEANUP ACTION PLAN (CAP)

Following completion of the Feasibility Study (FS), Ecology issued a draft CAP in 1999. After public review and comment, Ecology issued a final CAP in March 1999. This final CAP was later amended in 2000. This amendment was primarily to change the remedy selected for the main tank farm soils from 'excavation followed by ex-situ bioremediation' to an 'in-situ treatment by SVE in combination with IAS'. The following are elements of the amended final CAP.

3.1 REMEDIAL ACTION GOALS

The remedial action goals for the Site are the following:

- Remove free-phase petroleum product.
- Prevent leaching of contaminants from soil into the ground water that would result in exceedance of ground water cleanup levels.
- Prevent direct contact and ingestion of soils in excess of cleanup levels by humans.
- Prevent direct contact and ingestion of contaminated ground water beneath the Site by humans.
- Prevent direct contact and ingestion of contaminated ground water, leaving the COE interceptor drain through the oil/water separator, by humans and biota in surface water.

3.2 CLEANUP STANDARDS

The two primary components of cleanup standards are: (1) cleanup levels, and (2) points of compliance.

3.2.1 Cleanup Levels

Cleanup levels determine the concentration in which a particular hazardous substance does not threaten human health or the environment. Site cleanup levels were developed as follows:

- Ground water – Method B cleanup levels protective of drinking water and surface water were used. Method A levels were used for TPH since Method B levels for TPH were not available at the time.
- Soils - Method C Commercial cleanup levels were used for Site soils. The 1997 Interim TPH Policy was used to develop cleanup levels for TPH.

- Surface Water - Ditch surface water is technically ground water discharging via the interceptor drain. Surface water cleanup levels were therefore taken to be the same as those for ground water.

- Sediments - No indicators were identified for ditch sediments, thus no cleanup levels were necessary.

Table 3.1 shows the final cleanup levels for the identified site indicators after consideration of background concentrations, Practical Quantitation Limits (PQLs), and total site risk.

3.2.2 Points of Compliance

The Point of Compliance is defined in MTCA as the point or points where cleanup levels established in accordance with WAC 173-340 720 through WAC 173-340-760 shall be attained (WAC 173-340-200). Once those cleanup levels have been attained at that point, the site is no longer considered a threat to human health and the environment.

Soils

For soil cleanup levels based on protection of ground water, the point of compliance is in the soils throughout the site under WAC 173-340-740(6).

For soil cleanup levels based on human exposure via direct contact, the point of compliance is established in the soils throughout the site from the ground surface to fifteen feet below the ground surface. This represents a reasonable estimate of the depth of the soil that could be excavated and distributed at the soil surface as a result of site development activities.

As stated in the CAP, actual soil concentrations based on protection of ground water will be determined from ground water monitoring data according to the Compliance Monitoring Plan and will over-ride the theoretical numbers specified. Soil cleanup levels based on protection of ground water will be met if ground water cleanup levels have been achieved as determined using the statistical requirements under MTCA for meeting cleanup levels. Should soil levels result in continued contamination of ground water, further remedial action will be necessary.

Ground Water

For ground water, WAC 173-340-720(6) governs the definition of the point of compliance. The point of compliance in ground water is established throughout the Site from the uppermost level of the saturated zone extending vertically to the lowest most depth which could potentially be affected by the site.

TABLE 3.1
SITE CLEANUP LEVELS (CULs)

Indicator	Ground Water		Soil	
	CUL, µg/L	Basis	CUL, mg/Kg	Basis
TPH				
Aliphatics				
EC 5-6			**1**	
EC>6-8			**5**	
EC>8-10			**760**	
EC>10-12			**810**	
EC>12-16			**1876**	
EC>16-21			**1094**	
Total aliphatic			**4546**	
Aromatics				
EC>8-10			**5**	
EC>10-12			**30**	
EC>12-16			**250**	
EC>16-21			**605**	
EC>12-35			**85**	
Total aromatic			**975**	
TPH, TOTAL	**1000**	Method A	**5521**	Interim TPH Policy, Method C Commercial
VOCs				
Benzene	**5**	MCL	**0.0065**	Interim TPH Policy, Method C Commercial
Ethylbenzene	**320**	MCL (adjusted)	**2**	Interim TPH Policy, Method C Commercial
Toluene	**320**	MCL	**1.7**	Interim TPH Policy, Method C Commercial
Xylenes	**4100**	MCL (adjusted)	**3**	Interim TPH Policy. Method C Commercial
1,2 dichloropropane (1,2-DCP)	**2**	MCL		
chloroform	**1**	Method B, Carcinogen		
1,1-dichloroethene (1,1-DCE)	**0.027**	Method B, carcinogen		
1,2-dichloroethane (1,2-DCA)	**0.3**	Method B, carcinogen		
Tetrachloroethene (PCE)	**1.75**	MCL (adjusted)	**0.175**	100xGW
Trichloroethene(TCE)	**2**	MCL (adjusted)		
cis-1,2-DCE	**53**	MCL (adjusted)		
Trans-1,2-DCE	**100**	MCL		
Total Metals				
Arsenic	**10**	PQL		
Lead	**10**	PQL		
LPAH				
naphthalene	**130**		**13**	100xGW
HPAH				
cPAHs	**0.1**	Method A		

Surface Water

WAC 173-340-730(6) requires that for surface water, the point of compliance shall be the point or points at which hazardous substances are released to surface waters of the state unless the department has authorized a dilution zone in accordance with WAC 173-210-035. Where hazardous substances are released to the surface as a result of ground water flow, no dilution zone shall be allowed to demonstrate compliance with surface water cleanup levels.

At this Site, ground water is released to surface water at the outlet of the COE interceptor drain. The point of compliance for ground water discharging to surface water is at the discharge point from the COE drain into the ditch, which is at the outlet of the oil/water separator.

3.3 SITE CLEANUP ACTION

The Site's selected cleanup actions identified in the final CAP, as amended, include the following:

3.3.1 Free-Phase Product

- Continue free-phase product recovery until the apparent free-phase product thickness is reduced to 0.1 foot or less. The recovery will be considered complete when there is no exceedance of the apparent hydrocarbon thickness of 0.1 foot for a period of 2 years or upon Ecology's concurrence.

- Design and installation of a monitoring well to effectively monitor possible accumulations of free-phase product in the area beneath the Continental Grain facility. If recoverable thicknesses of free-phase product are detected in the well, then a passive skimming system will be implemented.

3.3.2 Soils

- Treat Site soils, including soils in the Main Tank Farm, in-situ by SVE in combination with IAS to treat the ground water. Pilot tests on IAS/SVE may be conducted to determine design parameters. Effluent from the IAS/SVE system will be treated as necessary to meet applicable air emissions limits. [*Note: In SVE, a vacuum is applied to the soil matrix that causes movement of volatile hydrocarbons towards extraction wells. The extracted vapors are then treated and discharged to the atmosphere. IAS involves the injection of air into the ground water causing a transfer of hydrocarbons from the ground water to the air stream. When combined with the SVE, this air stream is also extracted and treated prior to being discharged to the atmosphere.*]

- Continue IAS/SVE until ground water cleanup levels are met. Compliance with ground water cleanup levels will be done in accordance with statistical requirements of MTCA and with Ecology's concurrence.

- Perform a sampling and analysis program following MTCA requirements upon completion of the IAS/SVE to determine the extent of vadose-zone soils remaining above cleanup levels. If necessary, remaining soils exceeding the cleanup levels will be treated by bioremediation. Applicable air emission requirements on bioremediation must be met.

- Treat contaminated soils that are stockpiled on site to cleanup levels by SVE and/or biotreatment. Applicable air emission requirements must be complied with.

3.3.3 Ground Water

- Treat ground water base flow collected in the COE interceptor drain and to meet ground water cleanup levels. The treatment may be applied to the effluent of the oil/water separator or may be moved closer to the source of contamination along the COE drain or in ground water. Pump-and-treat tests on ground water may be conducted if necessary. Air discharges from the treatment systems will meet applicable air emission limits.

- Treat ground water in-situ using aeration trenches or as modified in the approved engineering design plans. Effluent from the aeration trenches will be removed through the SVE piping and treated as necessary to meet applicable air emission limits. Active treatment of ground water will continue until cleanup levels are met throughout the Site. Practicability of active treatment may be reviewed in accordance with MTCA.

- Ground water pumped for water depression in product recovery, for pump and treat pilot tests or for dewatering excavations, will be required to meet discharge requirements. Prior to discharging to the COE drain, the water will be treated to meet discharge requirements until a treatment system is in place to treat the dissolved contaminants in the drain. Water to be discharged to the City of Pasco sanitary sewer will meet discharge requirements.

3.3.4 Surface Water

- Ground water discharging to the ditch from the COE drain-oil/water separator system will be treated to meet ground water cleanup levels which are protective of surface water. No remediation of surface water in the ditch is required.

4.0 SUMMARY OF CLEANUP ACTIONS

Cleanup actions completed at the Site include the following:

- Free product recovery continued until 2003. Free product monitoring ended after May 2006 since free product thicknesses in all wells had been <0.1 ft.
- Soil piles on site were placed over the surface soils of the main tank farm and are being treated in-situ together with other soils.
- IAS/SVE treatment systems were constructed in seven (Areas 1 to 7) of the nine remediation areas shown in Figure 4.1. IAS systems consist of wells and SVE systems make use of trenches. Treatment systems as-builts are described in the Cleanup Action Reports. Construction was implemented in three stages. Operation of these systems has involved alternating active treatment and putting the area in recovery mode, as necessary.
- Pump and treat tests were conducted in MW-34 and MW-48.
- Ground water monitoring started and is still ongoing to determine compliance with cleanup levels and treatment system performance.

4.1 CONSTRUCTION STAGES

The three different stages for the cleanup actions are described as follows:

Stage 1

- Installation and operation of IAS-SVE in Area 2 (the main tank farm area).
- Installation and operation of IAS-Biosparging in Area 3. [*Note: Biosparging uses lower air flow rates than in IAS to increase biological activity to degrade organic constituents.*]
- Continued operation of the IAS-SVE pilot system in MW- 46 (Area 4).
- Installation and operation of a pump-and-treat system in MW- 48 (Area 8).

Stage 1 construction started and was completed in 2001. Treatment systems were put in full-time operation by February 2002.

Stage 2

- Continued Stage 1 IAS/SVE treatment in Area 2, and pump-and-treat in Area 8.
- Full-scale installation of IAS-SVE in Area 4, replacing the pilot system in MW-46.
- Expansion of the Area 3 system, including the addition of SVE, and integration with Area 4.
- Installation and operation of IAS-SVE in Areas 1 and 5. In Area 5, the initially installed IAS-SVE system in MW-35 and MW-38 areas was later expanded in 2005/2006 to include the area around MW-34.

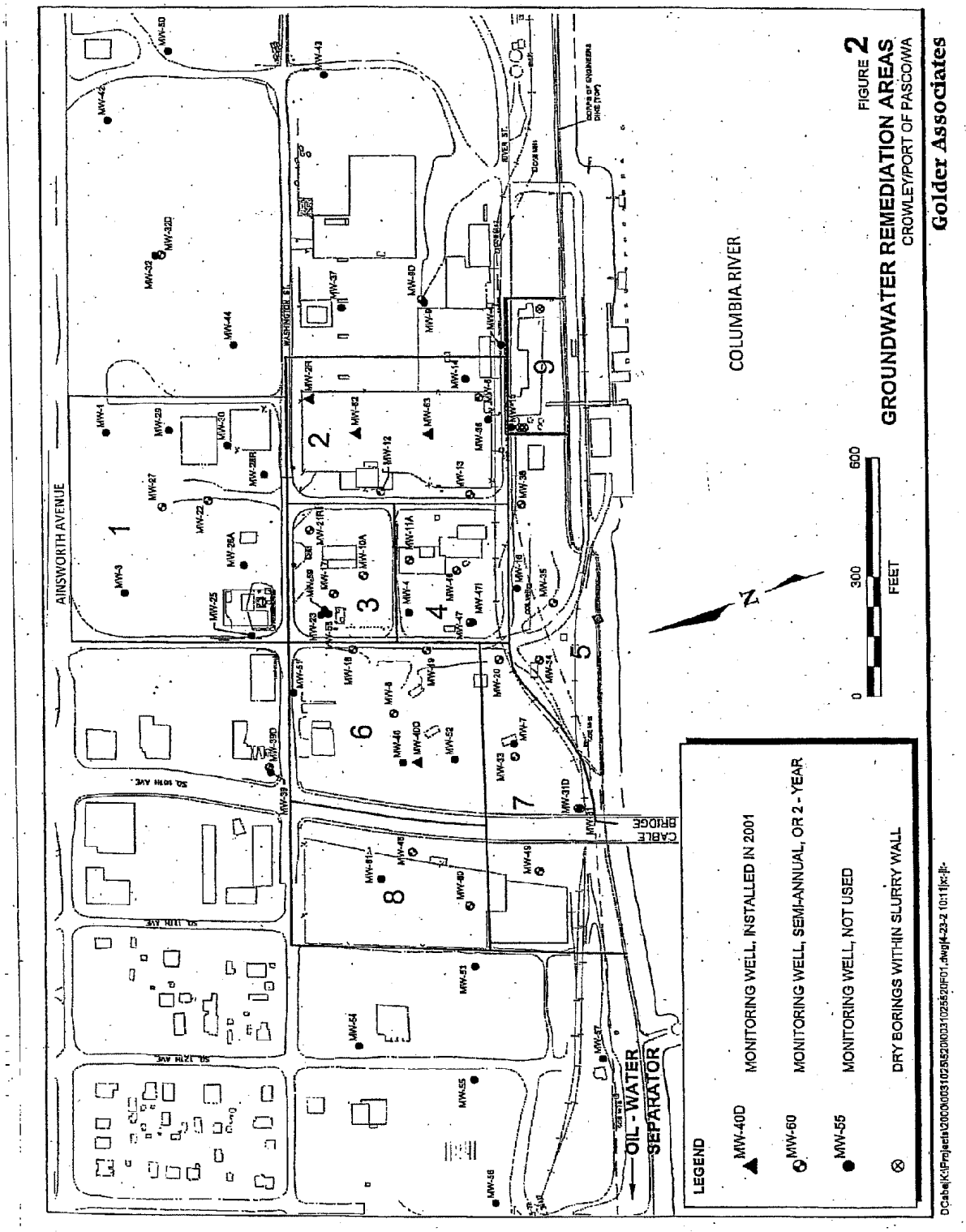


FIGURE 4.1 GROUNDWATER REMEDIATION AREAS

Stage 2 construction started in 2002 and was completed in January 2003. Treatment started between January and April 2003.

Stage 3

- Installation and operation of IAS-SVE in Areas 6 and 7.

Stage 3 construction started and was completed in 2006. IAS/SVE in Areas 6 and 7 started in August 2006.

4.2 ADDITIONAL ACTION

Area 9, the area contained by the slurry wall, was investigated in 2006 after the grain facility was demolished, and COE ceased dewatering this area in 2004. The investigation showed no indications of free product in the wells installed. Contamination was found to be very limited. Thus, no remedial action was required for this area.

4.3 GROUND WATER MONITORING

In accordance with the Compliance Monitoring Plan, ground water monitoring is being conducted semi-annually to determine compliance with cleanup levels. Monthly sampling is also being conducted in selected wells for performance monitoring. Monitoring well locations are shown in Figure 4.1.

4.4 INSTITUTIONAL CONTROLS

Institutional controls are required when residual concentrations of hazardous substances which exceed Method A or Method B cleanup levels are to remain on Site (WAC 173-340-440) or when industrial or commercial exposure assumptions are used (WAC 173-340-706(1)(a). For this Site, Method C Commercial exposure, under the Interim TPH Policy, is used for the soils.

Currently, there are no institutional controls in place for the Site. As remediation is ongoing in-situ at the Site, activities involving ground water extraction and/or soil excavations/drilling are all related to the cleanup operations at the Site. The CAP states that soil concentrations that are protective of ground water will be determined from ground water compliance monitoring and will over-ride the theoretical numbers initially developed. Thus, after ground water cleanup levels are met and soil cleanup levels have also been attained, restrictive covenants will be placed on areas that exceed Method B soil cleanup levels.

5.0 GROUND WATER DATA REVIEW

This periodic review evaluates semi-annual ground water data for all compliance monitoring wells and also includes monthly performance monitoring ground water data on selected wells since the start of Stage 1 treatment system operations in 2002 up to the May 2008. Based on Ecology's statistical guidance, all concentrations below the Method Detection Limit (MDL) were assigned a value equal to one-half the MDL; and, all concentrations above the MDL, but below the Practical Quantitation Limit (PQL), were assigned a value equal to the MDL.

The discussions that follow for each remediation area include:

- The treatment schedule.
- A table showing indicators that exceeded cleanup levels during the review period and selected results.
- Pertinent graphs for illustration purposes.
- Discussion of contaminant trends.

5.1 AREA 1 (MW-22R , MW-27)

[*Note: MW-22R is shown as MW-22 in Figure 4.1*]

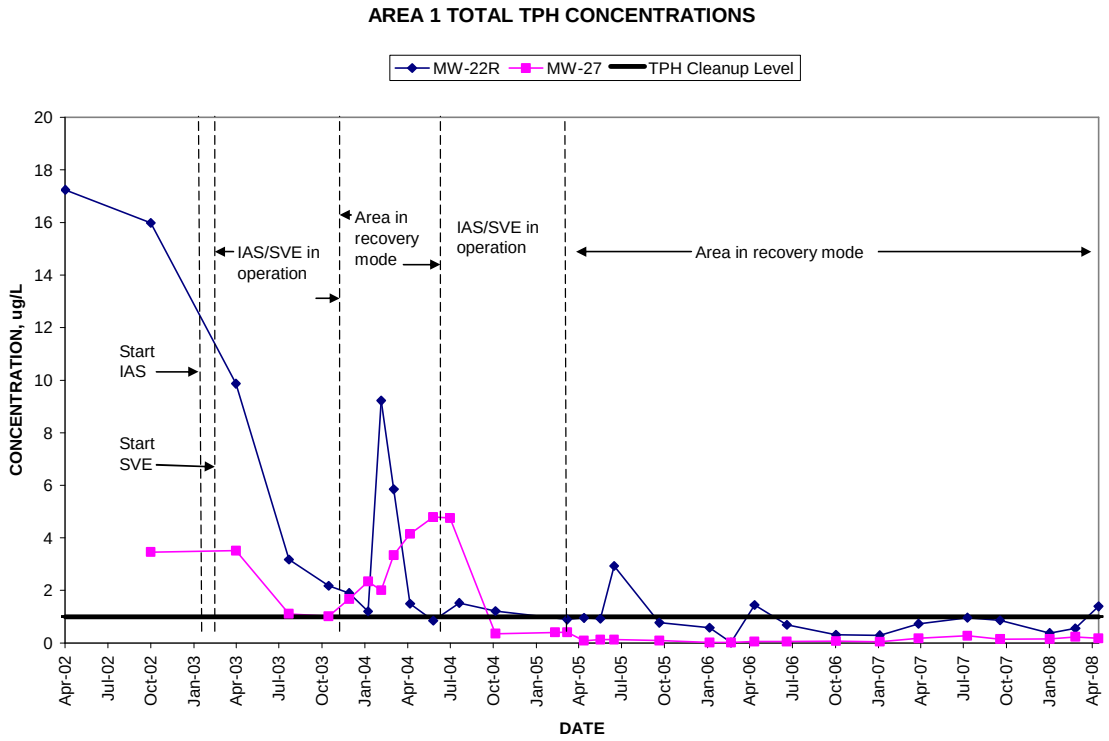
- January 2003 – started IAS.
- February 2003 – added SVE.
- November 2003 - area put in recovery mode.
- June 2004 – resumed IAS/SVE.
- March 2005 – area put in recovery mode.

TABLE 5.1
AREA 1 CONCENTRATIONS

Indicator	**CUL**	***MW***	**Concentration, µg/L (mg/L for TPH)**							
			Apr 03	**Nov 03**	**Jun 04**	**Oct 04**	**Mar 05**	**Oct 06**	**Mar 08**	**May 08**
Total TPH (Figure 5.1)	1 mg/L	*22R*	**9.9**	**2.18**	0.845	**1.21**	0.89	0.30	0.51	**1.387**
		27	**3.51**	**1.01**	**4.79**	0.35	0.40	0.07	0.23	0.180
benzene	5 µg/L	*27*	**61.4**	< 0.5		< 1.0	< 0.5	< 0.1	2.1	1.5
ethylbenzene	320 µg/L	*22R*	**414**	93.5		18.7	24.1	1.7	3.6	8.2
1,1-DCE	0.027 µg/L	*22R*		<1*				< .098*	<.098*	<.098*
		27		<0.5*				<.098*	<.098*	<.098*
arsenic	10 µg/L	*27*		1.99		< 6		**12**	4.1	4.0
cPAHs	0.1µg/L	*22R*		<.56*				<0.034	<0.028	<0.029
		27		<.48*				<0.035	<0.029	<0.029

#.# - exceeds cleanup level (CUL)
< MDL – undetected at the Method Detection Limit (MDL).
* - MDL > 2 x CUL

FIGURE 5.1



Area 1 Contaminant Trends

- Total TPH concentrations decreased in both MW-22R and MW-27 during the 2003 IAS/SVE treatment operations. Concentrations increased after the system was put in recovery mode and decreased again after the system was put back in operation in 2004. Concentrations have been below the cleanup level since October 2004 in MW-27. In MW-22R, concentrations have been below the cleanup level since October 2005 except for two concentrations that were slightly above the cleanup level – 1.44 mg/L in May 2006 and 1.39 mg/L in May 2008.

- Benzene and ethylbenzene concentrations in both wells dropped to below cleanup levels during the 2003 treatment and have remained below the cleanup levels.

- Except for 1,1-DCE, all chlorinated indicators are below cleanup levels. 1,1-DCE concentrations have all been non detects. However, the MDL used in the analysis is not sufficiently low for cleanup level compliance assessment. [Note: The MDL used was greater than two times the cleanup level such that the nondetect concentration which is taken to be ½ of the MDL is still greater than the cleanup level. A nondetect concentration at the MDL of 0.098 µg/L, taken to be at ½ of the MDL or 0.049 µg/L is higher than the cleanup level.]

- Arsenic concentrations have been below the cleanup levels in both wells except for the October 2006 concentration of 12 µg/L (cleanup level is 10 µg/L) in MW-27.

- cPAHs concentrations were all nondetects. The MDLs from 2002 to 2005 were not low enough to assess compliance with cleanup levels. Since 2005, when appropriate MDLs were used, concentrations of cPAHs have been below the cleanup level.

5.2 AREA 2 (MW-02R, MW-06, MW-12, MW-13, MW-63)

- January 2002 – started IAS/SVE
- February 2006 – area put in recovery mode
- October 2007 – resumed IAS/SVE

TABLE 5.2
AREA 2 CONCENTRATIONS

Indicator	CUL	*MW*	Concentration, µg/L (mg/L for TPH)							
			Apr 02	Oct 05	May 06	Oct 06	Oct 07	Nov 07	Mar 08	May 08
Total TPH (Figure 5.2.1)	1 mg/L	*02R*	**3.24**	0.318	0.385	0.07	0.07			0.07
		06	**7.58**					**1.18**	0.53	0.65
		12	**8.73**		**4.49**		**4.34**			**4.35**
		13	**3.58**	0.835	0.75		**1.67**			**1.6**
		63	**85.3**		**5.63**		**3.82**		**2.43**	**2.39**
Benzene	5 µg/L	*06*	**142**					<0.1	1.4	0.74J
		12	**2830**	**330**	**200**		**77**			**81**
		13	**152**	1.5	0.36J			0.47J		0.41J
		63	**17700**	**3400**	**1000**		**1200**		**360**	**460**
Ethylbenzene	320 µg/L	*63*	**626**	4.7J	< 3.2		2.1		1.6	1.3
Toluene	320 µg/L	*63*	**11700**	37J	3.6J		4.5		1.2	1.2
Xylenes	4100 µg/L	*63*	**5060**	**1204**	**482**		19		12.2	1.26J
1,1-DCE	0.027 µg/L	*02R*		<.18*		<.098*	<.098*			
		06						<.098*		
		12		<1.8*		<.098*	<.098*			
		13		<1.8*		<.098*	<.098*			
		63		<8.9*		<2*	<.098*			
Arsenic (Figure 5.2.2)	10 µg/L	*06*	**82.5** Nov 03					**76**	**55**	**59**
		12		**14**	**13**		**20**			**21**
		13		**24**	**27**		**31**			**28**
		63		**45**	**35**		**93**		**62**	**44**
cPAHs	0.1 µg/L	*02R*		<0.35*		<0.14	<0.28*			
		06						<0.29*		
		12		<0.33*		<0.14	<0.26*			
		13		<0.34*		<0.14	<0.33*			
		63	**1.22** Oct 04	<0.33*		<0.14	<0.28*			

#.# - exceeds the CUL
* - MDL is >2 x CUL
< MDL- undetected at the Method Detection Limit (MDL)
J – < than the PQL but > than the MDL

.

FIGURE 5.2.1

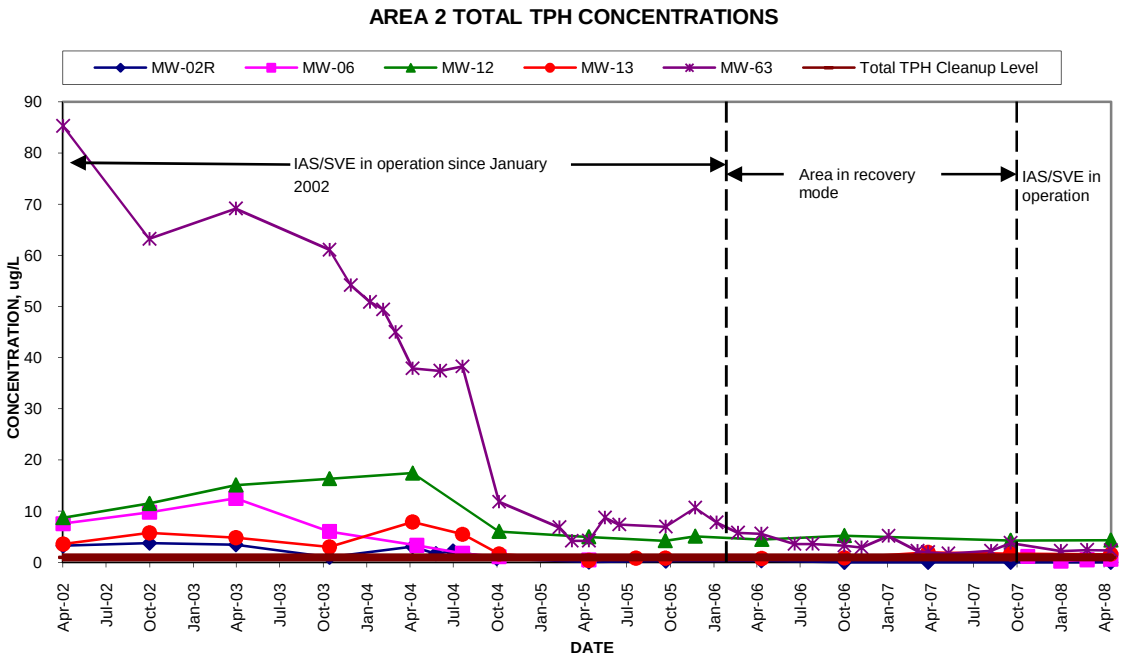
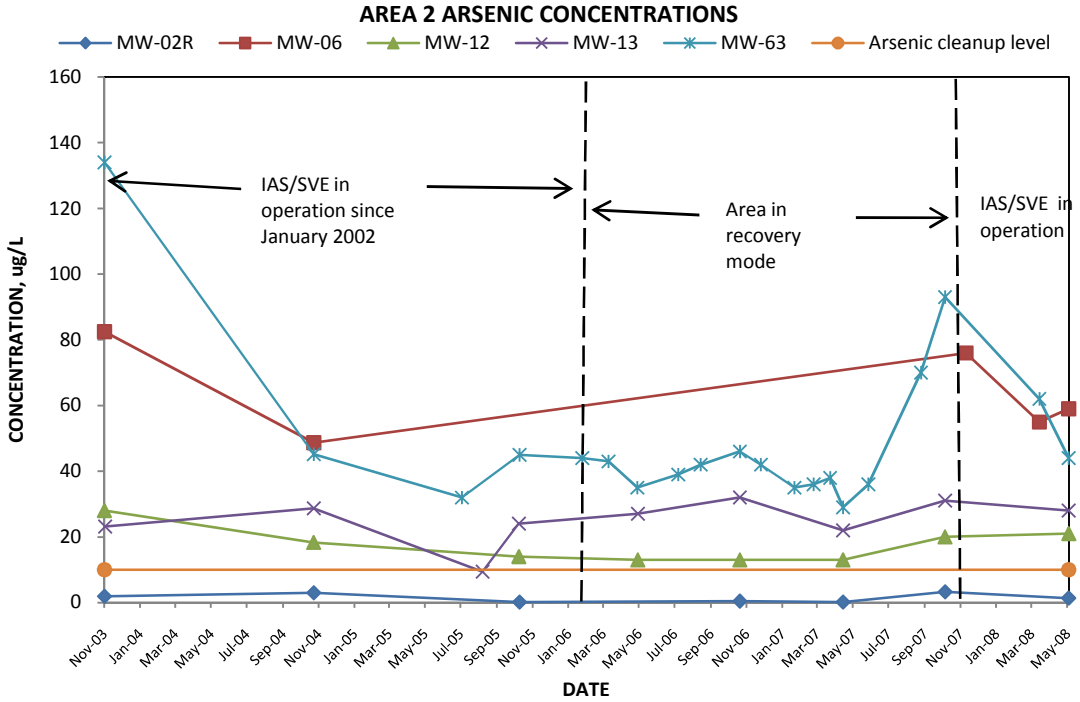


FIGURE 5.2.2



Area 2 Contaminant Trends

- TPH concentrations decreased in all wells since the start of treatment in 2002. TPH in MW-63 dropped significantly from 85.3 mg/L in April 2002 to 11.84 mg/L in October 2004. In May 2008, the TPH in MW-63 is 2.39 mg/L which is still above the cleanup level. Changes in TPH concentrations in MW-12 and MW-13, which are located near the edge of the treatment system, were not as significant as in other wells. TPH concentrations still exceed the cleanup level in MW-12, MW-13, and MW-63.

- Concentrations of volatiles decreased significantly (Table A2.1) as a result of the treatment. Benzene decreased in concentration from 17,700 µg/L in April 2002 to 460 µg/L in May 2008. In MW-12, the benzene concentration decreased from 2830 µg/L in April 2002 to 81 µg/L in May 2008. Benzene concentrations in the rest of the monitoring wells, MW-02R, MW-13, and MW-06 are now all below the cleanup level of 5 µg/L. Concentrations of ethylbenzene, toluene, and xylenes have been below cleanup levels for at least the past four years.

- Except for 1,1-DCE, all chlorinated indicators are below the cleanup levels. The MDL used in the analysis of 1,1-DCE is not sufficiently low for cleanup level compliance assessment.

- Arsenic concentrations, except in MW-02R, have remained above the cleanup level of 10 µg/L.

- cPAHs were all non detects except for total benzofluoranthenes which was detected in MW-63 at 1.22 µg/L in October 2004. Except for the October 2006 event, the MDLs used for the cPAHs were not low enough to be used for assessing compliance with cleanup levels. The October 2006 results show cPAHs to be below the cleanup level.

5.3 AREA 3 (MW-10A, MW-17, MW-21R)

- January 2002 – started IAS with biosparging
- December 2002 to March 2003 – treatment was off due to Stage 2 construction
- April 2003 – started alternating IAS with biosparging and IAS/SVE
- December 2005 – area put in recovery mode.

TABLE 5.3
AREA 3 CONCENTRATIONS

Indicator	CUL	*MW*	Concentration, µg/L (mg/L for TPH)				
			Apr 02	Oct 04	Oct 06	Jan 08	May 08
Total TPH (Figure 5.3.1)	1 mg/L	*17*	**12.66**	**1.55**	0.178	0.214	0.26
		21R	**3.52**	0.978	0.288	0.558	0.83
Benzene	5 µg/L	*17*	**104**	<1	0.13J	0.19J	0.22J
		21R	**81.7**	<1	<0.1	0.23J	1.3J
1,1-DCE	0.027 µg/L	*10A*			<0.098*	<0.098*	<0.098*
		17			<0.098*	<0.098*	<0.098*
		21R			<0.098*	<0.098*	<0.098*
Arsenic (Figure 5.3.2)	10 µg/L	*10A*		**18.8**	**10**	**12**	**11**
		17		**12.2**	7.9	**22**	**18**
cPAHs	0.1 µg/L	*10A*		<0.56*	<0.035	<0.029	<0.029
		17		<0.56*	<0.035	<0.028	<0.029
		21R		<0.56*	<0.035	<0.028	<0.029

#.# - exceeds the CUL
< MDL – undetected at the MDL
J – < than the PQL but > than the MDL
* - MDL > 2 x CUL

FIGURE 5.3.1

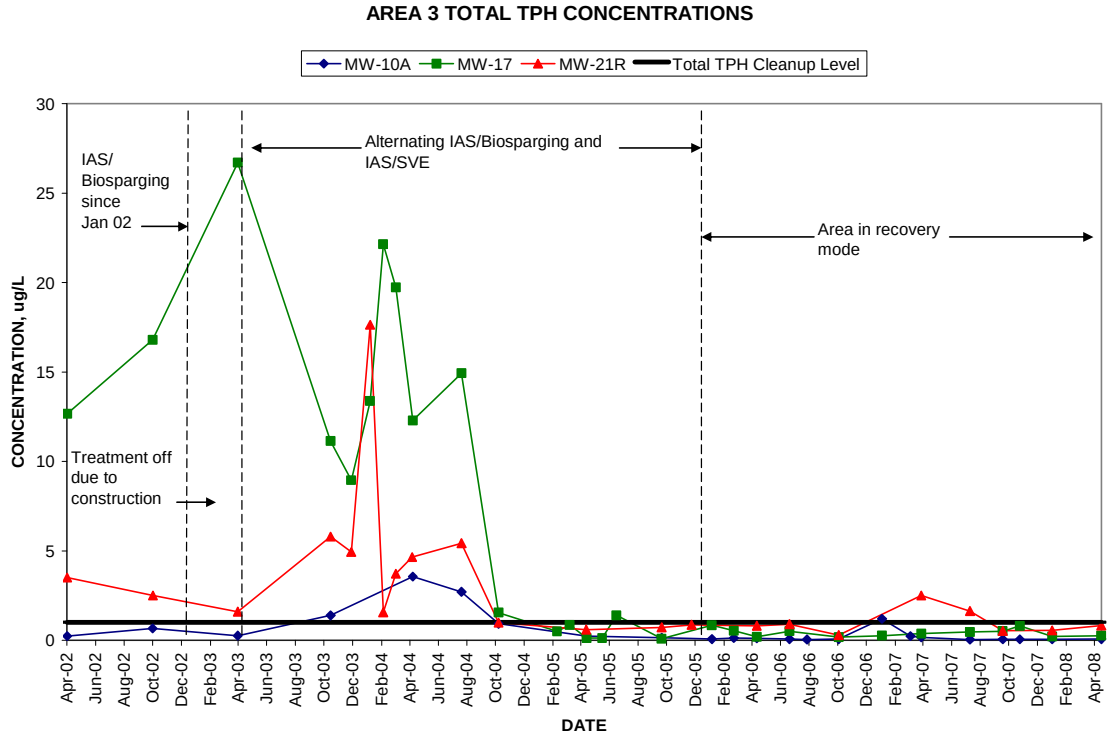
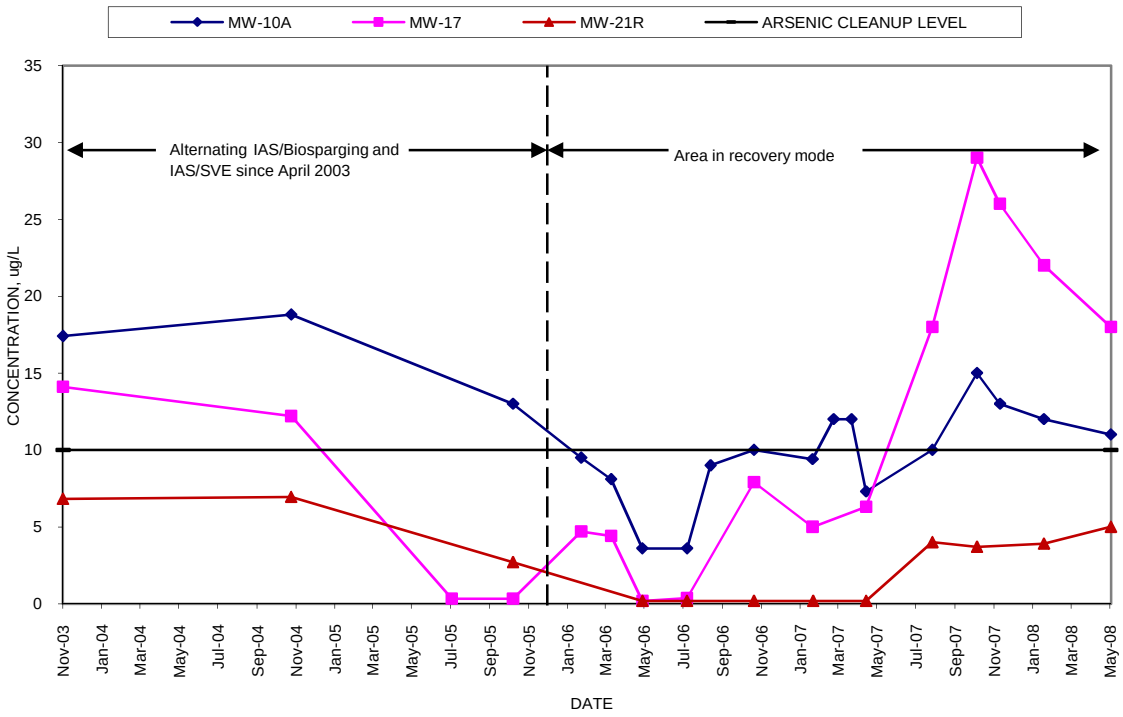


FIGURE 5.3.2

AREA 3 ARSENIC CONCENTRATIONS



Area 3 Contaminant Trends

- Total TPH concentrations, except for the MW-21R April 2007 results (Figure 5.3.1), have been reduced to below the cleanup level in all wells.

- Benzene concentrations exceeded cleanup levels in MW-17 and MW 21R at the start of the treatment operations in 2002 but have all been below the cleanup level since 2003.

- Chlorinated indicators, except for 1,1-DCE, have been below cleanup levels in all wells. 1,1-DCE concentrations have been all non detects but the MDLs used are not sufficiently low for cleanup levels compliance assessment.

- Arsenic concentrations (Figure 5.3.2) still exceed the cleanup level in MW-10A and MW-17.

- cPAHs concentrations have all been non detects. MDLs used from 2002 through 2005 were not sufficiently low to assess compliance with the cleanup levels. Lower MDLs used from 2006 through 2008 show cPAHs meeting cleanup levels in the wells.

5.4 AREA 4 (MW-11A, MW-46, MW-47)

- April 2003 – started IAS/SVE.
- February 2005 – IAS was modified to focus on MW-11A and MW-46.
- December 2005 – Area was put in recovery mode.
- February 2006 – resume IAS/SVE.
- October 2007 – area put in recovery mode.

TABLE 5.4
AREA 4 CONCENTRATIONS

Indicator	CUL	*MW*	Concentration, µg/L (mg/L for TPH)					
			Apr 03	Oct 05	Oct 06	Oct 07	Mar 08	May 08
Total TPH (Figure 5.4.1)	1 mg/L	*11A*	**32.76**	**14.24**	**13.81**	**6.16**	**7.92**	**10.05**
		46	**12.42**	**2.94**	**1.37**		0.30	0.45
		47	**4.92**	0.24	0.28			0.06
Benzene	5 µg/L	*11A*	**3710**	**540**	**430**	**31**	**50**	**59**
		46	**16.1**	<0.67	0.49J		0.28J	0.42J
		47	**6.21**	<0.13	<0.1			<0.1
Ethylbenzene	320 µg/L	*11A*	**553**	**360**	**340**	61	130	170 J
Toluene	320 µg/L	*11A*	**744**	170	300	9.4	38	46
Xylenes	4100 µg/L	*11A*	**4446**	1470	1790	240	570	830
1,1-DCE	0.027 µg/L	*11A*	<5*	<3.5*	<0.98*	<0.098*		<0.098*
		46	**8.35**	<0.89*	<0.098*		<0.098*	<0.098*
		47	**1.11**	<0.18*	<0.098*			<0.098*
1,2-DCA	0.3 µg/L	*11A*	<5*	**13**	<2*	<0.2		<0.2
		46	<5*	<0.79*	<0.2		<0.2	<0.2
PCE	1.75 µg/L	*46*	**<5***	**11.1** **May 05**	<0.088		0.11J	0.14J
		47	**45.9**	0.53J	0.81J			0.25J
TCE	2 µg/L	*46*	<5*	1.7J	0.35J		1	0.9J
		47	**41.1**	0.96J	0.42J			0.088J
Cis-1,2-DCE	53 µg/L	*46*	**5790**	15	9.4		45	48
		47	**459**	3.7	1.4			<0.079
Arsenic (Figure 5.4.2)	10 µg/L	*11A*		**120**	**120**	**79**	**120**	**130**
		46		**58** **Oct 04**	**26**		7.8	8.8
		47		**15**	**24**			7.0
Naphthalene	130 µg/L	*11A*	**240** **Nov 03**		99J	25		
cPAHs	0.1 µg/L	*11A*		<0.33*	<0.14	<0.289*		
		46		<0.36*	<0.14			<0.028
		47		0.20*	<0.14			

#.# - exceeds the CUL
< MDL – undetected at the MDL
J- < than the PQL but > than the MDL
*- MDL > 2 x CUL

FIGURE 5.4.1

AREA 4 TPH CONCENTRATIONS

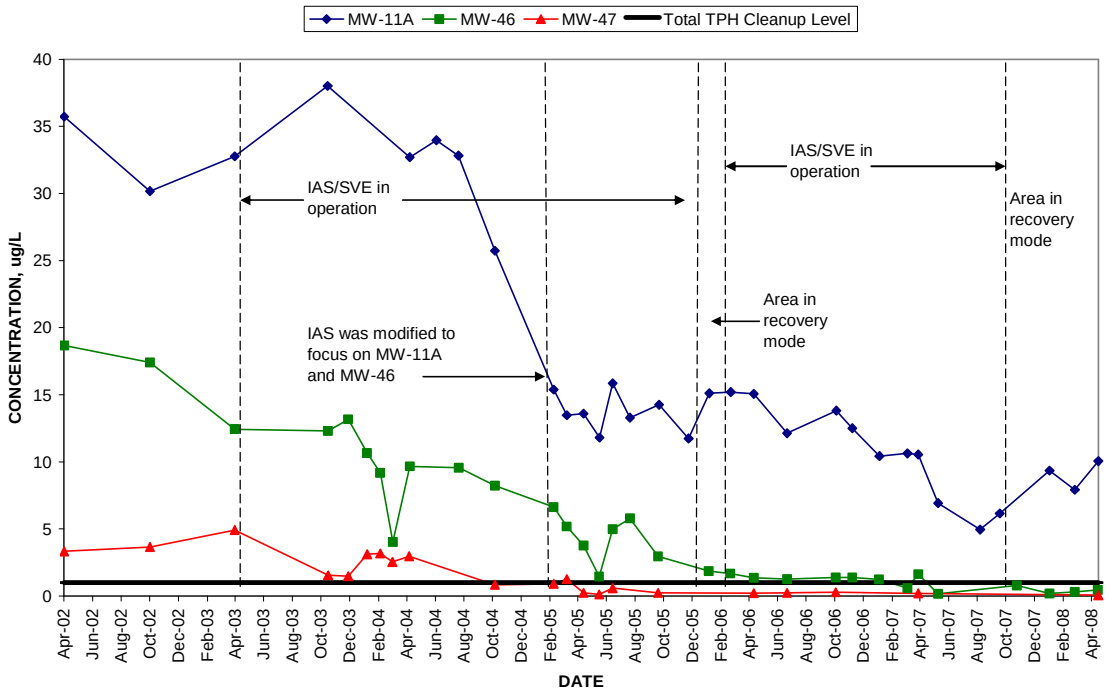
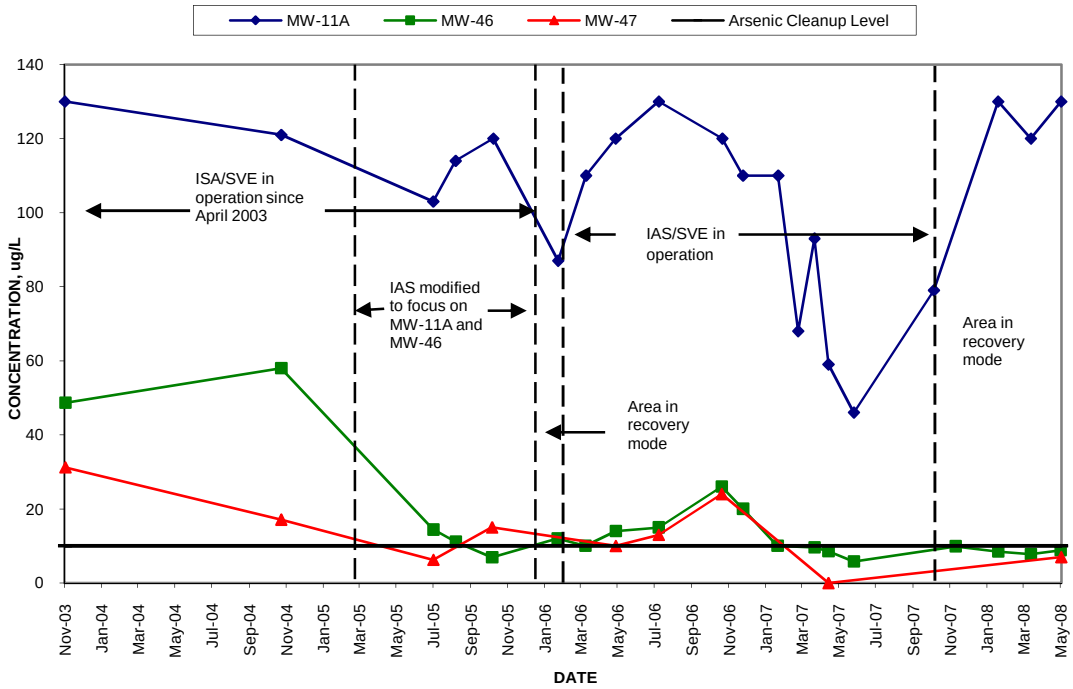


FIGURE 5.4.2

AREA 4 ARSENIC CONCENTRATIONS



Area 4 Contaminant Trends

- TPH decreased significantly in all wells until mid 2005. TPH concentrations have been reduced to below the cleanup level in MW-46 and MW-47. TPH concentration in MW-11A continued to decrease at a slower rate in 2006 to 2007 and appears to be slightly increasing after the area was put in recovery mode in October 2007.

- Benzene concentrations in MW-46 and MW-47 have decreased to below the cleanup level since 2003. Benzene concentration in MW-11A decreased from 3710 µg/L in April 2003 to 59 µg/L in May 2008 but is still above the cleanup level.

- Ethylbenzene, toluene, xylenes in MW-11A have all been reduced to below their respective cleanup levels.

- 1,2-DCA, PCE, TCE, and cis-1,2-DCE concentrations have been reduced to below their respective cleanup levels in this area. The MDL used for 1,1-dichloroethene is not low enough to determine compliance with the cleanup level of 0.027 µg/L.

- Arsenic concentration in MW-11A remains very high. Arsenic concentrations in MW-46 and MW-47 are now below the cleanup level.

- Naphthalene concentration in MW-11A appears to have decreased to below cleanup levels.

- cPAHs are nondetects, except for one detection of chrysene in MW-47 in October 2005. Majority of the MDLs used were not low enough for cleanup level assessment. When sufficiently low MDLs were used, concentrations of cPAHs were below the cleanup level.

5.5 AREA 5 (MW-34, MW-35, MW-38)

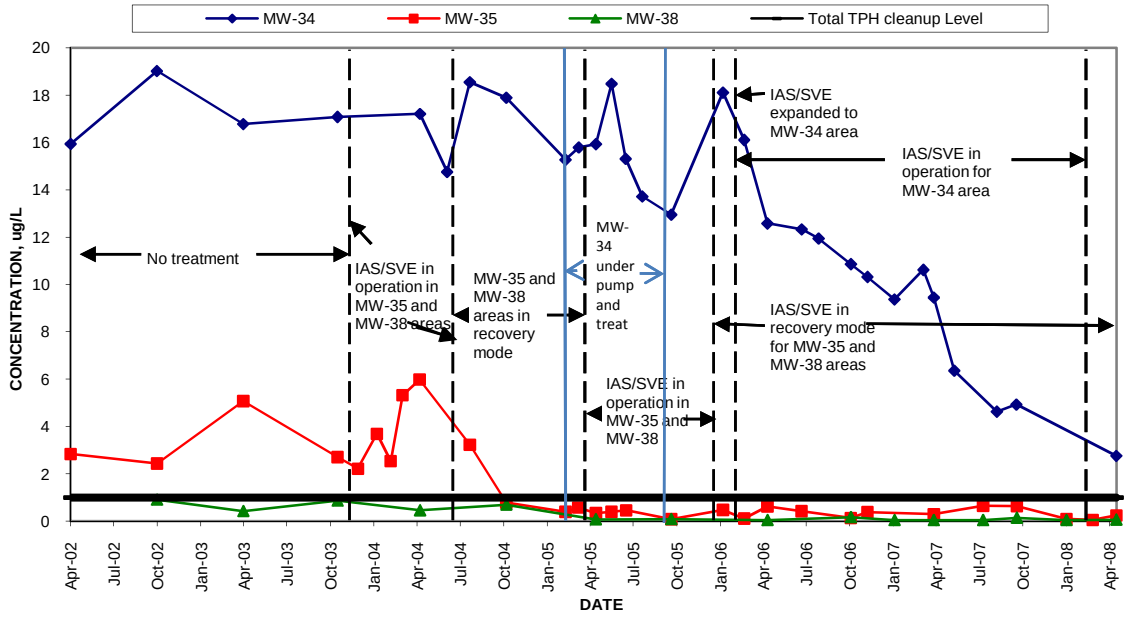
- November 2003 – started IAS/SVE focusing on areas covered by MW-35 and MW-38.
- June 2004 – area put in recovery mode.
- February to September 2005 – pump and treat was performed on MW-34.
- March 2005 – resumed IAS/SVE in MW-35 and MW-38 areas.
- December 2005 – MW-35 and MW-38 areas put in recovery mode.
- February 2006 – IAS/SVE was expanded to cover MW-34.
- February 2008 – MW-34 area put in recovery mode; entire area in recovery mode.

TABLE 5.5
AREA 5 CONCENTRATIONS

Indicator	CUL	MW	Concentration, µg/L (mg/L for TPH)							
			Nov 03	Jun 04	May 05	Oct 05	Mar 06	Aug 06	Oct 07	May 08
TPH (Fig. 5.5)	1 mg/L	34	**17.08**	**14.76**	**15.93**	**12.94**	**16.10**	**11.94**	**4.93**	**2.76**
		35	**2.71**		0.35	0.09	0.12		0.64	0.24
1,2-DCP	2 µg/L	34	**<5**	<2.5	**17.2**	<3	<1.6	<1.8	<0.09	<0.09
		35	**5.6** Dec 03		0.35J	<0.15			<0.09	0.09
Chloroform	1 µg/L	34	<5*	<2.5*	**6.71**	<3.6*	<1.4	<1.3	<0.07	<0.07
1,1- DCE	0.027 µg/L	34	<5*	<2.5*	**0.9J**	<3.5*	<1.7*	<2*	<.098*	<. 098*
		35	<0.5*		<0.06 *	<0.18*			<. 098*	<. 098*
		38	<0.5*		<0.06 *	<0.18*			<. 098*	<. 098*
1,2-DCA	0.3 µg/L	34	<5*	<2.5*	<0.27	<3.2*	<0.86*	<4*	<0.2	<0.2
PCE	1.75 µg/L	34	<5*	<2.5	**7.51**	**6.9 J**	**3.1 J**	<1.8	**2.6**	**4.7**
TCE	2 µg/L	34	<5*	**2.89 J**	**12.3**	**4.6 J**	**3 J**	<1.5	0.42J	1.4
Cis-1,2-DCE	53 µg/L	34	**274**	**292**	**219**	**83**	**85**	**70**	0.2J	1.6
Arsenic	10 µg/L	34	**29.3**			**19**	**21**	**39**	9.6	**15**
		35	**11.2**			**11.0**	7.3		10.0	5.0
Naphthalene	130 µg/L	34	**182**			85			<0.01	
cPAHs	0.1 µg/L	34	<0.56*			**0.35**			<0.28*	
		35	<0.56*			<0.31*			<0.029	<0.029
		38	<0.56*			<0.56*			<0.029	<0.029

#.# - exceeds the cleanup level
< MDL - undetected at the MDL
J - < than the PQL but > than the MDL
*- MDL > 2 x cleanup level

FIGURE 5.5
AREA 5 TOTAL TPH CONCENTRATIONS



Area 5 Contaminant Trends

- Concentrations of TPH in MW-35 have been below the cleanup level since October 2004. Concentrations of TPH in MW-34 have decreased since the IAS/SVE treatment system was expanded to include this area in February 2006. TPH concentration was reduced from 16.10 µg/L in March 2006 to 2.7 µg/L in May 2008 but still exceeds the cleanup level.

- PCE concentration has slightly decreased in MW-34 but is still above the cleanup level. Concentrations of 1,2-DCP, 1,2-DCA, TCE, cis-1,2-DCE in MW-34 have all been reduced below the cleanup level. The MDLs used for 1,1-DCE were not low enough for cleanup level compliance assessment.

- Arsenic concentrations in MW-34 still exceed the cleanup level.

- Naphthalene concentrations in MW-34 have decreased to below the cleanup level.

- cPAHs concentrations in this area were mostly nondetects except for one detection in MW-34 [benzo(b)fluoranthene] in October 2005, and detections of several cPAHs in MW-38 in April 2007. Concentrations of cPAHs in MW-35 and MW-38 are currently below the cleanup level. The MDLs used in MW-34 are not sufficient for cleanup level compliance assessment.

5.6 AREA 6 (MW-08, MW-18, MW-19)

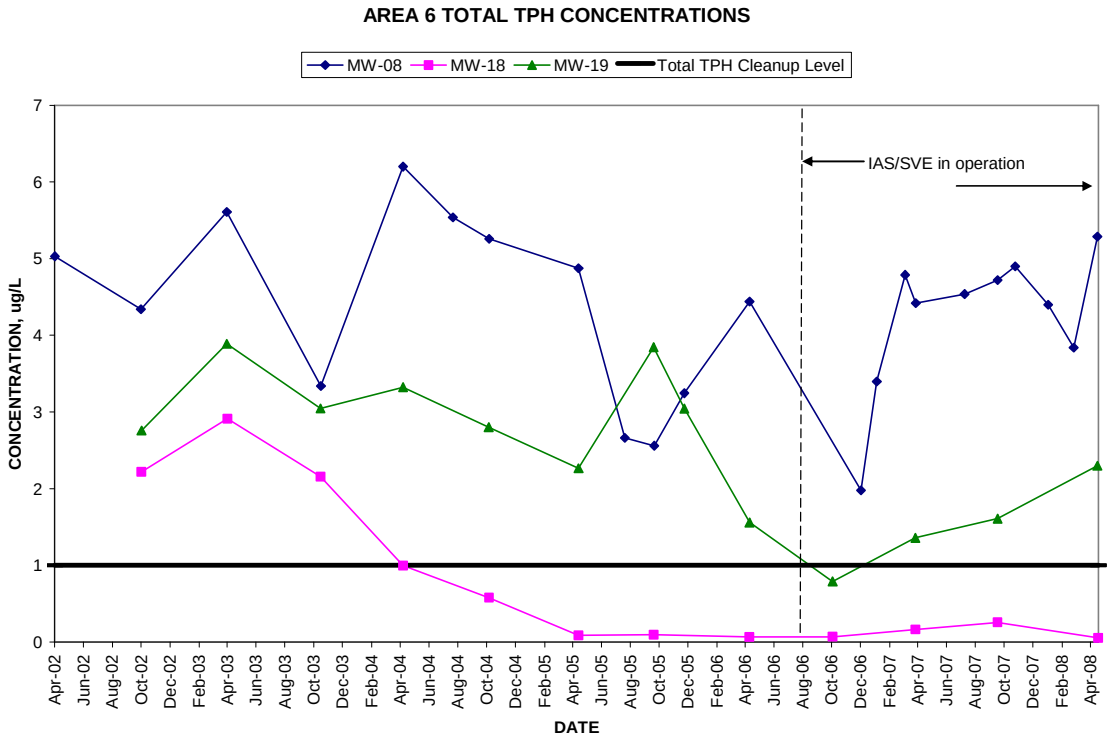
- August 2006 – started IAS/SVE

TABLE 5.6
AREA 6 CONCENTRATIONS

Indicator	**CUL**	***MW***	**Concentrations, ug/L (mg/L for TPH)**				
			May 06	**Oct 06**	**Apr 07**	**Oct 07**	**May 08**
Total TPH (Figure 5.6)	1 mg/L	*08*	**4.44**	**1.98**	**4.53**	**4.90**	**5.29**
		19	**1.56**	0.79	**1.36**	**1.61**	**2.29**
Benzene	5 ug/L	*08*	**180**	**77**	**150**	**100**	**72**
		19	**48**	**12**	**27**	**17**	**7.8**
Chloroform	1 ug/L	*08*		<0.067	**1.1** **July 07**	<0.067	
1,1-DCE	0.027 ug/L	*08*		<0.098*		<0.098*	
		18		<0.098*		<0.098*	
		19		<0.098*		<0.098*	
Arsenic	10 ug/L	*08*	**11**	**18**	**13**	**20**	**15**
cPAHs	0.1 ug/L	*08*		<0.144		<0.28*	
		18		<0.144		<0.27*	
		19		<0.144		<0.27*	

#.# - exceeds the CUL
< #MDL- undetected at the MDL
J - < than the PQL but > than the MDL
*- MDL > 2 x CUL

FIGURE 5.6



Area 6 Contaminant Trends

- TPH and benzene concentrations in MW-8 and MW-19 have not shown a decreasing trend and remain above the cleanup level even after the start of the IAS/SVE treatment in August 2006. This behavior appears similar to the start-up of Area 2 where it took some time for the TPH concentrations to exhibit a decreasing trend. This behavior was attributed to the extraction of free product in the smear zone soil column during startup.

- The MDL used for 1,1-DCE is not adequate for cleanup level compliance assessment.

- Arsenic concentrations in MW-8 remain high and are indicative of the hydrocarbon contamination in the area.

- cPAHs concentrations were mostly nondetects except for detections of Dibenzo(a,h)anthracene and Indeno (1,2,3-cd)pyrene in MW-18 in October 2002. MDLs used were not sufficient for cleanup level compliance assessment except for the October 2006 samples. The October 2006 results show the total cPAHs was below the cleanup level.

5.7 AREA 7 (MW-20, MW-31, MW-33, MW-49)

- August 2006 – started IAS/SVE.

TABLE 5.7
AREA 7 CONCENTRATIONS

Indicator	CUL	*MW*	Concentrations, µg/L (mg/L for TPH)					
			Oct 05	May 06	Oct 06	Apr 07	Oct 07	May 08
Total TPH (Figure 5.7.1)	1 mg/L	*31*	**3.03**	**2.30**	**2.14**	**2.87**	**2.31**	**1.98**
		33	**27.95**	**21.39**	**26.00**	**26.67**	**21.43**	**21.69**
Benzene	5 µg/L	*33*	**7.4J**	**21J**	**18J**	**9J**	**10**	**5.6**
Ethylbenzene	320 µg/L	*33*	**280**	**1000**	**980**	**770**	**1000**	**840**
1,1-DCE	0.027 µg/L	*31*	<0.89*	<0.8*	0.19J	0.14J	0.16J	<0.098*
		33	<8.9*	<8.6*	<2*	<0.98*	<0.098*	<0.098*
		49	<0.18*	<0.086*	<0.098*	0.13J	<0.098*	<0.098*
PCE (Figure 5.7.2)	1.75 µg/L	*20*	**19**	**20**	**6.9**	**3.7**	0.96J	0.99J
		31	**32**	**7J**	**5.3**	**7.7**	**6.2**	**2.4**
TCE (Figure 5.7.2)	2 µg/L	*20*	**3.4**	**4.2**	1.8	1.2	0.43J	0.34J
		31	**18**	**13**	**3.4**	**6.5**	**3.5**	1.7
		49	**7.1**	**4.9**	**4.1**	**2.6**	1.7	1
Cis-1,2-DCE	53 µg/L	*31*	**82**	**54**	28	23	15	9.2
Arsenic	10 µg/L	*33*	5	7.8	7.9	2.8	**12**	8.1
Naphthalene	130 µg/L	*33*	15J		**250**		**330**	

#.# - exceeds the CUL
< MDL - undetected at the MDL
J - < than the PQL but > than the MDL
*- MDL > 2 x CUL

FIGURE 5.7.1

AREA 7 TOTAL TPH CONCENTRATIONS

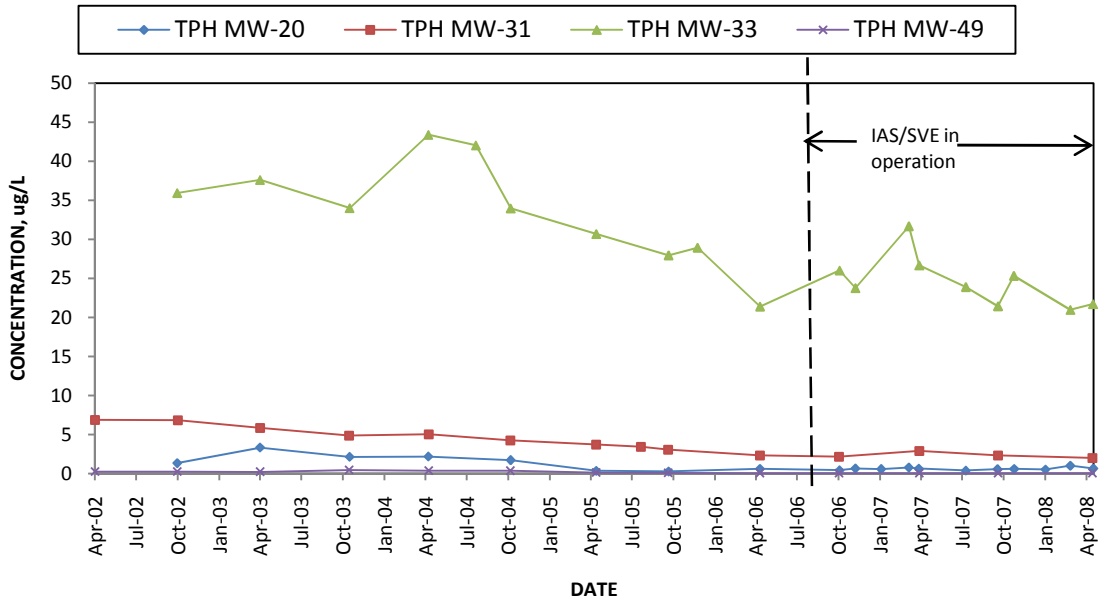
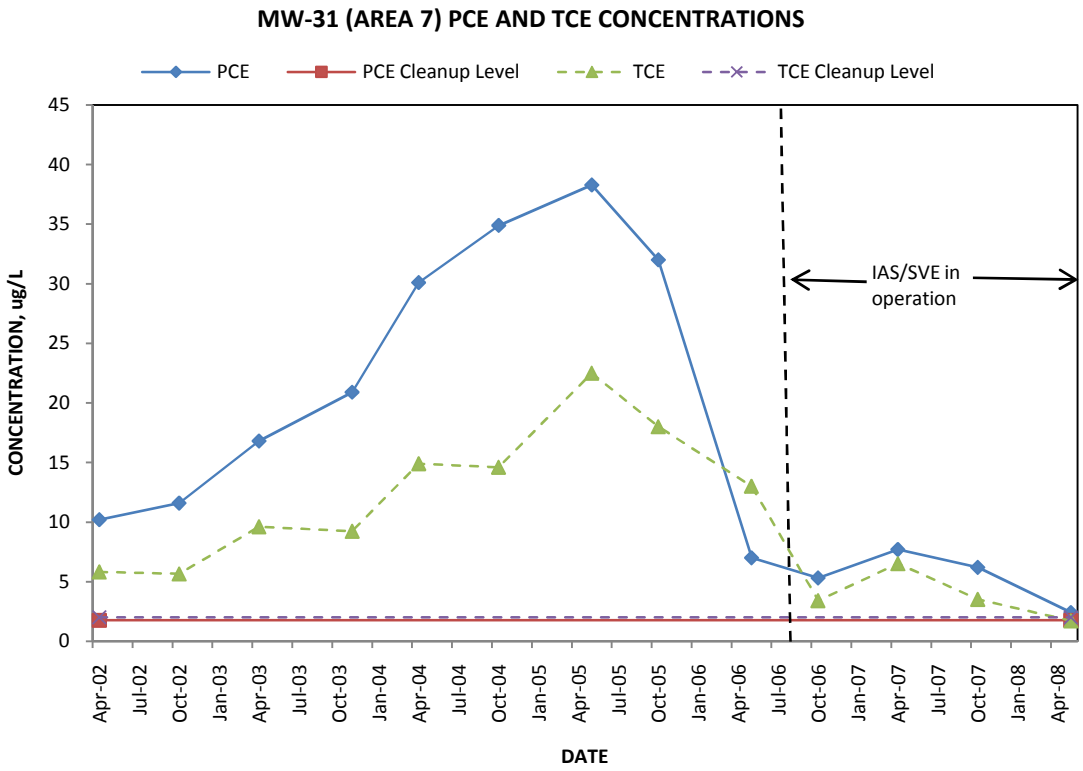


FIGURE 5.7.2



Area 7 Contaminant Trends

- TPH concentrations in MW-33 and MW-31 have decreased slightly. TPH concentration in MW-33 was at 26.00 mg/L in October 2006, just after the IAS/SVE was started, and was 21.69 mg/L in May 2008.

- Benzene and ethylbenzene concentrations in MW-33 also appear to have a slight decreasing trend but are still above the cleanup levels.

- Like in all other areas, the MDLs used for 1,1-DCE were not sufficiently low for compliance with the cleanup level compliance assessment.

- PCE is below cleanup level in all the wells except in MW-31. TCE concentrations have decreased and are now below the cleanup level in all three area compliance wells. Cis-1,2-DCE in MW-31 has also decreased to below the cleanup level.

- Arsenic concentrations in all wells are now below the cleanup level.

- Naphthalene concentrations still exceed the cleanup level in MW-33 but are below the cleanup level in the other three wells.

5.8 AREA 8 (MW-48, MW-60)

- October 2001 – started pump and treat on trench adjacent to MW-48.
- July 2004 – area put in recovery mode.

TABLE 5.8
AREA 8 CONCENTRATIONS

Indicator	CUL	MW	Concentration, µg/L (mg/L for TPH)						
			Oct 02	Apr 03	Oct 04	Oct 05	Oct 06	Oct 07	May 08
TPH	1 mg/L	48	**7.11**	**5.34**	**5.99**	**2.018**	**2.56**	**2.22**	**3.61**
Arsenic	10 µg/L	48	**31.2**		**175**	**75**	**76**	**53**	**42**
cPAHs	0.1 µg/L	48			<0.56*	<0.33*	<0.144	<0.289*	

#.# - exceeds the CUL
J - < than the PQL but > than the MDL
< MDL - undetected at the MDL
*- MDL > 2 x cleanup level

Area 8 contaminant trends

- Pump and treat in MW-48 from 2001 through 2004 did not reduce TPH concentrations to cleanup levels. Since the area was put in recovery mode, the TPH concentrations have remained above the cleanup level.

- Arsenic concentrations in MW-48 have stayed at very high levels.

- cPAHs were all nondetects. The MDLs used, except for the October 2006 event, were not low enough to assess compliance with the cleanup level. Total cPAHs for the October 2006 sampling event showed <0.144 or 0.072 µg/L which is below the cleanup level.

- All indicators are below the cleanup levels for the other compliance well, MW-60.

5.9 OIL-WATER SEPARATOR

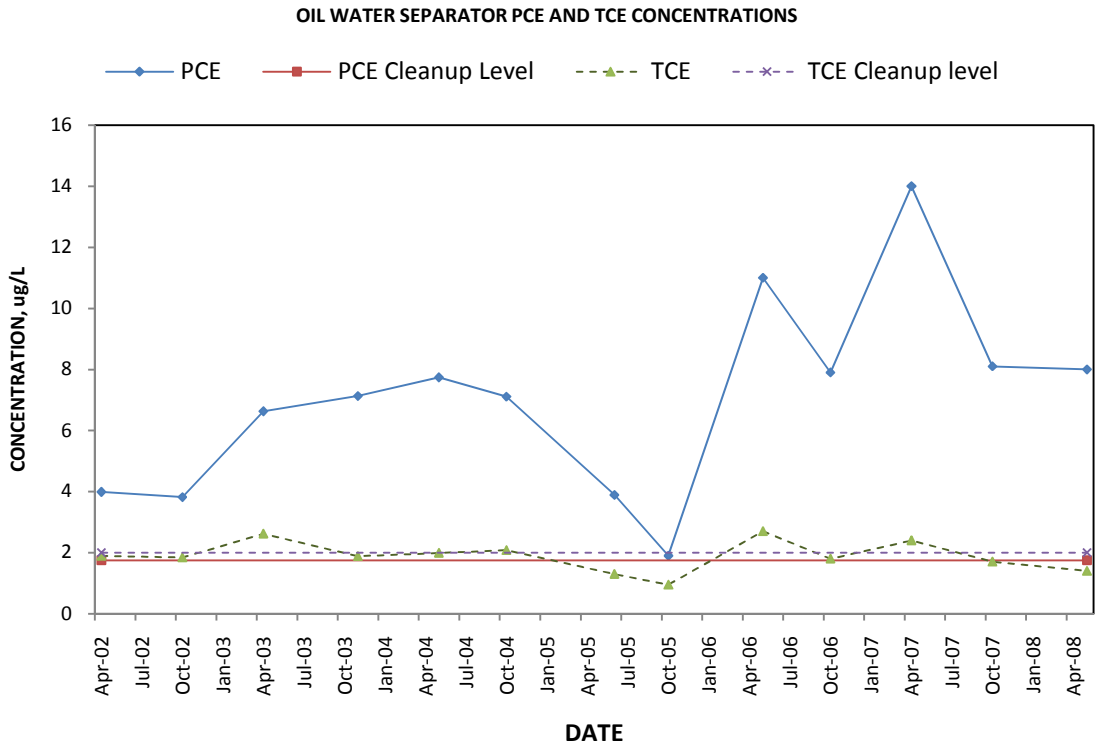
No active treatment is currently being undertaken at the outlet of the oil/water separator. The intent of the remedy that has been undertaken is to treat the ground water discharging to the COE interceptor drain to cleanup levels.

TABLE 5.9
OIL/WATER SEPARATOR OUTLET CONCENTRATIONS

Indicator	CUL	Concentration, µg/L						
		Oct 02	Apr 03	May 04	Oct 05	Oct 06	Apr 07	May 08
1,1-DCE	0.027 µg/L	<0.5*	<0.5*	<0.5*	<0.18*	<0.086*	<0.098*	
1,2- DCP	2 µg/L	**2.15**	1.66	0.948J	0.98J	<0.092	1.9	1.8
PCE	1.75 µg/L	**3.82**	**6.63**	**7.74**	**1.9**	**7.9**	**14**	**8**
TCE	2.0 µg/L	1.84	**2.62**	1.99	0.95J	1.8	**2.4**	1.4
cPAHs	0.1 µg/L	<0.56*	<0.067	<0.105	**0.903**	<0.0346	<0.0284 Oct 07	

#.# - exceeds the cleanup level
J - < than the PQL but > than the MDL
< MDL - undetected at the MDL
*- MDL > 2 x cleanup level.

FIGURE 5.9



Oil/Water Separator Contaminant Trend

- 1,2-DCP has been reduced to below the cleanup level.
- TCE has been hovering over and below the cleanup level and was below the cleanup level in May 2008.
- PCE has consistently been above the cleanup level.
- Compliance with the 1,1-DCE cleanup level cannot be assessed because the MDLs used were not sufficiently low.
- Total cPAHs concentration has been below the cleanup level since 2006.

6.0 PERIODIC REVIEW

WAC 173-340-420(2) requires that:

"When evaluating whether human health and the environment are being protected during periodic reviews, the factors the department shall consider include:

(a) The effectiveness of ongoing or completed cleanup actions;
(b) New scientific information for individual hazardous substances or mixtures present at the site;
(c) New applicable state and federal laws for hazardous substances present at the Site;
(d) Current and projected site use;
(e) Availability and practicability of higher preference technologies; and
(f) The availability of improved analytical techniques to evaluate compliance with cleanup levels.

The department shall publish a notice of all periodic reviews in the site register and provide an opportunity for public comment."

6.1 EFFECTIVENESS OF COMPLETED CLEANUP ACTIONS

- The IAS/SVE treatment systems installed in the different remediation areas continue to operate and function as designed to remove contamination at the Site. Figure 6.1 shows the amount of hydrocarbons removed from the Site.

- Cleanup levels have been attained for some indicators in several compliance monitoring wells. Continued operations of the treatment systems will likely lead to additional cleanup levels being met.

- In MW-63 (Area 2) and MW-11A (Area 4), concentrations of TPH and/or benzene have dropped significantly due to the IAS/SVE treatment but are still above the cleanup levels and have started to exhibit slow decreasing concentration trends. Continued operation of the treatment system may eventually lead to cleanup levels being met but may take a longer time.

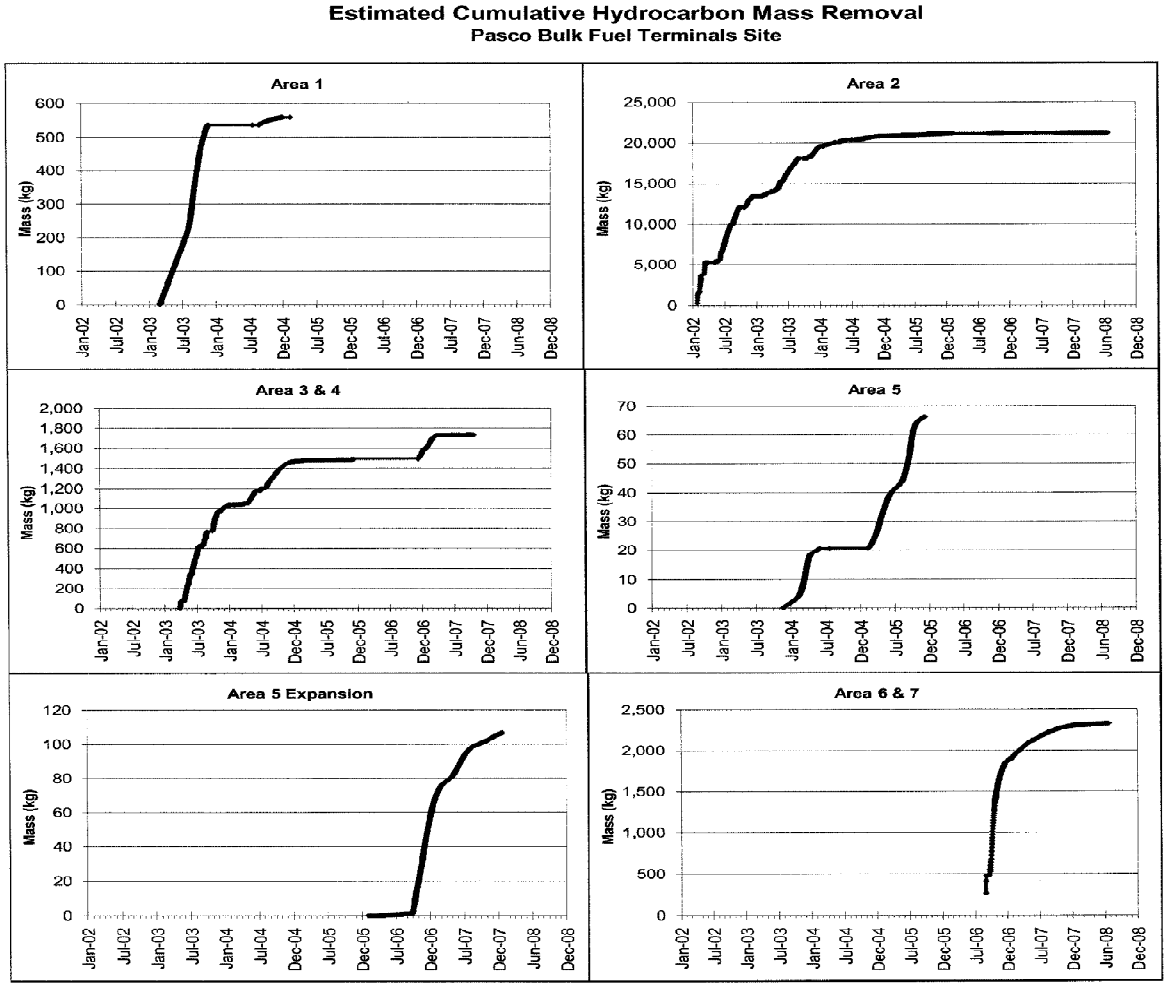
- Arsenic concentration decreases and Dissolved Oxygen (DO) concentrations increases do not immediately respond to TPH and VOCs concentrations decreases. For example, in MW-17 (Area 3) TPH and benzene have been below the cleanup level for about four years but arsenic still exceeds the cleanup level, and the DO of the ground water remains low.

- The PCE cleanup level at the outlet of the Oil/Water Separator has consistently exceeded the cleanup level. The site remedy being implemented is to treat ground water before it is discharged to the COE drain. Also noted is that PCE still

exceeds the cleanup level in MW-34 (Area 5), and MW-31 ((Area 7). IAS/SVE in the MW-34 area started in February 2006, and in MW-31 treatment started in August 2006.

- MDLs for 1,2-DCE and for most cPAHs are not sufficient for compliance with cleanup levels assessment.

FIGURE 6.1*



* - Source: Pasco Bulk Fuel Terminals Site Monthly Report for July 2008

6.2 NEW SCIENTIFIC INFORMATION FOR INDIVIDUAL HAZARDOUS SUBSTANCES OR MIXTURES PRESENT AT THE SITE

Toxicity factors for some Site ground water indicators listed in the table below have been updated since the issuance of the FCAP in 1999. These new toxicity factors led to changes in Method B cleanup levels and risk calculations.

Indicator	1999 MCL	2008 MCL	Ground Water Method B Formula Cleanup Level (Carcinogen @ 1 x 10-6 cancer risk, Non-carcinogen @ Hazard Quotient of 1)			
			1999		2008	
			Carcinogen	Non-carcinogen	Carcinogen	Non-carcinogen
Benzene	5	5	1.51		0.8	32
Toluene	1	1		1600		640
Xylene	10	10		16000		1600
Chloroform	NA	80	7.17	80	7.2	80
1,1-DCE	7	7	.0729	72	NA	80
1,2-DCA	5	5	0.481		0.64	
PCE	5	5	0.858	80	.081	80
TCE	5	5	3.98		.11	2.4
naphthalene				1600		160

6.3 NEW APPLICABLE STATE AND FEDERAL LAWS FOR HAZARDOUS SUBSTANCES PRESENT AT THE SITE

WAC 173-340-420. Periodic Review

The following sections of WAC 173-340-420 on periodic reviews as amended in 2001 state:

> **(2) Applicability**. The department shall conduct periodic review of a site whenever the department conducts a cleanup action; whenever the department approves a cleanup action under an order, agreed order or consent decree; or, as resources permit, whenever the department issues a no further action opinion; and one of the following conditions exists, at the Site:
>
> (a) Where an institutional control and/or financial assurance is required as part of the cleanup action;
> (b) Where the cleanup level is based on a practical quantitation limit as provided for under WAC 173-340-707; and
> (c) Where, in the department's judgment, modifications to the default equations or assumptions using site-specific information would significantly increase the concentration of hazardous substances remaining at the site after cleanup or the uncertainty in the ecological evaluation of the reliability of the cleanup action is such that additional review is necessary to assure the long-term protection of human health and the environment.
>
> **(3) General requirements**. If a periodic review is required under subsection (2) of this section, a review shall be conducted by the department at least every five years after initiation of a cleanup action. The department may require potentially liable persons to submit information required by the department to conduct a periodic review.

The review criteria remain unchanged and are listed under WAC 173-340-420(4) under the amended MTCA.

These amendments do not change the requirement that periodic reviews are necessary for this Site. Method C Commercial soil cleanup levels require institutional controls. In addition, arsenic and lead cleanup levels are based on the PQLs.

MTCA 2001 and 2007 Amendments on Cleanup Levels

The February 2001 and November 2007 amendments both made changes to the cleanup standards.

- The Site total TPH ground water cleanup level is 1000 µg/L based on Method A (1991 ed). The February 2001 amendment revised the Method A total TPH groundwater to:

  Gasoline Range Organics
  Benzene present - 800 µg/L
  No detectable benzene – 1000 µg/L
  Diesel Range Organics – 500 µg/L
  Heavy Oils – 500 µg/L
  Mineral Oil – 500 µg/L
  (For mixtures, the lowest applicable level must be met.)

  The February 2001 revisions also included the optional use of site specific TPH cleanup level for ground water using risk-based equations under Method B.

- Soil TPH cleanup level for the Site was based on the 1997 Interim TPH Policy for direct human health contact and soil-to-groundwater. This approach set risk-based cleanup levels for petroleum sites. The February 2001 revisions included this opportunity to use a similar approach of site specific TPH soil cleanup level using risk-based equations under Method B.

- The February 2001 revision also removed commercial soil cleanup levels; soils are considered for unrestricted and industrial use only.

- The February 2001 amendment added new provisions applicable to PAH mixtures by allowing the use of the Toxicity Equivalent Factor (TEF) methodology in assessing the potential carcinogenic risks of cPAHs. The Method A cleanup level for cPAHs was revised. Method A cPAHs cleanup level is based on the cleanup level of benzo(a)pyrene; concentrations of other cPAHs must be converted to an equivalent concentration of benzo(a)pyrene using toxicity equivalent factors. The 2007 amendments included a requirement that the cleanup level for a mixture of carcinogenic PAHs be based on a cancer risk of $1x10^{-6}$ (i.e. cPAHs mixture is to be treated as a single substance).

Terrestrial Ecological Evaluation

The 2001 amendment included a tiered process for evaluating potential threats posed by soil contamination to terrestrial ecological receptors and by establishing criteria for ecological protectiveness, WAC 173-340-7490 through WAC 173-340-7493 (2001/2007 MTCA eds.). This Site is zoned industrial. Thus, the current or future potential exposure to soil contamination needs to be only evaluated for terrestrial wildlife protection. Remedial actions conducted at the Site are expected to result in soil cleanup levels at the points of compliance identified in the final CAP. Site cleanup Levels for Gasoline Range Organics and Diesel Range Organics are below the criteria in Table 749-2 (2007 ed.).

6.4 CURRENT AND PROJECTED SITE USE

The Site is zoned industrial. There is no projected change in the future use of the Site.

6.5 AVAILABILITY AND PRACTICABILITY OF HIGHER PREFERENCE TECHNOLOGIES

The technology used is already of high preference.

6.6 AVAILABILITY OF IMPROVED ANALYTICAL TECHNIQUES TO EVALUATE COMPLIANCE WITH CLEANUP LEVELS

The analytical techniques used in the analysis for the Site indicators, except for 1,1-dichloroethene, are adequate for compliance with cleanup levels. The MDL used for 1,1-DCE needs to be lowered so compliance with the cleanup level can be assessed.

Site cleanup levels for arsenic (10 µg/L) and lead (10 µg/L) are based on PQLs. These PQLs are now lower due to improved analytical techniques. Actual PQLs used in the ground water arsenic and lead analysis are as low as 2 µg/L for both.

7.0 CONCLUSIONS

- Remedial actions being implemented continue to remove contaminants from the Site. Cleanup levels for the indicators are continuing to be met in Areas 1 through 5; these are areas where IAS/SVE was started during Stage 1 and Stage 2. For Areas 6 and 7, where IAS/SVE started in August 2006 under Stage 3, indicator concentrations either show no clear trends or slight reductions.

- The efficiency of the IAS/SVE has been observed to decrease in limited areas where the rate of concentration decrease has leveled off and concentrations have still remained above cleanup levels.

- Arsenic concentrations still exceed cleanup level in most of the monitoring wells and have responded slowly to decreases in TPH and VOCs concentrations.

- PCE has consistently exceeded the cleanup level at the oil/water separator and have not shown a decreasing trend.

- Contamination in MW-48 (Area 8) has not shown a decreasing trend since this was put in recovery mode in July 2004.

- Cleanup levels developed for the Site were based on MTCA rules in effect at the time the department issued the final CAP in 1999. New toxicity information and MTCA amendments in 2001 and 2007 have resulted in updated cleanup levels and risk calculations. WAC 173-340-702(12)(c) [2001/2007 eds.] provides that "A release cleaned up under the cleanup levels determined in (a) or (b) of this subsection shall not be subject to further cleanup action due solely to subsequent amendments to the provision in this chapter on cleanup levels, unless the department determines, on a case-by-case basis, that the previous cleanup action is no longer sufficiently protective of human health and the environment". Ecology is not proposing to change cleanup levels at this time.

8.0 RECOMMENDATIONS

- Continue operation of IAS/SVE systems, putting areas in active treatment and recovery mode, as necessary.

- Continue semi-annual monitoring of ground water according to the compliance monitoring plan. Continue monthly performance monitoring of appropriate selected wells. Propose monitoring frequency changes for Ecology's approval, as necessary.

- Evaluate the practicability and feasibility of implementing enhancements to the IAS/SVE system in areas where the concentrations reductions have slowed down but still exceed cleanup levels. These enhancements must be for the purpose of attaining cleanup levels at a reasonable restoration time frame.

- Evaluate how PCE can immediately attain the cleanup level at the outlet of the oil/water separator. The current remedy that treats the ground water discharging to the COE drain has not resulted in PCE concentration reductions in the oil/water separator outlet. The practicability and feasibility of treating the oil/water separator outlet, or alternative treatment options, should be considered.

- Evaluate and propose treatment options for MW-48 (Area 8). This contamination appears to be much localized around MW-48.

- The MDL achievable for 1,1-DCE is greater than 2 times the cleanup level throughout the entire first review period. The next periodic review should look into the current cleanup level in relation to its PQL/MDL.

- The next periodic review must include an evaluation of the Site cleanup levels in relation to current toxicity and risk calculations, and MTCA revisions.

9.0 REFERENCES

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