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Five Year Review

Frontier Hard Chrome Superfund Site

January 2008



Five-Year Review Report

for

Frontier Hard Chrome Superfund Site

City of Vancouver
Clark County, Washington

Prepared By:

United States Environmental Protection Agency
Region 10
Seattle, WA

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1/29/2008
Date

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EXECUTIVE SUMMARY

The remedy for the Frontier Hard Chrome site included excavation of contaminated source material, construction of an Insitu Redox Manipulation Treatment Wall to address ground-water concerns, and source area treatment using a reductant. The primary goal of these actions was to change the oxidation-reduction state in the contaminated area and the groundwater moving through this source area to convert hexavalent chromium to the far less toxic and far less mobile trivalent chromium. The site achieved construction completion with the signing of the Preliminary Close Out Report on September 23, 2003. The Washington Department of Ecology is currently the lead for operations and maintenance.

The assessment of this five-year review found that the remedy was constructed in accordance with the requirements of the 2001 Amendment to the Records of Decision and that the remedy is functioning as designed. All immediate threats have been addressed. Because the remedial actions at all operable units are protective, the site is protective of human health and the environment. In the summer and fall of 2007, EPA conducted a long term monitoring optimization (LTMO) study to assess adequacy of monitoring system and frequency, as well as to assess status of the plume.¹

¹ The term "plume" is standardly used to describe groundwater with contaminant levels above clean-up standards. In this analysis as well as the Long-Term Monitoring Optimization study, we use the term "plume" to indicate areas with detectable contaminant levels, even when they are below the clean-up standard. The Long-Term Monitoring Optimization Study was completed December 21, 2007.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION

Site Name: Frontier Hard Chrome, Inc.

EPA ID: WAD053614988

Region: 10

State: WA

City / County: Vancouver, Clark County

SITE STATUS

NPL status: Final

Remediation Status: OU1 Soils – Complete; OU2 Groundwater – Operating

Multiple OUs? Yes

Construction Complete date: 9/22/2003

Has site been put into reuse? The area above the historic plume is already being redeveloped; development plans are underway for the source area.

REVIEW STATUS

Lead Agency: State of Washington

Author Name: Claire Hong

Author Title: EPA Remedial Project Manager for FHC

Review Period: 1/29/2005 to 1/29/2008

Dates of Site Inspection: 7/27/2007 and 10/15/2007

Type of Review: Policy

Review number: 1 (first five-year review)

Triggering action: Actual RA Start at OU 1

Triggering Action Date: 01/29/2003

Due date (5 years after triggering action date): 01/29/2008

ISSUES:

1. Some existing monitoring wells have been physically impacted by the development south of the Frontier Hard Chrome site. The continuing development of that area as well as the Frontier Hard Chrome property could further endanger the monitoring network.
2. The Long-Term Monitoring Optimization (LTMO) study of the groundwater monitoring network identified and recommended changes to the monitoring program.
3. Ground Water sampling for VOCs during Sample Event 10 in monitoring well W85-3A up-gradient of FHC has concentrations above 5 µg/l or the MCL. Event 10 measured 23 µg/l of Perchloroethylene (PCE) at that well.

RECOMMENDATIONS AND FOLLOW-UP ACTIONS:

1. Redevelopment of the Area may endanger the monitoring network. The Washington State Department of Ecology must provide close oversight and communication with the developers over the next 1 to 2 years. (Issue #1)
2. Survey existing monitoring wells that were physically impacted by the development south of the Frontier Hard Chrome site. (Issue #1)
3. Ensure proper abandonment of monitoring well W-97-18A and installation of a suitable replacement. (Issue #1)
4. Adopt groundwater monitoring frequency recommendations from the LTMO study. (Issue #2)
5. Notify State of potential impacts of the former Cascade Manufacturing facility on Perchloroethylene (PCE) concentrations at FHC. (Issue #3)

PROTECTIVENESS STATEMENT: Operable Unit #1 focuses on soils. EPA finds that for OU #1, the remedy was constructed in accordance with the requirements of the 2001 Amendment to the Records of Decision and that the remedy is functioning as designed. The cleanup levels have been met. We anticipate that OU #1 will be designated as fit for unlimited use and unrestricted exposure at the time of site closure.

Operable Unit #2 addresses groundwater. EPA finds that for OU #2, the remedy was constructed in accordance with the requirements of the 2001 Amendment to the Records of Decision and that the remedy is functioning as designed. All immediate threats have been addressed. Current monitoring data indicate that the remedy is functioning as required to achieve groundwater cleanup goals. Groundwater monitoring and statistical analyses will be conducted to confirm that the remedy is functioning as required. We anticipate that OU#2 will be designated as fit for unlimited use and unrestricted exposure at the time of site closure.

When considering the site as a whole, the assessment of this five-year review found that the remedy was constructed in accordance with the requirements of the 2001 Amendment to the Records of Decision and that the remedy is functioning as designed. All immediate threats have been addressed. Current monitoring data indicate that the remedy is functioning as required to achieve groundwater cleanup goals. Because the remedial actions at all operable units are protective, the site is protective of human health and the environment.

OTHER COMMENTS: EPA finds that the remedy is currently protective of the groundwater and we believe that it will continue to be protective. All 33 monitoring wells at the site have measured groundwater concentrations below the cleanup standards. The Long-Term Monitoring Optimization study that was completed in December 2007 found that approximately two-thirds of monitoring locations have achieved the cleanup goals with 80% or greater statistical power. However, the statistical test to determine whether wells have attained the cleanup standards is a more stringent test. Using methods outlined in EPA's 1992 Methods for Evaluating the Attainment of Cleanup Standards Volume 2: Ground Water, the LTMO found that only 4 wells could be determined to have met the cleanup standards. Continued monitoring of groundwater at the Frontier Hard Chrome site is needed to ensure that chemical rebound does not occur, that the variability of past data was truly due to seasonal and riverine influences, and that the remedy continues to function as intended. The current review team anticipates that monitoring should continue for at least five more years. With additional data, we may be able to meet statistical tests for attaining cleanup sometime after the next Five-year Review.

ABBREVIATIONS AND ACRONYMS

AOC	Administrative Order on Consent
ARAR	Applicable, Relevant and Appropriate Requirement
bgs	Below Ground Surface
CD	Consent Decree
COC	Contaminant of Concern
Cy	cubic yard
EPA	Environmental Protection Agency
FHC	Frontier Hard Chrome
ISRM	Insitu Redox Manipulation (treatment wall)
LTMO	Long-term Monitoring Optimization
mg/kg	milligram per kiligram
MCL	Maximum Contaminant Level
MTCA	Model Toxics Control Act
NCP	National Contingency Plan
NPL	National Priorities List
OU	Operable Unit
PCE	<u>Tetrachloroethylene</u> (Perchloroethylene)
PQL	Practical Quantification Limit
RA	Remedial Action
RAO	Remedial Action Objectives
ROD	Record of Decision
RPM	Remedial Project Manager
SARA	Superfund Amendments and Reauthorization Act
TBC	To Be Considered
TCA	Trichloroethane
TCE	Trichloroethene
µg/L	Microgram per liter
VOC	Volatile Organic Compound
WDOE	Washington State Department of Ecology

1.0 INTRODUCTION

The purpose of five-year reviews is to determine whether the remedy at a site is protective of human health and the environment. The United States Environmental Protection Agency (EPA) prepared this five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) §121 and the National Contingency Plan (NCP). CERCLA § 121 states:

If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106] of the NCP, the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.

The agency interpreted this requirement further in the NCP as codified as follows in 40 Code of Federal Regulations (CFR) §300.430(f)(4)(ii):

If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.

This five-year review is for remedial actions implemented at the Frontier Hard Chrome Superfund Site in Vancouver, Washington. This review was conducted from April to October 2007 for the period of January 2003 through October 2007. This report documents the results of the review.

This is the first five-year review for the Frontier Hard Chrome site. The five year review is required to evaluate the success and protectiveness of the remedy. The primary contaminant of concern is hexavalent chromium. All 33 monitoring wells at the site currently measure hexavalent chromium concentrations below the ROD specified cleanup level of 50 µg/liter, however additional monitoring is needed for at least several more years to verify these results and confirm the groundwater will continue to meet clean up levels, and to ensure Institutional Controls remain in place and effective until they are no longer necessary.

2.0 SITE CHRONOLOGY

Initial discovery of problem or contamination	1982: Washington Department of Ecology found FHC to be illegally disposing hazardous wastes.
Pre-NPL responses	1983: WDOE prohibits use of dry well for chromium wastes. 1983: EPA and WDOE sign Cooperative Agreement to investigate wastes. WDOE had the lead for the site until it was listed on the NPL.
NPL Listing	9/08/83
Removal actions	1994: WDOE conducted an interim removal action of chromium contaminated soil on the property adjacent to and east of the FHC site. (≈ 160 cubic yards were removed)
Remedial Investigation/Feasibility Study complete	July 2000: Final Focused Feasibility Study completed
Long Term Monitoring Optimization Study	2007: Assessment of Ground Water Monitoring Network
ROD and ROD amendments	1987: ROD for source control and soils operable unit (OU). 1988: ROD for groundwater OU. 2001: ROD amendment for both soil and groundwater
Remedial design start	1988
EPA issues Remedial Design Scope of Work	October 2001
Treatability Tests Conducted and Design	2002
Remedial Action Start	2002
Completed Source Area Treatment	August 2003
Construction Completion date	2003: Preliminary Close Out Report
WDOE takes lead for site	Fall 2004. WDOE resumes lead for site during Operation and Maintenance phase.
Final Close-out Report	Future Action
Deletion from NPL	Future Action
Previous five-year review	None

3.0 BACKGROUND

3.1 PHYSICAL CHARACTERISTICS

The Frontier Hard Chrome (FHC) Superfund Site is located in the southwestern part of the State of Washington, in the City of Vancouver, see Figure 1.0. The address of the site is 113 Y Street, Vancouver, Washington.

The FHC site is located on a former floodplain of the Columbia River at an elevation of approximately 30 feet above mean sea level, about 0.5 mile north of the north bank of the river. A short distance north of the site (north of the 5th Street), a bluff rises to an elevation of approximately 160 feet. The FHC site covers approximately 0.5 acre and is bordered to the east by Grand Avenue, and to the west by "Y" Street.

3.1.2 GEOLOGY AND HYDROGEOLOGY

The FHC Site is underlain by several geologic units, with the upper two being of interest for this Five Year Review. The top unit consists of hydraulic fill and construction debris used to elevate the adjacent floodplain in the 1940's and 1950's. Fill materials are largely silt and sand and heterogeneous, poorly-compacted construction waste. Fill extends approximately 12 to 20 feet below ground surface (bgs) across the site. The fill unit is generally unsaturated, but localized areas of perched groundwater may be present (USEPA, 2001). Underlying the fill is an alluvial unit, consisting of a clayey silt subunit and a sand and gravel unit. Groundwater in the alluvial unit is hydraulically connected to the Columbia River. The clayey silt is heterogeneous in character and is 3 to 7 feet thick, thinning to the north of the site. The clayey silt unit separates the lower sand-and-gravel unit from the fill. The sand-and-gravel unit consists of poorly sorted sandy gravels, silty sandy gravels and sandy silts with scattered large cobbles. Deposits in this unit resulted from overbank deposition during flooding of the Columbia River and from channel deposition that resulted in more particle sorting than the overbank deposits. The alluvial unit is approximately 70 feet in thickness and is highly heterogeneous and anisotropic.

During initial site characterization, the alluvial unit was considered to have three layers. Upper and lower permeable zones (Zones A and B) separated by an aquitard were described in the RI/FS (issued in 1987). Zone A was described as a sand and gravel layer beginning about 20 ft bgs and extending to about 35 ft bgs. A confining "lower aquitard" below Zone A is described in the 1988 ROD (USEPA, 1988) and was the basis for separating groundwater in the alluvial unit into A and B zones. Currently, this silt zone is seen as semi-continuous fine-grained unit of dense sandy silt to silty sand. The layer is

now thought to be semiconfining and not a significant hydraulic barrier within the alluvial aquifer.

Zone B, or the deeper alluvial unit, is also made up of sands and gravel, but with higher permeability than Zone A. The lower alluvial unit extends from approximately 35 ft bgs down to 80 to 100 ft bgs. Groundwater velocity in this zone is about 2.25 feet/day to the south-southwest. There is no distinct vertical gradient between A and B Zones. Wells in the FHC network are designated as either A or B Zone wells based on the depth of the screened interval.

Groundwater flow in the region of the FHC site is generally to the south/southwest as the potentiometric surface data indicate a shallow slope to the south. Historically, groundwater flow direction has been influenced by industrial water supply wells that had operated southwest of the FHC site. When these industrial supply wells were deactivated, groundwater flow returned to a generally southerly flow direction. The average hydraulic gradient is 0.00015 ft/ft and groundwater velocity is between 0.5 and 5 ft/d. Recharge to site groundwater occurs from local infiltration of precipitation and from the recharge from another alluvial aquifer north of the site near the topographic rise. Down gradient from the Site, groundwater discharges to the Columbia River and area potentiometric surfaces are influenced by Columbia River stage.

3.1.3 LAND USE

Two chrome platers operated on this site. Pioneer Plating operated at the site from 1958 to 1970. During the operation of Pioneer Plating, chromium plating wastes were discharged to the sanitary sewer system. The business was taken over by FHC and operated from 1970 to 1983.

During the operation of Pioneer and the initial operation of FHC, chromium plating wastes were discharged to the sanitary sewer system. In 1975, the City of Vancouver determined that chromium in the wastewater from FHC was interfering with the operation of its new secondary treatment system. FHC was directed by the city and the Washington State Department of Ecology (WDOE) to cease discharge to the sewer system until an appropriate wastewater treatment system could be installed to remove the chromium at the site.

In 1976, WDOE gave the FHC facility a wastewater disposal permit for discharge of chromium-contaminated wastewater to an on-site dry well. The permit also contained a schedule for the installation of an appropriate treatment system for the FHC wastewater stream. Between 1976 and 1981, several extensions of the permit and schedule were granted, as the deadlines were passed without compliance.

3.3 HISTORY OF CONTAMINATION

In 1982, WDOE found FHC in violation of the Washington State Dangerous Waste Act for the illegal disposal of hazardous wastes. WDOE also discovered that an industrial supply well about one quarter mile southwest of FHC was contaminated with chromium at more than twice the federal drinking water standard. FHC's wastewater permit was again modified with a new compliance date. FHC again did not comply with the permit requirements for economic reasons, and in December 1982, the site was proposed for inclusion on the National Priorities List under CERCLA. The listing was finalized in September 1983.

In 1983, WDOE ordered FHC to stop discharge of chromium plating wastes to the dry well. FHC was also required to prepare a plan for the investigation of the groundwater. At that time, FHC closed down all operations at the site.

3.4 INITIAL RESPONSE

In March 1983, EPA and WDOE signed a Cooperative Agreement which gave Ecology the lead for investigation of the FHC site under Superfund. WDOE began the investigation in the fall of 1984.

Releases from FHC operations contaminated groundwater with chromium concentrations as high as 300,000 $\mu\text{g/L}$. At the time the contamination was first detected in 1982, a groundwater plume exceeding federal drinking water standards extended approximately 1600 feet southwest from the facility. Groundwater monitoring since initial discovery has shown that the plume had receded.

Concentrations of total chromium in surface soils collected during the RI were found as high as 5,200 mg/kg. Subsurface concentrations for total and hexavalent chromium have been noted as high as 31,800 mg/kg and 7,506 mg/kg respectively. Contaminated subsurface soil extended beneath the former neighboring Richardson Metal Works building.

The Washington Department of Ecology completed a removal action in 1994 to reduce the threat of direct exposure and further impact to groundwater from the most heavily contaminated surface soils. This action consisted of excavation and off-site disposal of limited quantity of surface soil with chromium concentrations exceeding 210 mg/kg from the easternmost portion of the site.

Subsequent to this initial response by Washington State Department of Ecology, EPA undertook the remedy outlined in the 2001 ROD Amendment. In 2003, EPA completed the building demolition and disposal of excavated source area debris. EPA then treated the source area by injection and augering in of a reducing agent. For soils, the 2001 ROD amendment specified that hexavalent chromium be less than 19 mg/kg (MTCA A) and trivalent chromium to be less than 80,000 mg/kg (MTCA B).

3.5 BASIS FOR TAKING ACTION:

High levels of hexavalent chromium posed exposure risks from soil, groundwater and the building debris. The primary route of concern for human health risk was the ingestion of groundwater containing hexavalent chromium. Releases from FHC operations contaminated groundwater with reported chromium concentrations as high as 300,000 µg/L. At the time the contaminated groundwater was first detected, a groundwater plume exceeding Washington State groundwater cleanup standards (50 µg/L) extended approximately 1600 feet southwest from the facility.

Six hazardous substances were identified in the Remedial Investigation (RI) to be present in one or more media at concentrations of potential concern to human health and the environment. All were considered in the 1987 Endangerment Assessment. These substances are: chromium, nickel, lead, PCE, TCE, and TCA. During the 1999 groundwater investigation activities, PCE and TCE were detected in 23 and 24 of the shallower zone (Zone A) groundwater samples. Only three PCE concentrations exceeded the federal drinking water standard, also known as "MCL," of 5 µg/L and only one TCE concentration exceeded the TCE MCL standard. VOCs are not being considered further for remedial actions because 1) concentrations have been extremely low and few detections have exceeded the respective MCL criteria, 2) VOCs in groundwater have historically been an area-wide problem, not specific to FHC, and 3) the presence of VOCs is not directly linked to past activities at FHC. Nickel and lead were also found in soils at the facility during the RI. The contaminant levels of these substances were much less than those for chromium. Nickel at the site did not exceed the 10^{-7} cancer risk for long-term airborne exposures. Lead also presented minimal risk at the site in that the levels did not exceed and were not expected to exceed the National Ambient Air Quality standards. Though the levels of exposure were not zero, the additional risk imposed by the dust was negligible. A review of the toxicological properties of these chemicals is contained in the Endangerment Assessment which is contained in the Administrative Record for the site.

4.0 REMEDIAL ACTIONS

4.1 REMEDY SELECTION

As discussed Section 3.4, in 1994 the State of Washington selected and implemented an initial response action. In 2001, after monitoring the effects of the earlier action and conducting a focused Feasibility Study, EPA selected a final remedy for the Site soils and groundwater through an Amended Record of Decision. The 2001 Amendment to the Records of Decision (ROD) included the following remedial action objectives (RAOs) for the site. Generally RAOs identify the exposure routes, receptors, chemicals of concern, and a human health or environmental cleanup objective.

For Groundwater:

1. Restore all hexavalent chromium-contaminated ground water to groundwater cleanup standards (MTCA A standards)
2. Prevent ingestion of hexavalent chromium-contaminated ground water above state groundwater cleanup standards (MTCA A standards)
3. Prevent chromium-contaminated groundwater from seeping into the Columbia River above chronic state standards for the protection of fresh water aquatic organisms.

For Soils:

1. Prevent hexavalent chromium in soils from serving as an uncontrolled, ongoing source of contamination to ground water
2. Prevent current and future exposure to soil contaminated with chromium above state standards for unrestricted future use.

Cleanup goals for the site outlined in the ROD are reduction of hexavalent chromium to less than 50 μ g/L in groundwater. For soils, the 2001 ROD amendment specified that hexavalent chromium be less than 19 mg/kg (MTCA A) and trivalent chromium to be less than 80,000 mg/kg (MTCA B).

4.1.1 REMEDY IMPLEMENTATION

Previous to the remedial action, there was a removal action. In 1994, a removal of 160 cubic yards of source material was conducted by the State of Washington.

In 2003, the buildings housing the Frontier Hard Chrome and the Richardson facilities were demolished and removed. A significant amount of the building material was heavily contaminated by chromium, and subsequently disposed of off-site. Large debris in fill material was also removed. The source area was treated by introducing reducing reagents that were injected into the subsurface soils and groundwater. An Insitu Redox Manipulation Treatment Wall was installed to reduce hexavalent chromium levels in groundwater down gradient of the source area.

Insitu Redox Manipulation Treatment Wall (ISRM Treatment Wall)

One of the main components of the remedy was the installation of the Insitu Redox Manipulation Treatment Wall, which occurred in the spring and summer of 2003. Eight pairs of injection wells were installed during ISRM Wall Installation. Each pair of wells included a deep well (screened from 28 to 33 feet below ground surface) and a shallow well (screened from 23 to 28 feet below ground surface). Each well pair was injected with 5,000 gallons of sodium dithionite reagent. The reagent was mixed with water prior to injection such that a total of approximately 40,000 gallons were injected into each well pair. Installation of the ISRM Treatment Wall met performance requirements. Based on monitoring during installation, no significant gaps in the treatment zone were present. The treatment wall is approximately 240 feet long and greater than 33 feet deep. The treatment zone extends from approximately 22 feet below ground surface to the bottom of the wall. The exact bottom of the treatment zone is not known due to sinking of the reagent, but is likely to be significantly deeper than the 33 foot installation depth.

Source Area Treatment

Areas were pre-excavated to a depth of approximately 20 feet to remove buried debris prior to treatment. Soil treatment on large scale began in June 2003. Treatment of hexavalent chromium in the source area soil and groundwater was completed by using in-situ soil mixing equipment to mix a proprietary reducing agent into the subsurface soils and groundwater. Treatment depths varied from 20 to 33 feet below ground surface.

The site achieved construction completion status when the Preliminary Close Out Report was signed on September 22, 2003.

4.1.2 SYSTEM OPERATION/OPERATION AND MAINTENANCE

The site was determined to be operational and functional on September 30, 2004. In the fall of 2004, the State of Washington assumed responsibility for Operation and Maintenance of the Site. The remedy selected for this site was in-situ treatment. The remedy is a passive remedy. Monitoring of groundwater, protection of the monitoring network, and analysis of data are currently the main operation and maintenance activities taking place.

4.1.3 COSTS OF SYSTEM OPERATIONS

Collecting and analyzing chromium concentrations in groundwater is the main activity at the site. The 2001 ROD Amendment anticipated 15 years of post remedy monitoring at the site. Due to differences in monitoring frequency at the site, the costs varied considerably. The costs for 2006 and 2007 reflect quarterly monitoring of 33 wells. The costs for 2005 were considerably less due to much lower frequency in monitoring.

Summation of Costs: (in dollars)

Year	Sample Collection and Report	Lab Analysis	Total Monitoring Costs
2005	16,517	17,002	33,520
2006	44,400	39,530	83,930
2007 (as of July 07)	22,083	25,999	48,082

Monitoring frequency was set out in the February 2004 Frontier Hard Chrome Long-Term Monitoring Plan. The Plan anticipated sampling on a quarterly basis for the first two years, semi-annually for the next two years and annually thereafter to create sufficient data set to evaluate monitoring network and plume characteristics.² Due to transition of site management, monitoring frequency was different than planned. However, groundwater monitoring has been conducted at least annually. Monitoring data are discussed in Section 7 of this document.

² The term "plume" is standardly used to describe groundwater with contaminant levels above clean-up standards. In this analysis as well as the Long-Term Monitoring Optimization study, we use the term "plume" to indicate areas with detectable contaminant levels, even when they are below the clean-up standard.

4.1.4 IMPLEMENTATION OF INSTITUTIONAL CONTROLS AND OTHER MEASURES

The 2001 ROD Amendment recommended institutional controls to be considered part of the remedy to protect the integrity of the remedy and prevent exposure until the time of site closure. At site closure, we anticipate that the site will be available for unlimited use and unrestricted exposure. There are several institutional controls recommended in the 2003 Institutional Control Plan, including deed restrictions for the source area and prohibitions against use of the groundwater. The EPA Review Team believes that the main function of the institutional controls should be the protection of the augured-in reductant and the Insitu Redox Manipulation (treatment wall) in the source area. The institutional controls provide these protections.

In July 2003, EPA entered into an Agreement and Covenant Not to Sue with the Kelly Development LLC, the owners of the former Frontier Hard Chrome site. The agreement included numerous institutional controls such as a prohibition against drilling wells and groundwater use. A copy of this Agreement and Covenant Not to Sue can be found in the Site File; the specific provisions regarding institutional controls is included in this Review as Attachment #4. The Agreement and Covenant Not to Sue also obliges the Kelly LLC to "ensure that assignees, successors-in interest, lessees, and sublessees of the Property shall provide the same access and cooperation, including compliance with Institutional Controls."

As part of this Five Year Review, EPA conducted a title search and review of the institutional controls recorded at Clark County Recorders office. On November 19, 2005, A Notice of Agreement and Institutional Controls was recorded at the Clark County Recorders office under Document 4068766. The Notice of Agreement does not specifically delineate the institutional controls, but notes that they exist and points the reader to the Agreement and Covenant Not to Sue. When the site moves closer to close-out, EPA may chose to consider whether the current documents at the Clark County Recorders office are sufficient or not. It may be useful to notify future land owners of the type of remedy in place and the importance of not changing the redox potential at the site.

The 2003 Institutional Control Plan also outlines additional prohibitions against the siting of wells and use of groundwater in the vicinity of the Frontier Hard Chrome site. Specifically, the Institutional Control Plan cites Washington Administrative Code, Title 173, Chapter 160, which establishes minimum standards for construction and maintenance of wells. This chapter mandates that wells shall not be located within certain minimum distances of known or potential sources of contamination, such as landfills and hazardous waste sites. During this Five Year Review, we determined that these provisions of the Washington Administrative Code still exist.

EPA evaluated the groundwater prohibitions for this Five-Year Review. EPA believes that the remedy is currently effective and that the layered institutional controls will protect the historic source area as well as the location of the Insitu Redox

Manipulation (treatment wall). The main institutional control is documented in the Agreement and Covenant Not to Sue. The parcels associated with those controls are appropriate, as they encompass the source area and the treatment wall. EPA believes that these institutional controls will be effective in preventing risk to the remedy.

In order to assess the effectiveness of the remedy, the monitoring well network is vital. EPA considered the benefits of trying to provide additional protections to the monitoring network through additional institutional controls. The Review Team found that the existing penalties for damaging government property and the threat of potential Superfund liability provide considerable protection of the wells. The Team noted that improved communication and oversight of the development was likely to be more effective than establishing additional institutional controls. The past damage to wells tended to be a result of miscommunication between contractors and subcontractors, which is unlikely to be addressed by increased penalties or institutional controls.

5. PROGRESS SINCE THE LAST FIVE-YEAR REVIEW

This is the first five-year review for the site.

6. FIVE-YEAR REVIEW PROCESS

6.1 COMMUNITY INVOLVEMENT

Community involvement has been an on-going part of remediation activities at the Site. A number of EPA fact sheets have been developed and distributed. The site chronology, contact information and historical documents can be found on the Region 10 website. Specifically to invite comment for the 5 year review, EPA sent out notifications to over 150 people who have previously been interested in the Frontier Hard Chrome site in early May 2007. We received one response requesting an address change.

In September 2007, EPA presented the tentative findings of the Long Term Monitoring Optimization assessment of ground-water monitoring at the site. EPA invited the Washington State Department of Ecology's lead on the site, Guy Barrett, representatives from JH Kelly (current property owner of former FHC site), and representatives from Killian Pacific (developers of the property due south of the former FHC site) to attend the meeting. WDOE and EPA are trying to work with developers to ensure that wells are protected. Additionally, in the case of accidental damage, we are trying to ensure that damage is quickly repaired.

Additionally, EPA has had extensive contact with Guy Barrett, the current Site Manager who has the lead overseeing the Operations and Maintenance of the Frontier Hard Chrome site.

Members of the Review Team:

Name	Title	Organization
Claire Hong	Remedial Project Manager	EPA
Bernie Zavala	Hydrogeologist	EPA
Jennifer Byrne	Attorney	EPA
Grechen Schmidt	Civil Investigator	EPA

As part of this review, we received input from the following people:

Person	Affiliation	Number
Guy Barrett	Site Manager of the Frontier Hard Chrome Site, Washington State Department of Ecology	360/407-7115
Brian DeDoncker	Clark County Center for Community Health	(360) 397-8000, ext. 7341
Richard Hoiland	Water Resource Protection, City of Vancouver	360/487-7199
Richard Szymarek	Well Regulations, Washington State Department of Ecology	360/407-6648

We had productive discussions about the status of the remedy and the site. The general concerns raised concerned the ability to maintain the remedy. The main input we received was from Mr. Barrett, the WDOE Site Manager currently managing the site. He noted that the remedy appears to be working effectively to clean up the site and reduce exposure to human health and the environment from site contaminants. He also noted that the soil and groundwater exposure pathways appear to no longer pose a threat as long as digging and drilling is restricted. Additionally, he appreciated that EPA conducted the long term monitoring optimization to assess the monitoring at the site, although he noted that he had not seen the final results.

Mr. Barrett emphasized the need to pay considerable attention to this site during the redevelopment of the site. As noted earlier, Mr. Barrett has been negotiating replacement of a damaged well and protections for other monitoring wells. Mr. Barrett also expressed concern that institutional controls should be examined and that protection of monitoring wells be improved in light of the past damage to them during redevelopment. EPA used this input in evaluating the institutional controls.

Mr. Hoiland of the City of Vancouver noted that they had inspectors that went out to sites and that some assistance monitoring Frontier Hard Chrome could be provided upon request.

6.2 DOCUMENT REVIEW

This five-year review consisted of a review of relevant documents including monitoring data. (see Attachment #3) Additionally, to assess the adequacy of monitoring network and monitoring frequency, EPA conducted a long-term groundwater monitoring assessment in preparation for this Five-year review.

6.3 DATA REVIEW

The Frontier Hard Chrome site was divided into two Operable Units: soils and groundwater. The soils OU was extensively monitored during the remedial action, which consisted of the demolition of the buildings, excavation of large materials, and augering in of reductant. The Remedial Action Report noted that 53 soil and 20 groundwater confirmation samples (includes duplicates) were collected from within the treatment zone. At the end of the site work, 28 surface soil samples (26 samples plus two duplicates) were also collected along the perimeter of the exclusion zone and along both sides of Y Street and 1st Street. These samples were collected to ensure no contaminated soil was tracked offsite that could pose a human health risk.

Chromium concentrations in soil ranged from 7 mg/kg to 990 mg/kg. With the exception of one sample, all samples were less than 300 mg/kg with most samples containing chromium at concentrations less than 100 mg/kg. All individual soil samples outside the site boundary were less than 2,000 mg/kg trivalent chromium and 19 mg/kg hexavalent chromium, which are the MTCA cleanup levels for unrestricted land use. The upper 95th confidence level about the mean of the total soil chromium concentration outside the site boundary (based on 26 samples) was 172 mg/kg; also well below the MTCA threshold of 2,000 mg/kg.

Since cleanup standards were met for the Soils Operable Unit, the main focus of monitoring has been chromium in groundwater. Chromium concentrations in groundwater will be discussed in Section 7, Technical Assessment part of this review.

In the 2001 ROD Amendment, EPA focused long-term monitoring on chromium rather than including volatile organic compounds (VOCs). EPA stated, "VOCs are not being considered further for remedial actions because 1) concentrations have been extremely low and few detections have exceeded the respective MCL criteria, 2) VOCs in groundwater have historically been an area-wide problem, not specific to FHC, and 3) the presence of VOCs is not directly linked to past activities at FHC." In addition to stabilizing the chromium, the remedy chosen for the site would assist in the break down of PCE and TCE, which were the two main volatile organic compounds found at the site. For this first five-year review, and as an additional precautionary step, EPA tested groundwater for VOCs during monitoring event #10. These monitoring results can be found in the Frontier Hard Chrome, Event 10 Monitoring Report, May 2007. During that sampling event, EPA determined that the only elevated VOC level was found up-gradient

of the soil treatment area and the ISRM treatment wall. All VOC measurements down-gradient of the ISRM treatment wall met federal drinking water standards. EPA believes that the VOCs measured up-gradient of the historical Frontier Hard Chrome site may be coming from the former Cascade Manufacturing facility.

6.4 SITE INSPECTIONS

The site was inspected on July 27, 2007. The site inspection was conducted by Bernie Zavala (EPA Hydrogeologist), Claire Hong (EPA Remedial Project Manager), Jennifer Byrne (EPA Attorney) and Guy Barrett (WDOE Site Manager). The Field Trip Report is included as Attachment #5.

Additionally, on October 15, 2007, Bernie Zavala (EPA Hydrogeologist) visited the site with the Kirby Biggs (EPA Office of Superfund Remediation and Technology Innovation), and Dr. Mindy Vanderford of GSI Environmental (the EPA contractor conducting the Long-Term Monitoring Optimization Study).

The area due south of the Frontier Hard Chrome source area has been undergoing major redevelopment in the last year. This area, which is located south of 1st Street and west of Grand Boulevard, is also the location of the historical groundwater plume of elevated chromium contamination. A large retailer, Fred Meyer, is moving into this development, which is now known as Grand Central.

During the July and October visits, EPA noted significant threat to monitoring wells at the site. During the July inspection, the inspection team attempted to visually verify the location of all monitoring wells on site. The inspection team was unable to find some of the wells. The team further noted that a number of the wells were buried under several feet of dirt, and other wells were endangered by the large graders and trucks being used at the site. The inspection team talked to the subcontractor on site. As a result, additional orange safety cones were placed to prevent additional damage to monitoring wells during the visit. EPA noted the need for temporary vaults and other protections. EPA submitted our Field Trip report to Guy Barrett of WDOE (See Attachment #5). Mr. Barrett followed up with the developers to try to identify the missing wells and protect the wells.

The October 2007 visit coincided with the quarterly Fall sampling event that was being conducted by Weston Solutions, Ecology's contractor. At that visit, it was determined that some of wells identified as missing in the July site inspection were now located in the roadway and were covered by asphalt. The road was being redeveloped to allow for easier entrance and egress from the Grand Central development. One of the wells (W97-18A) was damaged and needed to be abandoned and re-sited. As Washington State Department of Ecology is the lead for the site, they are currently working with the contractors to re-site the well, and get better protections for the other monitoring wells.

Another site visit took place on November 15, 2007 with Bernie Zavala, EPA and Guy Barrett, WDOE (See Attachment #6) to inspect the conditions of the retrofitted monitoring wells that were physically impacted by the development which is taking place south of the Frontier Hard Chrome Superfund site. All of the monitoring wells were adequately retrofitted but still need to be surveyed for elevation and for Washington state plane coordinates. Also, monitoring well W97-18A needs to be properly abandoned and re-installed.

Kelly Development LLC, the owners of the Frontier Hard Chrome source area, notified WDOE and EPA of their desire and plans to re-develop the Frontier Hard Chrome source area next year. The development will be known as Grand Central North. WDOE and EPA are working with the developer to ensure the re-development plans will not endanger the existing monitoring network.

7. TECHNICAL ASSESSMENT

EPA in 2001 Amended the Record of Decision (ROD) which combined the two previous RODs (1987 ROD for soil and a 1988 ROD for ground water). This Amended ROD fundamentally changed the remedy by addressing both soils and ground water contamination through an in-situ reduction of highly mobile and toxic hexavalent chromium to the trivalent chromium, which is generally immobile and non-toxic. (Weston, 2003). This technical assessment will cover both soil and ground water separately when answering Questions A through C.

7.1 SOILS

Question A: Is the remedy functioning as intended by the decision document?

A review of the Amended ROD, Remedial Action Report, Remedial Action Objectives (RAOs), the Ground Water Monitoring Reports 1-11 and the Groundwater Monitoring Network Optimization Study report indicates that the remedy is functioning as intended in accordance with the 2001 ROD Amendment. The remedial action was complete as of November 2003 and cleanup levels have been achieved.

The RAOs for the source area soils are:

- Prevent hexavalent chromium in the soil from serving as an uncontrolled, ongoing source of contamination to groundwater.
- Prevent current and future exposure to soil contaminated with chromium above stated standard for unrestricted future use.

The in-situ treatment of the source area soils consisted of drilling overlapping borings with either a 10 or 6- foot diameter auger with injectors which injected a reductant throughout the soil column to a treatment depth of 20 to 25-feet below ground surface (see Figure 2.0). The overall treatment volume was approximately 21,000 cubic yards of soil. Confirmatory soil and ground water samples were collected in the source area which consisted of 53 soil samples and 19 ground water samples. The concentrations of the soil samples were below the site cleanup standard of 19 mg/kg for hexavalent chromium.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Yes, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection are still valid.

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. There have been no changes in the exposure assumptions and toxicity data since the selection of the remedy. There have been no changes in exposure pathways. The principal exposure pathway for the site related contaminant (hexavalent chromium) is through ingestion and dermal contact. This pathway has been eliminated since the remedial action reduced the hexavalent chromium to trivalent chromium. The remedial action objectives have been met for soils. Conformational soil samples collected during the remedial action at the source area are less than 19 mg/kg for hexavalent chromium. The maximum trivalent chromium concentration for soils during the conformational sampling was 2,200 mg/kg. The cleanup level for chromium in soils was set by the Washington State Department of Ecology "Model Toxics Control Act;" method A was used for hexavalent chromium (19 mg/kg) and method B for trivalent chromium (80,000 mg/kg).

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. No weather related or naturally occurring events (earthquakes) have affected the protectiveness of this remedy. Land development is currently taking place outside the area of the Frontier Hard Chrome property but EPA and WDOE have coordinated with the developers to ensure that impacts to the remedy have been minimized.

7.2 GROUND WATER

Question A: Is the remedy functioning as intended by the decision document?

A review of the Amended ROD, Remedial Action Report, Remedial Action Objectives (RAOs), the Ground Water Monitoring Reports 1-11 and the Groundwater Monitoring Network Optimization Report indicates that the remedy is functioning as intended in the ROD Amendment. The remedial action was completed as of November 2003 and cleanup levels have been achieved.

The RAOs for Ground Water are:

- Restore all hexavalent chromium-contaminated ground water to groundwater cleanup standards (MTCA A standards, 50 µg/l)
- Prevent ingestion of hexavalent chromium-contaminated ground water above state groundwater cleanup standards (MTCA A standards)
- Prevent chromium-contaminated groundwater from seeping into the Columbia River above chronic state standards for the protection of fresh water aquatic organisms.

The remedial action for the soils and the ground water are functioning as intended in the Amended ROD. The remedy for ground water is a permeable reactive wall. The In-Situ Redox Manipulation (ISRM) wall is located down-gradient of the source control area, see Figures 3.0 & 4.0. This ISRM wall was developed and installed by Pacific Northwest Laboratory (PNNL). The installation of this treatment wall was conducted by injecting a sodium dithionite solution (reagent) into the subsurface through injection wells at two different depths: 23 to 28 feet and 28 to 33 feet below ground surface (BGS). This chemical reagent reacts with the natural occurring iron in the soil which creates or alters the redox potential of aquifer fluids and sediment (Battelle-PND, January 2004). The ISRM wall was built in two phases. The first phase was a proof of concept and it was successful by reducing the hexavalent chrome to trivalent chrome. The ground water concentrations in the monitoring wells were below the site standard of 50 µg/l after the injection. The second phase was to install the rest of the injection wells or a total of 16 wells at eight different locations with overlapping areas of the reagent in the subsurface for a continuous wall. The treatment wall is 240 feet long with a depth of greater than 33 feet below the ground surface. The wall was completed in August 2003.

A ground water monitoring program was developed to evaluate the effectiveness of the remedial action for both soil and ground water operable units. This ground water monitoring program began February of 2004 (see Figure 5.0). This monitoring program contains thirty-three monitoring wells at two different depths A&B-zones monitoring the depths from 20 to 50 feet BGS. The ground water quality concentrations in all 33 monitoring wells for total chromium concentrations as of August 2007 were below the site standard of 50 µg/l. As mentioned earlier, there were delays in implementing this monitoring program due to transition of site management.

The system operation / operation and maintenance (O&M) is the long term ground water monitoring program. Ground water samples have generally been collected on a quarterly basis for total chromium as well as ground water elevation data for ground water flow direction. Eleven ground water sampling events have occurred since the remedy was completed. The ground water quality data collected to date in monitoring wells down-gradient from the soil source area have water quality concentrations below the cleanup standard of 50µg/l since 2004. The ground water flow direction remains the same since the completion of the remediation.

The EPA Region 10 requested a ground water optimization study of the long term monitoring program which was conducted by GSI Environmental, Inc. (GSI Environmental, Inc. December 2007). This optimization was conducted in the winter of 2007 with the primary goal of evaluating the efficacy of the chosen remedy and to recommend an optimized long term monitoring program. The following are the results taken from the final optimization report by GSI:

"Results

Statistical and qualitative evaluations of FHC Site analytical data have been conducted and the following general conclusions have been drawn on the results of these analyses:

- *After a qualitative evaluation of well locations, screened intervals and hydrogeologic characteristics, affected groundwater at the FHC Site is delineated to the relevant regulatory standards established for the site (Washington State Department of Ecology MTCA A Standards). Groundwater areas where concentrations routinely exceed regulatory standards are bounded by wells where results are below the standard. No major data gaps in site characterization were found.*
- *The groundwater plume evaluated shows overall stable to decreasing concentration trends. None of the well data reviewed show increasing concentration trends. Many "no trend" findings result from intermittent detections, data outliers or apparently cyclical variation in concentrations, especially in Zone B wells.*
- *Moment trend analysis indicated that total dissolved mass in the plume is decreasing. The center of mass in Zone B is retreating toward the source.*
- *Results from the spatial redundancy analysis indicate that several wells could be removed from the program, as they do not provide unique information. Wells identified as redundant are listed in Table 5.*
- *No areas of high concentration uncertainty were found; therefore no new monitoring locations are recommended.*
- *The sampling frequency analysis recommended a reduced sampling frequency for the majority of wells. Annual to biennial sampling frequencies were recommended by the MAROS algorithm based on the rate of change and trend of well concentrations.*
- *Many locations evaluated were statistically below the screening level for chromium using both the student's T-test with a power analysis and the sequential T-test. Approximately two-thirds of monitoring locations have achieved the cleanup goals with 80% or greater statistical power, given the current dataset."*

The recommendations for an optimized long-term ground water monitoring program can be found on Table 1.0. These twenty-three monitoring wells locations will be monitoring both zones A&B. The frequency of sampling will be annually. Along with the water quality sampling ground water elevations will be collected in all of the 33-existing monitoring wells.

The institutional controls that are in place for the FHC property have prevented and will continue to prevent exposure to, or ingestion of, contaminated ground water. The

ground water quality for all the monitoring wells at FHC is below the State of Washington, MCTA Method A standard for total chromium which is 50 µg/l.³

The remedial action objective for the prevention of chromium-contaminated groundwater from seeping into the Columbia River above chronic state standards for the protection of fresh water aquatic organisms (10.5 µg/l) has been met. The monitoring wells that are the closest to the Columbia River monitoring wells W99 R5A&B located approximately 1,500 feet from the river have had concentrations below 10.5 µg/l since February 2004.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection still valid?

Yes, the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy selection, are still valid.

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. There have been no changes in the exposure assumptions and toxicity data since the selection of the remedy. There have been no changes in exposure pathways. The principal exposure pathway for the site related contaminant, hexavalent chromium in ground water, is through ingestion and dermal contact. This pathway has been eliminated since the remedial action reduced the hexavalent chromium in ground water to trivalent chromium by the ISRM treatment wall. The remedial action objectives have been met for ground water at all of the monitoring well locations based on the existing long-term ground water monitoring program (33-monitoring wells). The cleanup level for chromium was set by the Washington State Department of Ecology "Model Toxics Control Act", using method A and the cleanup number for Total Chromium is 50 µg/l. All of the existing monitoring well total chromium concentrations are below 50 µg/l.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. No weather related or naturally occurring events (earthquakes) have affected the protectiveness of this remedy. Land development is currently taking place outside the area of Frontier Hard Chrome property but has not affected nor is it expected to affect the soil remedy. The current owner has plans to develop the FHC property in the near future but is aware of Site conditions and the

³ During the site characterization, ground water samples were collected at the same location for both total chromium and hexavalent chromium. The results showed that the total chromium sample were similar to the hexavalent chromium samples. Therefore when sampling for total chromium we are assuming the sample results reflect the concentrations for hexavalent chromium.

institutional controls and is coordinating with the agencies to ensure his actions do not compromise the remedy”

Some of the monitoring wells located south of East First Street have been physically impacted by development activities. The EPA and the State of Washington Department of Ecology, on November 15, 2007 performed a site inspection of the retrofit of the monitoring wells and found that most of the work had been completed except for monitoring well survey for elevation and Washington state plan coordinates. Also, a monitoring well still needed to be properly abandoned per state regulations and re-installed at a nearby location. This replacement well will be part of the long term monitoring program.

EPA finds that the remedy is currently protective of the groundwater and we believe that it will continue to be protective. As noted above, the LTMO found that approximately two-thirds of monitoring locations have achieved the cleanup goals with 80% or greater statistical power. However, the statistical test to determine whether wells have attained the cleanup standards is a more stringent test. Using methods outlined in EPA's 1992 Methods for Evaluating the Attainment of Cleanup Standards Volume 2: Ground Water, the LTMO found that only 4 wells could be determined to have met the cleanup standards. Continued monitoring of groundwater at the Frontier Hard Chrome site is needed to ensure that chemical rebound does not occur, that the variability of past data was truly due to seasonal and riverine influences, and that the remedy continues to function as intended. The current review team anticipates that monitoring should continue for at least five more years. With additional data, we may be able to meet statistical tests for attaining cleanup sometime after the next Five-year Review.

8.0 ISSUES

Issue	Currently Affects Protectiveness (Y/N)	Affects Future Protectiveness (Y/N)
Some existing monitoring wells have been physically impacted by the development south of the Frontier Hard Chrome site. The continuing development of that area as well as the Frontier Hard Chrome property could further endanger the monitoring network.	N	Y
Surveying of existing monitoring wells that were physically impacted by the development south of the Frontier Hard Chrome site.	Y	Y
Abandonment and installation of monitoring well W-97-18A	Y	Y
LTMO study identified and recommended changes to the monitoring program.	N	N
Ground Water sampling for VOCs during Sample Event 10 in monitoring well (W85-3A 23 µg/l of Perchloroethylene) up-gradient of FHC has concentrations above 5 µg/l or the MCL.	N	N

9. RECOMMENDATIONS and FOLLOW-UP ACTIONS

Issue	Recommendations/ Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness? (Y/N)	
					Current	Future
1	The Washington State Department of Ecology must provide close oversight and communication with the developers over the next 1 to 2 years.	State of Washington	EPA	12/31/2010	N	Y
2	Survey existing monitoring wells that were physically impacted by the development south of the Frontier Hard Chrome site.	Killian Pacific Inc.	State of Washington/ EPA	9/30/2008	Y	Y
3	Ensure proper abandonment of monitoring well W-97-18A and installation of a suitable replacement.	Killian Pacific Inc.	State of Washington/ EPA	12/31/2008	Y	Y
4	Adopt groundwater monitoring frequency recommendations from the LTMO study	State of Washington	EPA	12/31/2008	N	N
5	Notify State of potential impacts of the former Cascade Manufacturing facility on PCE concentrations at FHC.	EPA	State of Washington	2008	N	N

10. PROTECTIVENESS STATEMENT

Operable Unit #1 focuses on soils. EPA finds that for OU #1, the remedy was constructed in accordance with the requirements of the 2001 Amendment to the Records of Decision and that the remedy is functioning as designed. The cleanup levels have been met. We anticipate that OU #1 will be designated as fit for unlimited use and unrestricted exposure at the time of site closure.

Operable Unit #2 addresses groundwater. EPA finds that for OU #2, the remedy was constructed in accordance with the requirements of the 2001 Amendment to the Records of Decision and that the remedy is functioning as designed. All immediate threats have been addressed. Current monitoring data indicate that the remedy is functioning as required to achieve groundwater cleanup goals. Groundwater monitoring and statistical analyses will be conducted to confirm that the remedy is functioning as required. We anticipate that OU#2 will be designated as fit for unlimited use and unrestricted exposure at the time of site closure.

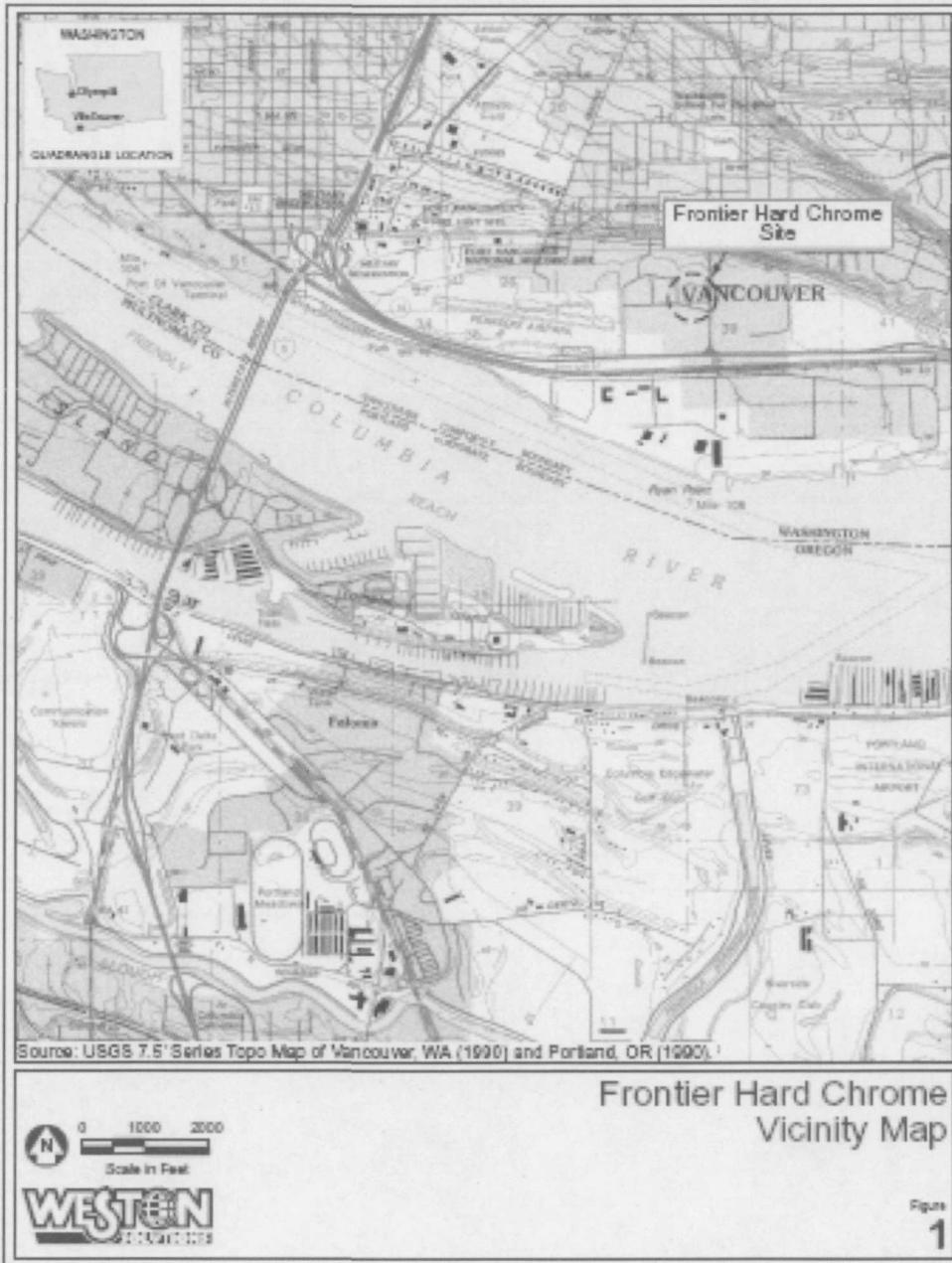
When considering the site as a whole, the assessment of this five-year review found that the remedy was constructed in accordance with the requirements of the 2001 Amendment to the Records of Decision and that the remedy is functioning as designed. All immediate threats have been addressed. Current monitoring data indicate that the remedy is functioning as required to achieve groundwater cleanup goals. Because the remedial actions at all operable units are protective, the site is protective of human health and the environment.

11. NEXT REVIEW

The next five-year review for the Frontier Hard Chrome Superfund Site is required by January 2013, five years from the date of this review.

ATTACHMENT #1 - FIGURES

Figure 1.0 Frontier Hard Chrome Vicinity Map



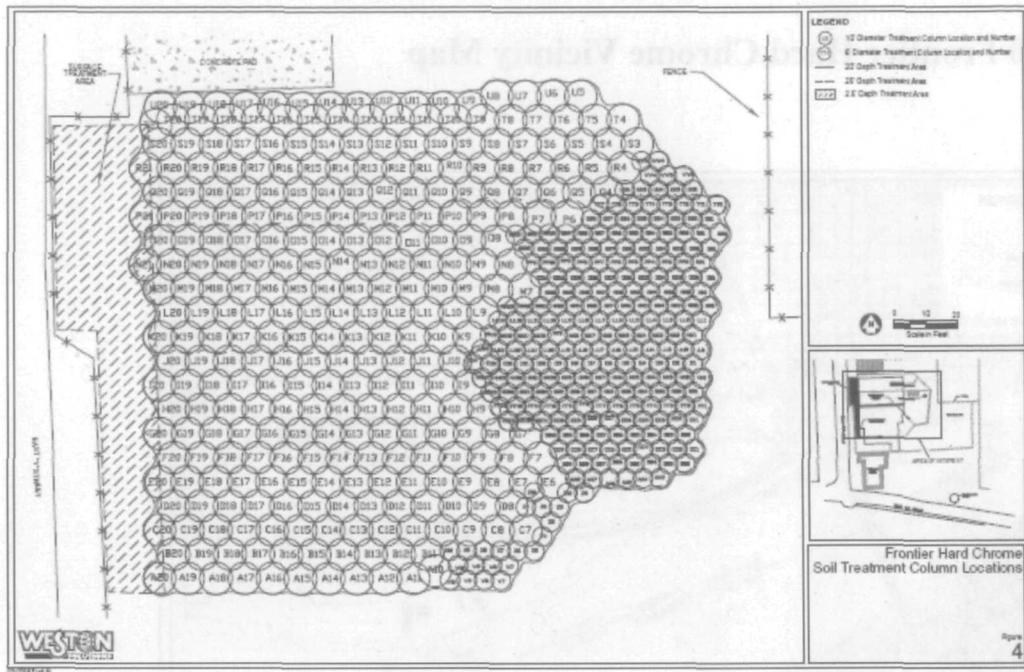


FIGURE 2.0 Soil Treatment Column Locations at the Soil Source Area at the Frontier Hard Chrome Site

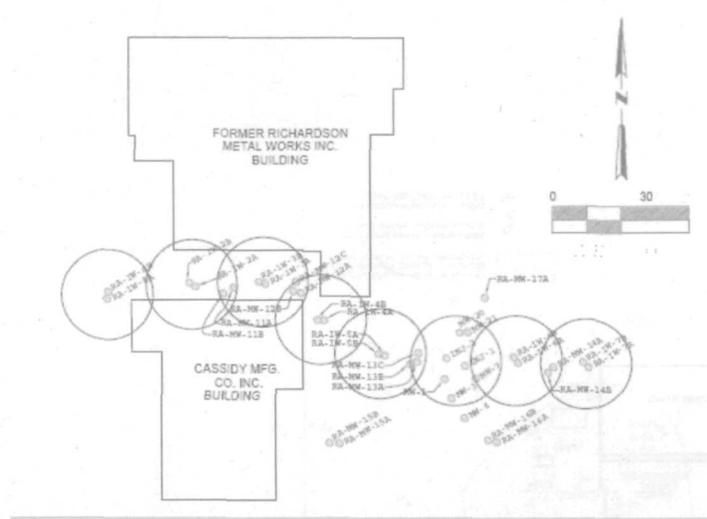


Figure 3.8. Well Location Map

Figure 4.0 Locations of the ISRM injection and monitoring wells

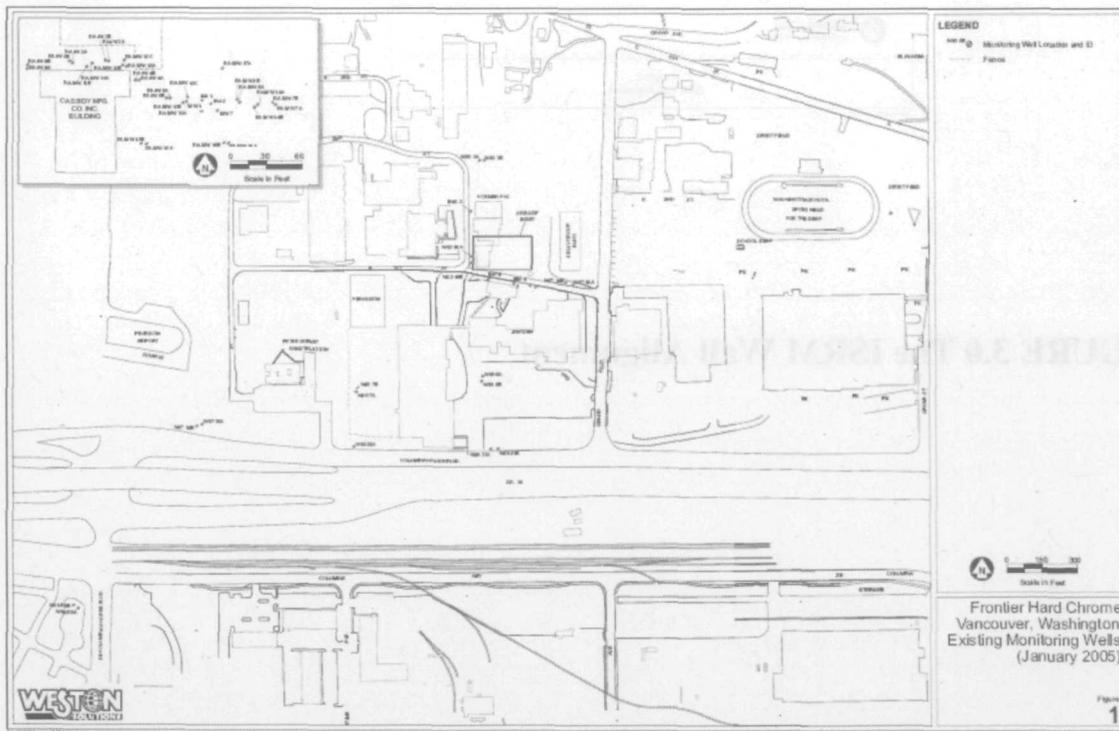


Figure 5.0 The existing monitoring well at the Frontier Hard Chrome Superfund site.

ATTACHMENT # 2 - TABLES

TABLE 1.0 Final Network Recommendations for the Long Term Ground Water Monitoring Program

(referred to in LTMO as "Table 7")

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TABLE 7
FINAL RECOMMENDED MONITORING NETWORK FRONTIER HARD CHROME

LONG-TERM MONITORING OPTIMIZATION
FRONTIER HARD CHROME SUPERFUND SITE
VANCOUVER, WASHINGTON

WellName	Total Chromium					
	Percent Detection	Mann Kendall Trend	Statistically Below Standard?	MAROS Redundancy Determination	Recommendation After Qualitative Review	Final Recommended Frequency
Zone A Wells						
B65-4	91%	D	✓	✓	Retain	Annual
RA-MW-11A	93%	D	✓	✓	Exclude	Annual
RA-MW-12A	100%	NT	✓	✓	Retain	Annual
RA-MW-13A	93%	S	✓	✓	Exclude	Exclude
RA-MW-14A	75%	S	✓	✓	Exclude	Exclude
RA-MW-15A	92%	NT	✓	✓	Retain	Annual
RA-MW-16A	92%	D	✓	✓	Retain	Annual
RA-MW-17A	92%	S	✓	✓	Retain	Annual
W95-6A	99%	S	✓	✓	Retain	Annual
W95-7A	92%	S	✓	✓	Exclude	Exclude
W92-16A	64%	NT	✓	✓	Retain	Annual
W97-18A	55%	S	✓	✓	Retain	Annual
W97-12A	91%	PD	✓	✓	Retain	Annual
W98-20A	91%	S	✓	✓	Exclude	Exclude
W98-21A	91%	PD	✓	✓	Retain	Annual
W99-R5A	98%	NT	✓	✓	Retain	Annual
Zone B Wells						
B85-3	73%	NT	✓	✓	Retain	Annual
B67-2	100%	NT	✓	✓	Retain	Annual
RA-MW-11B	92%	D	✓	✓	Exclude	Exclude
RA-MW-12B	83%	D	✓	✓	Retain	Annual
RA-MW-12C	100%	S	✓	✓	Retain	Annual
RA-MW-13B	50%	NT	✓	✓	Exclude	Exclude
RA-MW-13C	91%	S	✓	✓	Exclude	Exclude
RA-MW-14B	75%	NT	✓	✓	Exclude	Exclude
RA-MW-15B	100%	NT	✓	✓	Retain	Annual
RA-MW-16B	100%	NT	✓	✓	Retain	Annual
W95-6B	59%	D	✓	✓	Retain	Annual
W95-7B	98%	D	✓	✓	Exclude	Exclude
W92-16B	100%	NT	✓	✓	Retain	Annual
W97-18B	73%	NT	✓	✓	Retain	Annual
W97-19B	92%	D	✓	✓	Retain	Annual
W98-21B	91%	D	✓	✓	Retain	Annual
W99-R5B	91%	D	✓	✓	Retain	Annual

Notes:

- Mann Kendall Trends: D = Decreasing; PD = Probably Decreasing; S = Stable; PI = Probably Increasing; I = Increasing; NT = No Trend; ND = well has all non-detect.
- Mann-Kendall trends 2003 - 2007 are shown.
- Statistically below standard based Student's T-Test with >90% statistical power for data between 2003-2007. Cleanup standard is Washington Ecology MTCA A = 50ug/L Total Chromium.
- MAROS redundancy indicates well has low SF and high AR and CR.
- Final Recommendation based on statistical as well as qualitative evaluation.

**Table 2.0 Final Long Term Ground Water Monitoring Network
Recommended Post Five Year Review 2007 for the Frontier Hard
Chrome Superfund Site.**

Monitoring Well Number	Zone A	Zone B	Parameter	Frequency
B85-4	X		² T.Chromium	Annual
RA-MW-16A	X		T.Chromium	Annual
W85-6A	X		T.Chromium	Annual
W92-16A	X		T. Chromium	Annual
RA-MW-12A	X		T. Chromium	Annual
RA-MW-17A	X		T.Chromium	Annual
¹ RW97-18A	X		T.Chromium	Annual
RA-MW-15A	X		T. Chromium	Annual
W97-19A	X		T. Chromium	Annual
W98-21A	X		T.Chromium	Annual
W99-5A	X		T. Chromium	Annual
B85-3		X	T. Chromium	Annual
B87-8		X	T. Chromium	Annual
RA-MW-12B		X	T.Chromium	Annual
RA-MW-12C		X	T.Chromium	Annual
RA-MW- 15B		X	T. Chromium	Annual
RA-MW-16B		X	T.Chromium	Annual
W85-6B		X	T.Chromium	Annual
W92-16B		X	T.Chromium	Annual
W97-18B		X	T.Chromium	Annual
W97-19B		X	T.Chromium	Annual
W98-21B		X	T.Chromium	Annual
W99-R5B		X	T.Chromium	Annual

1- RW97-18A is the replacement monitoring well for W97-18A

2- T.Chromium is Total Chromium.

Attachment #3: Documents Reviewed for Five-Year Review

List of Documents Reviewed:

Groundwater Monitoring Network Optimization, Frontier Hard Chrome Superfund Site, December 2007.

Frontier Hard Chrome Monitoring Reports 1-11:

- Frontier Hard Chrome, Event 11 Monitoring Report, August 2007.
- Frontier Hard Chrome, Event 10 Monitoring Report, May 2007.
- Frontier Hard Chrome, Event 9 Monitoring Report, December 2006.
- Frontier Hard Chrome, Event 8 Monitoring Report, September 2006.
- Frontier Hard Chrome, Event 7 Monitoring Report, June 2006.
- Frontier Hard Chrome, Event 6 Monitoring Report, May 2006.
- Frontier Hard Chrome, Event 5 Monitoring Report, February 2006.
- Frontier Hard Chrome, Event 4 Monitoring Report, May 2005.
- Frontier Hard Chrome, Event 3 Monitoring Report, August 2004.
- Frontier Hard Chrome, Event 2 Monitoring Report, June 2004.
- Frontier Hard Chrome, Event 1 Monitoring Report, May 2004.

Frontier Hard Chrome Post Remedial Action Long-Term Monitoring Plan, February 2004.

In Situ Redox Manipulation Permeable Reactive Barrier Emplacement: Final Report
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Frontier Hard Chrome Remedial Action Report, December 2003.

Frontier Hard Chrome Institutional Control Plan, December 2003.

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Agreement and Covenant Not To Sue, Kelly Development LLC, July 2003.

Washington State Department of Ecology, Docket for Cascade Manufacturing, 1999 - 2002.

Record of Decision Amendment, Frontier Hard Chrome, Inc. August 2001.

Record of Decision, Frontier Hard Chrome, Inc., OU #1 Soils, December 1987.

Record of Decision, Frontier Hard Chrome, Inc., OU#2 Water, July 1988.

Attachment #4 – Institutional Controls from the Agreement and Covenant Not to Sue

Settling Respondent shall comply with the following institutional controls at the Frontier Hard Chrome Site:

1. No installation of groundwater or dry wells on Site, exclusive of any storm water treatment and/or detention ponds required by regulatory bodies.
2. No use of groundwater from the Site.
3. Soil that is to be excavated for use or disposal off-Site must first be tested for hexavalent chromium and trivalent chromium. The use or disposal of such soil must comply with State and Federal regulations. EPA must be consulted prior to such excavation.
4. Soil that is to be excavated for use or storage on-Site must first be tested for hexavalent chromium and trivalent chromium. The use or disposal of such soil must comply with State and Federal regulations. EPA must be consulted prior to such excavation.
5. The controls outlined in (3) and (4) above shall not apply to shallow trenching conducted for purposes of installing utilities, footings, etc., when soils from such activities are returned to their original locations. Settling Respondent shall provide EPA with a diagram of proposed trenching activities prior to excavation.
6. Any disturbance of soil at the Site must be undertaken in a manner that prevents human exposure to any hazardous substances contained in the soil.
7. Any of the above institutional controls may be waived in writing by EPA should EPA determine that there may otherwise be a potentially acceptable level of risk of exposure to hazardous substances absent the particular institutional control.



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, WA 98101

Attachment #5

August 22, 2007

Reply to
Attn Of: OEA-095

MEMORANDUM

SUBJECT: Field Trip Report -July 27, 2007 for Frontier Hard Chrome Superfund Site, Vancouver, Washington

FROM: Bernie Zavala, LG, LHG, Hydrogeologist
Office of Environmental Assessment

TO: Claire Hong, Remedial Project Manager
Office of Environmental Cleanup

CC: Guy Barrett, Site Manager
Department of Ecology

Background

This field visit had two functions; the first is to document that a site visit took place for the Five Year Review for the Superfund site Frontier Hard Chrome located in Vancouver, Washington. The Five-Year Review site inspection will report out on the current conditions of the site and the details of this visit will be contained under a separate cover. The second function of this field trip will be to report out on the *conditions of the monitoring well locations which are part of the long term ground water monitoring program (LTGWM)*. The area surrounding the former location of Frontier Hard Chrome (FHC) Superfund site is undergoing a major re-development; see the figure 1.0, for the site location. The area of redevelopment is just south of East First Street, west of Grand Blvd. and north of Columbia House Blvd. This construction project/development is just south of the former FHC Superfund site. Also, the former property of FHC is being used as staging area for this construction project/development.

A site team from EPA-Region 10 visited all the monitoring well locations that are part of the LTGWM program. This survey will report out on the conditions of the well locations. The EPA team was Claire Hong, RPM for the Superfund site, Frontier Hard Chrome, Bernie Zavala, EPA and Jennifer Byrne, EPA. Washington Department of

Ecology, Guy Barrett, Site Manager was also part of the survey team. The remedy that was implemented by EPA-Region 10 at the FHC Superfund site consisted of treating hexavalent chromium in the source area soil and ground water. The goal for this remedy was to treat the ground water concentration of chromium to less than 50 µg/l. In addition to treating the source area, a permeable reactive barrier (PRB) was installed to treat the dissolved chromium plume down gradient of the former FHC building. As mentioned above a ground water monitoring program was included as part of this remedy to determine the effectiveness of the remedy. The long-term ground water monitoring program consists of 33-monitoring wells which are sampled for total chromium as well as collecting water levels for ground water elevations and flow direction. Table 1 list the 33-monitoring wells stations and identifies whether or not the monitoring wells were located during this survey and the current condition of the monitoring well location.

Findings of Field Visit

All of the wells were located except W97-18A&B, W98-21A&B, and W98-20A. The W85-7A&B location was partially covered by the redevelopment effort just north of Columbia House Blvd. The survey team, when conducting this monitoring well survey met Mr. Bret Tucker from the Nutter Corporation. The Nutter Corp. is a subcontractor to BooCo Construction which is the general contractor for this development. Both of these construction companies are performing the current work in the area south of the former FHC. Mr. Tucker told us he was aware of the monitoring wells and he wanted to make some adjustments regarding heights on certain monitoring wells. The BooCo Construction built the wooded barrier around some of the monitoring well locations for protection and to allow for access by the governments when sampling, see figures 2.0 through 6.0. The lead agency for the LTGWM program is the Washington State Department of Ecology and Guy Barrett is Ecology's site manager for FHC. Mr. Barrett will follow-up with Mr. Tucker on his request to adjust the height of the monitoring wells in question and to make sure all the monitoring wells in the LTGWM program are protected and are following the regulations regarding resource protection wells.

Table 1.0 –Frontier Hard Chrome –Status on current conditions of the monitoring wells, 7/27/2007, displays information on whether or not the wells were located. This table also reports on the condition of the wells and the surrounding area and any comments based on observations. As mentioned above, seven out of 33-monitoring wells were not located or visually seen. The well locations for three of the monitoring wells were found but the wells were buried under construction fill except W97-18A&B which was covered by dirt. This monitoring well cluster is located along East First Street.

Recommendations

The EPA makes the following recommendations based on the observations during this site visit. It should be noted that EPA is currently conducting a long-term monitoring optimization study of the monitoring wells at this site. That study should better enable our Agency to make recommendations to the Department of Ecology regarding which wells need more permanent protection.

- ALL the monitoring wells should continued to be protected and the EPA and Ecology should have complete access to the monitoring wells to continue the ground water sampling as required in the LTGW monitoring program.
- Recognizing that this is an active construction site, at a minimum, there is a strong and immediate need to provide secure temporary protection for several of the monitoring wells. One form of temporary protection might be the use of a temporary protective vault (these vaults generally require two men to lift).

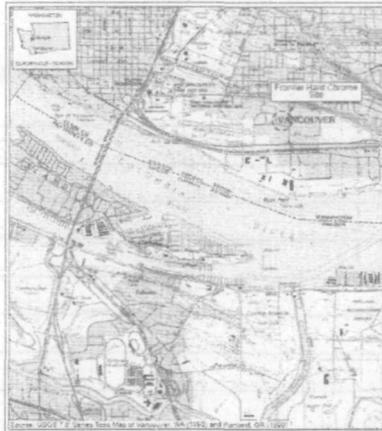
Since these wells are in the active construction site, we recommend protective vaults be erected for:

- Monitoring well Clusters W85-7A&B, W98-21A&B and monitoring well W98-20A.
 - Construction fill should be removed from the top of those wells.
 - These wells must be placed into a protective vault and raised to the proper grade or ground surface elevation, if necessary, so ground water monitoring can continue into the future.
 - If the casing needs to be adjusted then the State regulation must be followed, WAC 173-160-500 for resource protection wells.
- W97-18A &B must be located and be placed into a protective vault.
- B87-8 and B85-4 must be placed into protective vaults.
- Due to the central placement of wells W85-6A and W85-6B in the development of the property, it may be advisable to install a permanent protective vault for these wells.
 - If adjustments to the casing are needed, the necessary adjustment should be made to ensure that ground water monitoring can continue into the future. If the casing needs to be adjusted then the State regulation must be followed, WAC 173-160-500 for resource protection wells.
- For all wells, if any elevation change takes place on the measurement point on the inside casing of a monitoring well then those casing must undergo an elevation survey by a licensed surveyor for its new elevation. This survey should be accurate to +/- 0.01 foot. This elevation must also be tied into a known datum.

If you have any questions on the above information please feel free to contact me.

Table 1.0 - Frontier Hard Chrome- Status on current conditions of the monitoring wells, 7/27/2007.

Well Number	Located	Condition	Comments
RA-MW-12A	yes	Good	
RA-MW-12B	yes	Good	
RA-MW-12C	yes	Good	
RA-MW-11A	yes	Good	
RA-MW-11B	yes	Good	
RA-MW-13A	yes	Good	
RA-MW-13B	yes	Good	
RA-MW-13C	yes	Good	
RA-MW-17A	yes	Good	
RA-MW-14A	yes	Good	
RA-MW-14B	yes	Good	
RA-MW-16A	yes	Good	
RA-MW-16B	yes	Good	
RA-MW-15A	yes	Good	
RA-MW-15B	yes	Good	
B87-8	yes	Good	This well needs protection
B85-3	yes	Good	
W92-16A	yes	Good	
W92-16B	yes	Good	
B85-4	yes	good	This well needs protection
W97-18A	no	Covered with dirt	
W97-18B	no	Covered with dirt	
W85-7A	no	Covered with gravel	This well is located within the redevelopment area & needs protection.
W85-7B	no	Covered with gravel	This well is located within the redevelopment area & needs protection.
W97-19A	yes	Good	
W97-19B	yes	Good	
W98-20A	no	Covered	This well needs protection
W99-R5A	yes	Good	
W99-R5B	yes	Good	
W98-21A	no	covered	This well needs protection
W98-21B	no	covered	This well needs protection
W85-6A	yes	Good	This well needs protection
W85-6B	yes	Good	This well needs protection



Frontier Hard Chrome
Vancouver, Washington
Vicinity Map

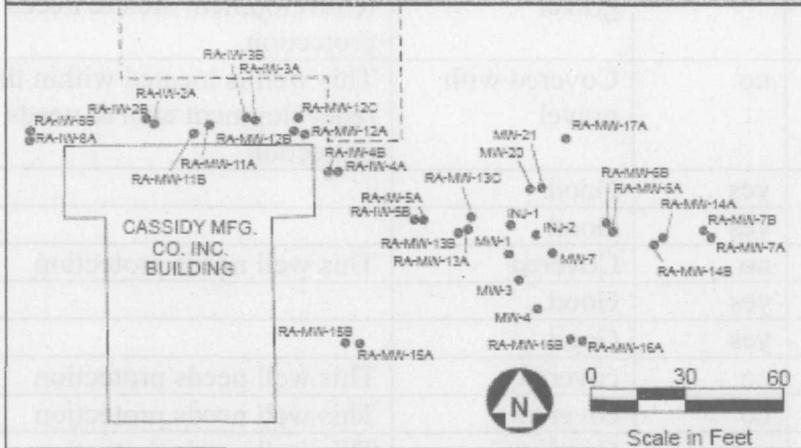
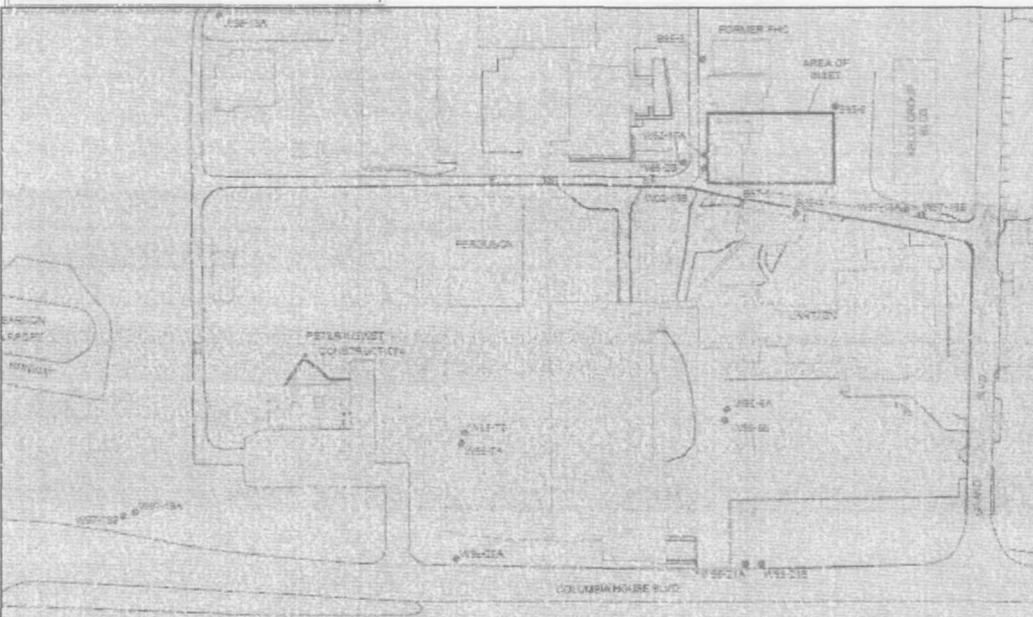


Figure 1.0, Figure taken from Weston Solution Sampling Event 11, not to scale. This figure is for illustration purposes to show locations of the monitoring wells that are part of the LTGWM program. Monitoring wells W99-R5A&B not shown but is located to the southwest of W97-19A&B. The bottom figure is the area of insert in the above figure.



Figure 2.0, Looking west just south of the former FHC site the following wells can be seen, RA-MW-12A, B&C, RA-IW-3A&B, RA-MW-11A&B, RA-IW-2A&B.



Figure 3.0, looking north near the former FHC site shows how the wells were being protected during the construction/development work. Wells inside the corral are inj-1, 2, MW-7, and MW-1.



Figure 4.0, looking northwest near the former FHC site, the wells were protected during the construction/development by a corral structure. This location is east of figure 3, and it contains the following wells: RA-MW-6A&B, RA-MW-14A&B, RA-MW-7A&B.

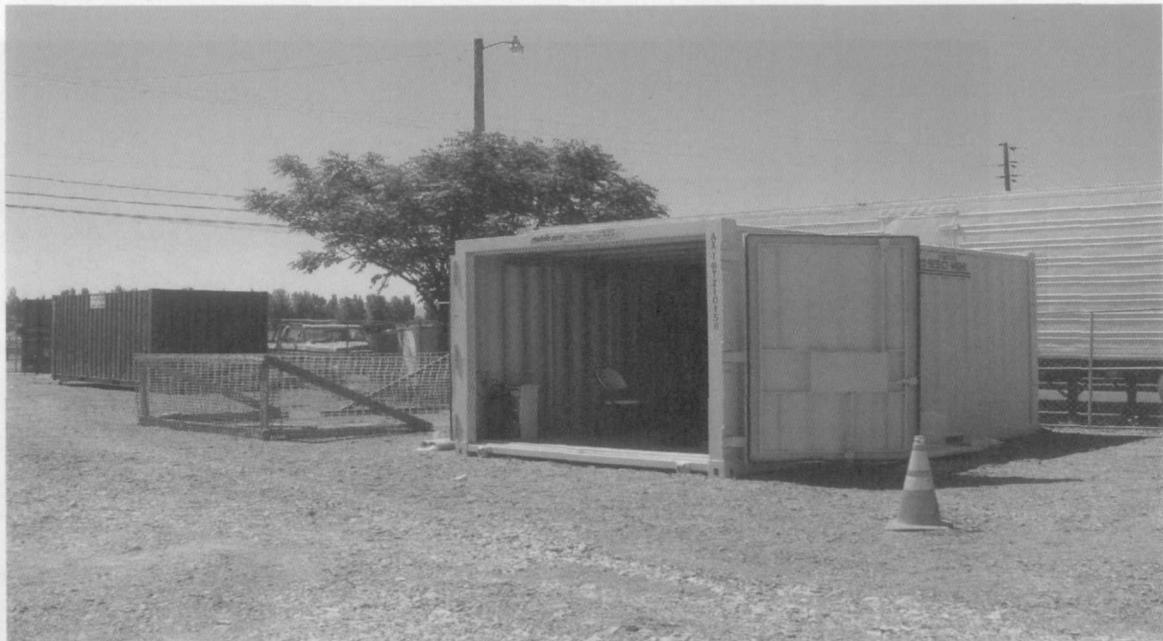


Figure 5.0, looking southwest near the former FHC site, west corral protecting surface mounted monitoring wells is also shown. MW-20 & 21 are located below storage container and underneath the orange cone shows the location of RA-MW-17A.



Figure 6.0, Looking north just south of East 1st Street in the middle of the development, monitoring wells W85-6A&B in the foreground.



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 900
Seattle, Washington 98101-3140

Attachment #6

November 19, 2007

Reply To: OEA-095

MEMORANDUM

SUBJECT: Trip Report, November 15, 2007 at the Superfund Site, Frontier Hard Chrome in Vancouver, Washington.

FROM: Bernie Zavala, Hydrogeologist
Office of Environmental Assessment

TO: Claire Hong, Remedial Project Manager
Office of the Environmental Cleanup

Cc: Guy Barrett, Remedial Project Manager
Washington Department of Ecology

Summary of Activities

The purpose of this field trip was to inspect the condition of the retrofitted monitoring wells that were physically impacted by the development which is taking place south of Frontier Hard Chrome Superfund site. These monitoring wells are part of the long-term ground water monitoring (LTGWM) program for this Superfund site. Development or construction activities in this area have had an impact on a number of the monitoring wells and repairs were needed. The developer Killian Pacific task their contractors to make the needed repairs and both EPA, Ecology along with Killian and their contractor meet at the site to inspect the work that was performed and to identify any additional work. The table below is a list of the monitoring wells (well number), the past condition, action taken, and the remaining action that is needed before this task is completed.

Well Number	Past condition	Action taken	Remaining action	Comments
W-98-20A	Well was buried	Well was brought up to grade & protected	Survey for elevation & state plane coordinates	Surveyed info must be forward to Ecology & EPA then task considered completed.
W-85-7A	Well was buried	Well was brought up to grade & protected	Survey for elevation & state plane	Surveyed info must be forward to

Well Number	Past condition	Action taken	Remaining action	Comments
			coordinates	Ecology & EPA then considered complete.
W-85-7B	Well was buried	Well was brought up to grade & protected	Survey for elevation & state plane coordinates	Surveyed info must be forward to Ecology & EPA then considered complete.
W-98-21A	Well was buried	Well was brought up to grade & protected	Survey for elevation & state plane coordinates	Surveyed info must be forward to Ecology & EPA then considered complete.
W-98-21B	Well was buried	Well was brought up to grade & protected	Survey for elevation & state plane coordinates	Surveyed info must be forward to Ecology & EPA then considered complete.
W-85-6A	Well needed protection	Well was brought up to grade & protected	Survey for elevation & state plane coordinates	Surveyed info must be forward to Ecology & EPA then considered complete.
W-85-6B	Well needed protection	Well was brought up to grade & protected	Survey for elevation & state plane coordinates	Surveyed info must be forward to Ecology & EPA then considered complete.
² B-87-8	Well needed protection	Well was brought up to grade & protected	Survey for elevation & state plane coordinates	Surveyed info must be forward to Ecology & EPA then considered complete.
² B-85-4	Well needed protection	Well was brought up to grade & protected	Survey for elevation & state plane coordinates	Surveyed info must be forward to Ecology & EPA then considered complete.
B-85-3	Well needed protection	Well was brought up to grade & protected	Survey for elevation & state plane coordinates	Surveyed info must be forward to Ecology & EPA then considered complete.
RA-MW-16B	Well needs protection	Traffic will be redirected around the well.	No additional action is needed.	Additional work may be needed when construction begins at the former location of FHC.
² W-97-18B	Well needs protection	Well was brought up to grade & protected	Survey for elevation & state plane coordinates	Surveyed info must be forward to Ecology & EPA then considered complete.
W-97-18A	Well needs to be abandoned per state regulations and re-installed.	None	Abandoned per state regulations and re-installed. Survey for elevation & state plane coordinates	Replacement well location will be across the Street (East 1 st Ave.) south of the sidewalk.
^{1,2} W-85-4B	Well needs protection.	Well was brought up to grade & protected	Survey for elevation & state plane coordinates	Surveyed info must be forward to Ecology & EPA then considered complete.

1- W-85-4A&B were installed by Ecology for the RI/FS. W-85-4A was previous abandoned. W-85-4B will be used for water elevations.

2- These monitoring wells, when sampled will need a traffic control permit from the City of Vancouver.

A discussion took place amongst the group regarding well development and an agreement was made that the new replacement well (RW-97-18A) will undergo the usual well development process with a goal of 5- NTU for a properly installed monitoring well. Also, the above monitoring wells will undergo the normal ground water sampling procedure and if turbidity is above the usual NTU readings greater then 10 NTU then those monitoring wells must be re-developed.

In summary once the above actions have been completed, Ecology and EPA can use the above monitoring wells for long-term ground water monitoring of the Superfund site Frontier Hard Chrome.

The following groups were present during this inspection:

EPA-Region 10

Bernie Zavala

Ecology

Guy Barrett

Killian Pacific & Contractors

Lance Killian

Ed Hagedorn, Nutter Corp.

Ron Hanson, Hanson Drilling

City of Vancouver

Ryan Miles

If you have any questions on the above please feel free to contact me at 206-553-1562.

REFERENCES

Battelle-Pacific Northwest Division, 2004. In Situ Redox Manipulation Permeable Reactive Barrier Emplacement: Final Report, Frontier Hard Chrome Superfund Site, Vancouver, Washington, January.

GSI Environmental, Inc. 2007. Groundwater Monitoring Network Optimization Frontier Hard Chrome Superfund Site. December 2007.

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