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Superfund Record of Decision:

Frontier Hard Chrome, WA

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First Remedial Action - Final

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16. Abstract (Limit: 200 words)

The Frontier Hard Chrome (FHC) site, covering approximately one-half acre, is located in the City of Vancouver, Washington. The areal ground water is used as the drinking water supply for the City of Vancouver, which has two well fields within one mile of the site. Since 1955, the site has primarily been occupied by two companies engaged in the chrome plating business. Pioneer Plating operated at the site from 1958 to 1970. The site was then occupied by FHC until 1983. Presently, the facility is being used as a storage and staging area for a neighboring business. 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 the chromium in the wastewater from FHC was upsetting the operation of its new secondary treatment system. FHC was directed by the City and the Washington Department of Ecology (Ecology) to cease discharge to the sewer system until a treatment system was installed to remove the chromium waste. At that time, FHC began discharge of their untreated plating wastes to a dry well behind the facility. In 1976, Ecology permitted FHC to discharge to the dry well. Additionally, the permit contained a schedule for completion of a waste treatment system. Between 1976 and 1981, several extensions of the permit and schedule were granted, as the deadlines passed without compliance. In 1982, Ecology found FHC in
(See Attached Sheet)

17. Document Analysis a. Descriptors
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Frontier Hard Chrome, WA
First Remedial Action - Final
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16. ABSTRACT (continued)

violation of the Washington State Dangerous Waste Act for the illegal disposal of hazardous wastes, and in 1983 ordered FHC to stop discharging to the dry well. As a result, FHC also was required to prepare a plan for the investigation of the ground water. FHC closed down all operations at the site. The company did not undertake the investigation. In December 1987, EPA published a ROD for the site's first operable unit, which addressed the soil contamination. This second and final operable unit addresses chromium contaminated ground water.

The selected remedial action for this site includes: ground water pump and treatment using selective media ion exchange to remove chromium, followed by carbon adsorption to remove VOCs with discharge into the river or the city sanitary sewer; ground water monitoring; and implementation of institutional controls to restrict ground water usage and to control new well drilling. The estimated present worth cost for this remedy is $3,800,000.

RECORD OF DECISION
DECLARATION

SITE NAME AND LOCATION

Frontier Hard Chrome Site
Vancouver, Washington

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for the Frontier Hard Chrome site in Vancouver, Washington, developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Contingency Plan. This decision is based on the administrative record for this site. The attached index identifies the items which comprise the administrative record upon which the selection of the remedial action is based.

The state of Washington has concurred verbally on the selected remedy.

DESCRIPTION OF THE REMEDY

This decision document, addressing contaminated groundwater, represents the second of two operable units for the site. The selected remedy for this operable unit is to pump and treat groundwater from the area of greatest contamination and to prevent anyone from using contaminated groundwater until concentrations are reduced to drinking water standards. The first operable unit at this site covered stabilization of contaminated soils.

The major components of the selected remedy include the following:

- A series of extraction wells to pump groundwater from the area of greatest contamination (defined as levels of chromium greater than 50 ppm).

- A treatment system for removal of chromium and organic solvents from the extracted groundwater to a level that would protect aquatic life in the Columbia River or be accepted for discharge to the city sanitary sewer.

- Discharging the treated water into the Columbia River or into the city of Vancouver sewer system. The Remedial Design will determine which method is cost effective.

- Developing regulatory controls to restrict the use of the groundwater and to control the drilling of new wells in the plume of chromium contamination.

DECLARATION

The selected remedy is protective of human health and the environment, attains federal and state requirements that are applicable or relevant and appropriate to this remedial action, and is cost effective. This remedy satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable.

Because this remedy will result in hazardous substances remaining on site above health-based levels, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

July 05, 1990
Date

Robie G. Russell
Regional Administrator
U.S. Environmental Protection Agency
Region 10

Index

The administrative record upon which this Record of Decision (ROD) is based contains the following items in addition to the index to the administrative record for the first ROD for the site signed December 30, 1987.

Title or Description	Date	#Pgs	Author	Addressee
Ecology Recommendation for Record of Decision (Part 2) for Frontier Hard Chrome	April 5, 1988	15	Mike Gallagher-Ecology	Bob Kievit-EPA Kevin Rochlin-EPA
ROD Number Two for Frontier Hard Chrome-delegation briefing	Feb. 12, 1988	2	Charles Findley-EPA	Henry Longest-EPA Headquarters
Record of Decision for Frontier Hard Chrome-Soils/Source Control	Dec. 30, 1987	34	Robie Russell-EPA	
Synopsis of briefing for local officials	Nov. 4, 1987	5	Lynn Bernstein-Ecology	
City of Vancouver comments on RI/FS	Nov. 5, 1987	2	John Ostrowski-Vancouver	David Rountry-Ecology
Transcript of Public Hearing	Nov. 4, 1987	94	Teresa Rider-Foster Rider & Associates	
Frontier Hard Chrome Fact Sheet	May, 1988	6	Ecology	
Site Visit Frontier Hard Chrome	Feb. 23, 1988	5	Gregory Thomas-ATSDR	
Frontier Hard Chrome Institutional Controls	April 20, 1988	2	David Rountry-Ecology	Carol Fleskes-Ecology
FHC Institutional Controls	Feb. 9, 1988	3	David Rountry-Ecology	John Ostrowski-Vancouver
FHC Institutional Controls	Feb. 9, 1988	3	David Rountry-Ecology	Tom Barton-Southwest WA Health District

FHC Institutional Controls	March 28, 1988	2	John Ostrowski-Vancouver	David Rountry-Ecology
Institutional Controls	Feb. 16, 1988	2	David Rountry-Ecology	Dick Waller-Ecology
Ground Water Standards and Requirements	Feb. 12, 1988	3	Carol Fleskes-Ecology	John Littler-Ecology
Change in Agency Lead at the Frontier Hard Chrome NPL Site	March 16, 1988	1	Otto Neth/ Walter Neth	Carol Fleskes-Ecology
Sixteenth Remedy Delegation Report, Part 1	March 3, 1988	5	J. Winston Porter-EPA	Reg. Administrators Regions 1-X
Proposal Plan comment letter	June 10, 1988	1	James Pomajevich	Mike Gallagher-Ecology
Proposal Plan comment letter	June 6, 1988	1	Eric Trued	Mike Gallagher-Ecology
Proposal Plan comment letter	May 24, 1988	2	Walter Neth	Mike Gallagher-Ecology

RECORD OF DECISION
SUMMARY

SITE LOCATION AND DESCRIPTION

The Frontier Hard Chrome (FHC) site is located in the southwestern part of the state of Washington, in the city of Vancouver, Washington. FHC is in an industrial area of the city directly across the Columbia River from the city of Portland, Oregon (see Figure 1). The area is generally flat, extending south, east, and west. About one quarter mile to the north, a ridge rises steeply to where a large residential area starts.

The site is approximately one-half mile north of the Columbia River and covers about one-half acre. The area is within a floodplain that has been extensively filled. There is a topographical depression about one and one-half acres in size adjacent to the east end of the FHC site. The depression is generally five to twenty feet below the level of the FHC site and represents a remnant of the old floodplain that has not been filled in. The groundwater table is within twenty feet of the ground surface and is affected by the stage height of the river. The groundwater is used as the drinking water supply for the city of Vancouver, which has two well fields within one mile of the site (see Figure 2, 3).

SITE HISTORY AND ENFORCEMENT ACTIVITIES

In approximately 1955, the site was filled with hydraulic dredge material and construction rubble. Since then the site has been primarily occupied by two businesses, both engaged in the chrome plating business. Pioneer Plating operated at the site from 1958 to 1970. The site was then occupied by FHC until 1983. The property has been leased to various other businesses since 1983. Presently the facility is being used as a storage and staging area for a neighboring business.

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 the chromium in the wastewater from FHC was upsetting the operation of its new secondary treatment system. FHC was directed by the city and the Washington Department of Ecology (Ecology) to cease discharge to the sewer system until a treatment system was installed to remove chromium from their waste. At that time, FHC began discharge of their untreated plating wastes to a dry well behind the facility.

In 1986, Ecology gave FHC a wastewater disposal permit for discharge to the dry well in 1976 by Ecology. The permit also contained a schedule for the installation of a treatment system for their wastes. Between 1976 and 1981, several extensions of the permit and schedule were granted, as the deadlines were passed without compliance.

In 1982, Ecology found FHC in violation of the Washington State Dangerous Waste Act for the illegal disposal of hazardous wastes. Ecology also discovered that an industrial supply well about one quarter mile southwest of FHC was contaminated with chromium at more than twice the 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 FHC site was proposed for inclusion on the National Priorities List under CERCLA or Superfund. The listing was finalized in September 1983.

In 1983, Ecology 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. FHC closed down all operations at the site. The company has not undertaken the investigation.

In March 1983, EPA and Ecology signed a Cooperative Agreement which gave Ecology the lead in investigating the FHC site under Superfund. Ecology began that investigation in the fall of 1984. The Remedial Investigation (RI) led to a Feasibility Study to determine the cost-effective remedial action for the FHC site. The Feasibility Study (FS) was completed in October 1987.

In December 1987, EPA published a ROD for the first operable unit at the site, which addressed the soil contamination. Design work for this operable unit began in April 1988, with the collection of soil samples from several locations on site to be used for bench scale testing.

In March 1988, the lead agency for the site was changed from Ecology to EPA in accordance with the revised operating agreement between the two agencies.

The regulatory and enforcement actions at the FHC site have centered around the owners of the site which was purchased and developed into a chrome plating business in the mid-1950s. Under Superfund, they are responsible parties and are liable for the cleanup of the site. Past negotiations between the responsible parties, EPA, and Ecology have not been productive. Since 1976, FHC has not complied fully with any agency orders. The site owners have not indicated any willingness or financial capability to undertake needed remedial actions at the site.

COMMUNITY RELATIONS

There have been two public meetings for the purposes of informing the local population about the activities at the site and providing opportunities to comment. The initial meeting was held in October 1984 at the commencement of the RI. The second meeting was held on November 4, 1987, to discuss the RI, the FS, and the proposed alternatives.

This site has resulted in the contamination of the drinking water aquifer utilized in this community. The present drinking water supply is not now affected. However, the potential industrial and commercial development of the area will be. The public interest at this site has been limited.

Attendance at the meetings has been sparse. The meetings were attended by the responsible parties and by people directly associated with the operation of FHC. Adjacent property owners were also in attendance at the meetings. A transcript of the November public meeting was made, and a responsiveness summary was prepared. People who commented at the November 1987 meeting indicated that there is no need to take any action at all at the FHC site, with the exception of constructing an impermeable cap over the dry well area.

Media interest in the site has been limited. The local media was in attendance at the November 1987 meeting. Much of the media interest centered around the cost of the work which has been conducted to date and the future cost.

An additional public notice and comment period took place in May and June 1988, to present information and receive comment on the modified alternative dealing with groundwater contamination (the subject of this ROD). An

opportunity for a public hearing has given; however, no one from the public requested one. Three comments were received on the proposed plan for groundwater cleanup. One comment indicated support for the proposed plan, and one indicated no objection to the plan. The third comment was from the site owner, who indicated that the only remedial action needed is to construct a building over the highly contaminated area and to blacktop over the remainder of the site. Further information on these comments can be found in the Responsiveness Summary.

Several meetings were held with local officials throughout the project for the purposes of keeping them up to date on site activities and to receive feedback from them. The city of Vancouver has indicated its support of the action to be taken at the site.

GROUNDWATER CONTROL OPERABLE UNIT

EPA and Ecology have divided the work at the site into two different phases called operable units. The second operable unit is the subject of this ROD, which addresses contaminated groundwater. The first operable unit was the subject of a ROD signed by EPA on December 30, 1987, which addressed contaminated soils. That ROD calls for removing soils to a depth of 15 to 20 feet, mainly around the dry well on site, and chemically treating it to bind chromium and other heavy metals to the soil. The treated soil will be replaced, and the whole area will be covered with a relatively impermeable cap to minimize the amount of precipitation entering the soil. Soil stabilization is intended to prevent human contact with the contaminants, to prevent the contaminants from leaking into the groundwater, from being carried to off-site soils or to surface waters through rainfall or snowmelt events, and to prevent the creation of air contamination from windblown dust. Additional details can be found in the December 30, 1987, ROD.

The second operable unit will remove most of the chromium already in the groundwater. The remaining chromium will be flushed slowly from the groundwater through natural processes. The groundwater will be monitored, and the use of groundwater will be controlled until the chromium levels meet drinking water standards.

Together the work in both operable units will provide a wide range of environmental protection by first eliminating the source of contamination, which is in the soils, and then cleaning up contaminated groundwater.

SITE CHARACTERISTICS

This section will describe the results for the groundwater portion of the RI conducted on the site. Soil contamination was addressed in a previous ROD dated December 30, 1987.

The RI determined that there are three zones to the groundwater in the area (see Figure 4). The upper, called the Level A zone, is a sand and gravel layer beginning about 20 feet below the ground surface. It is about 10 to 15 feet thick and sits upon a confining layer of clay. The clay layer is generally less than five feet in thickness and is not continuous throughout the area. Movement of groundwater in the Level A zone is approximately 0.5 feet per day to the south-southwest toward the Columbia River.

The next groundwater layer, called the Level B zone, is also made up of sands and gravel but was found to be more permeable than the Level A zone.

The Level B zone extends from about 35 feet below the ground surface down to about 80 to 100 feet below the ground surface. The groundwater velocity in this layer is about 2.25 feet per day to the south-southwest toward the Columbia River. Hydraulic connection exists between the Level A and B zones, but there are no distinct vertical gradients.

The lowest groundwater layer is called the Troutdale Formation which begins about 100 feet below the ground surface in this area. The Troutdale is interconnected with the Level B zone.

Aquifer pump tests performed in the Level A and B zones during the RI indicate that the groundwater in the area can produce large quantities of water with little drawdown.

The investigation found a plume of chromium-contaminated groundwater extending from the site to the Columbia River about 1/2 mile to the south. The contaminated plume is currently about 3000 feet long and 1500 feet wide. The source of the plume is the highly contaminated soil around the on-site dry well. The dry well, which extends into the clay layer situated on the top of the Level A groundwater zone, was used to dispose of untreated process wastewaters until FHC closed in 1983.

The Level A zone was found to contain concentrations of chromium up to 300 parts per million (ppm), which is 6000 times the drinking water standard of 0.05 ppm (see Figure 5 for chromium concentrations in the Level A zone). The highest concentration of chromium found in the Level B zone was 1 ppm (see Figure 6 for chromium concentration in the Level B zone). Low and inconsistent levels of lead and nickel were found in the Level A zone in the area of the dry well. Most groundwater analyses did not detect any nickel or lead and only two out of about 100 samples contained levels of lead above the drinking water standard. These two metals are not believed to be a factor at the site. Based upon the data available, the Troutdale Formation is not believed to be impacted by the contamination. Since the Troutdale Formation is interconnected with the Level B zone, the potential exists for the upper portion of the Troutdale Formation to be affected in the future.

Although the chromium contamination in the groundwater has spread to the Columbia River 1/2 mile away, most of it is located in a highly concentrated plume in the vicinity of the dry well. About 65 to 70% of the total chromium in the groundwater is located in an oval-shaped plume within the Level A zone that is about 300 feet long and 150 feet wide and contains total chromium levels from 50 to 300 ppm. The chromium outside this hot spot diffuses rapidly, although the levels 1/2 mile away are still above drinking water standards.

The city of Vancouver has two municipal supply well fields drawing water from groundwater zones interconnected with the contaminated zones. One well field is about one mile to the east and contains six supply wells drawing water from about 85 feet below the ground surface. The other well field is about one mile to the north and contains five supply wells drawing water from about 200 feet below the ground surface. There is also an irrigation supply well about 1000 feet to the east, which draws water from about 105 feet below ground surface. However, the investigation found that these wells were not affected by the contamination from the FHC site. The RI also confirmed that the wells were not in the direction of groundwater flow from the FHC site and likely would not likely be contaminated in the future. The only wells affected have been two industrial water supply wells used by FMC Corporation about 1/4 mile southwest of the site. The wells, which draw water from 30 to

95 feet, were found to contain 0.12 ppm chromium, which is about two times the drinking water standard. The wells have not been used since 1983, when the facility shut down.

The RI indicated that even with soil stabilization, groundwater will remain contaminated for over 300 years if no groundwater remedial action is taken. Groundwater in the area is a very important resource. Groundwater currently provides nearly all domestic water supplies and most industrial and municipal supplies, as the aquifers in the area can produce large quantities of water with little drawdown. Future growth in the area will result in an increased need for groundwater.

The RI has also found that both the Level A and B zones at the site are contaminated with organic solvents including tetrachloroethylene, trichloroethylene and 1,1,1 trichloroethane. The solvents were found in groundwater at concentrations generally less than 0.06 ppm, but also as high as the following:

Contaminant	Level A zone	Level B zone	Drinking Water Standards
Tetrachloroethylene	6.32 ppm	0.07 ppm	---
Trichloroethylene	0.09 ppm	0.02 ppm	0.005 ppm
1,1,1 Trichloroethane	0.41 ppm	0.06 ppm	0.2 ppm

The RI did not determine the source or extent of this contamination, but the highest levels were found in a monitoring well to the north of the dry well (upgradient) and in the Level A zone.

The Columbia River itself was not sampled, but the groundwater discharge to the river was modeled. The model showed that no measurable increase of chromium would be detected in the river from the impact of the contaminated groundwater.

SUMMARY OF SITE RISKS

An endangerment assessment was conducted as part of the FS to evaluate the risk to public health posed by the site and to assist in determining the proper level of remedial response. The endangerment assessment examines the particular hazardous substances at the site, the amounts of the substances which are found, the routes of exposure or how people would encounter those substances, and the levels of those substances which are known to cause harm. The determination of this level of risk provides an additional basis for the selection of remedial action.

Chromium is the hazardous substance of primary concern at the FHC site. It was found in concentrations up to 300 ppm, which is 6000 times the drinking water standard. Chromium is present in two forms, trivalent chromium and hexavalent chromium. Of the two, hexavalent is the more hazardous. Most of the chromium found in the groundwater on site is in the hexavalent form. Also, organic solvents, primarily tetra and trichloroethylene and 1,1,1 trichloroethane, were found in the groundwater at levels above health standards. Tetrachloroethylene is classified as a probable human carcinogen and trichloroethylene is classified as a potential human carcinogen. The chances of contracting cancer from drinking water contaminated with the highest level of tetrachloroethylene found on site is estimated at one in 100 over a lifetime of exposure. If no groundwater cleanup action is taken, concentrations of chromium are expected to stay above the drinking water standard for about 300 years.

Water supplies currently used in the area include two city of Vancouver municipal supply wells about one mile to the north and one mile to the east of the site and an irrigation well about 1000 feet to the east. These wells were sampled

and found not to be affected by the site. Groundwater modeling done in the FS indicates very little chance of the contamination spreading to these existing wells, as they are not in line with the direction the contaminated plume is spreading. However, any future well developed within or near the existing plume contaminated groundwater would be severely impacted.

Observed groundwater monitoring results for chromium show levels that present a substantial and imminent endangerment to the public if drinking water resources were developed in the area of the existing and predicted plume to the south of the site. There is also concern over using groundwater from the highly contaminated plume for irrigation or industrial purposes because of health effects from direct human contact, accidental ingestion of contaminated soils, or indirect contact through breathing contaminated water vapor.

Future water needs in the area are dependent on growth of the Vancouver area. Although it is impossible to forecast growth over a 300 year period, it is very probable that Vancouver and its environs will grow over this period. Future growth in the Vancouver area will result in increased water demand for industrial, commercial, agricultural, and domestic purposes. Groundwater currently provides nearly all domestic water supplies, most industrial and municipal supplies, and more than half the irrigation supplies in Clark County. Groundwater supplies near the Columbia River are particularly important, as large volumes of water are available at relatively shallow depths. The groundwater aquifer in the area of the site is very productive as evidenced by pump tests conducted during the RI and by the two municipal well fields within one mile of the site. To leave a large area of this aquifer contaminated with levels of chromium above health standards for 300 years represents an unacceptable future risk to public health.

As the contaminated plume of groundwater ultimately flows to the Columbia River, the possible impact on aquatic life in the river was investigated in the FS. The concentrations of chromium in the groundwater immediately adjacent to the Columbia River were predicted using a groundwater flow simulation model. With no groundwater cleanup, the level of chromium at receptors along the river was predicted to rarely exceed the chronic aquatic toxicity standards for hexavalent chromium at 0.011 ppm. This is due to dilution of the contaminated plume which occurs as groundwater migrates to and enters the river.

DESCRIPTION OF ALTERNATIVES

The alternatives evaluated for this ROD specifically address the hazards associated with contaminated groundwater at the site. A ROD evaluating alternatives addressing soils and building contamination was issued on December 30, 1987.

The basic remedial alternatives developed and evaluated in the FS are:

1. No action - groundwater contamination will be monitored only.

2. Extraction and treatment of all contaminated groundwater until the aquifer meets drinking water standards. This alternative would involve construction of a series of groundwater extraction wells (approximately 21 wells) and construction of a treatment plant to remove the contaminants from the extracted groundwater. The system would extract and treat about 18 million gallons a day for about 15 years. A pipeline and pumping system would be constructed to transport and dispose of treated water into the Columbia River. The extracted groundwater would be treated to a level that is protective of aquatic life in the Columbia River (.011 mg/l hexavalent chromium).

3. Extraction and treatment of contaminated groundwater in the Level A zone only until the upper portion of the aquifer meets drinking water standards. This alternative was developed because the Level A zone is much more contaminated than the Level B zone, the volume of water to be treated is much less than in the Level B zone, and the water in the Level A zone is closer to the ground surface than is the Level B and thus more accessible to the public. This alternative involves construction of a series of groundwater extraction wells (approximately 15 wells) and construction of a treatment plant to remove the contaminants from the extracted groundwater. This system would extract and treat about 1.1 million gallons a day for about 15 years. A pipeline and pumping system would be constructed to transport and dispose of treated water to the Columbia River. The extracted groundwater will be treated to a level protective of aquatic life in the river (.011 mg/l hexavalent chromium).

EPA and Ecology developed an additional alternative subsequent to the completion of the FS. This alternative was evaluated along with the previous three mentioned. This alternative includes the following:

4. Extraction and treatment of the highly contaminated plume of groundwater (or hot spot) around the dry well. Levels of total chromium in this hot spot contain from 50 to 300 ppm or more of chromium and represent approximately 65 to 70 percent of the total chromium contamination in the aquifer. This area is about 300 feet long and 150 feet wide and extends out from the dry well in a southerly direction. Treatment of this hot spot will continue until chromium concentrations are reduced to 10 ppm. This is the concentration at which groundwater chromium concentrations are expected to equilibrate after pumping groundwater from extraction wells within the zone of high contamination levels.

   This alternative involves construction of a system of wells to extract contaminated groundwater from within the hot spot (about 7 wells) and a treatment plant to remove contamination from the extracted groundwater. The system would extract and treat approximately 300,000 gallons a day for a period of 2 to 5 years. The treated groundwater would then be discharged either to the City of Vancouver sanitary sewer where it would be processed through a secondary sewage treatment plant and then discharged to the Columbia River or directly to the Columbia River through a pipeline and pumping system. The extracted water will be treated to a level that is protective of aquatic life in the Columbia River or to a level that meets the City of Vancouver's pretreatment requirements depending on the location of discharge. If it is pumped directly to the river, a half-mile pipeline, and pumping system would be constructed from the site to the River. Very little pipeline construction would be needed if the treated water were discharged to the Vancouver sewage system as the site is already served by the sewer system.

   The alternative also consists of implementing institutional controls that will prevent anyone from drilling wells into or near the area of the contaminated plume of groundwater without the approval of EPA or Ecology until chromium levels reach drinking water standards. This groundwater control area is shown on Figure 1.

Various wastewater treatment technologies were considered and evaluated against agency criteria. The treatment technologies considered for the removal of chromium from groundwater follow:

1. Ion exchange
2. Selective media ion exchange

3. Carbon adsorption
4. Precipitation and sedimentation
5. Reverse osmosis
6. Filtration
7. Distillation

The treatment technologies considered for removal of solvents from groundwater were:

1. Carbon adsorption
2. Air or steam stripping
3. Ozonation
4. Distillation

Selective media ion exchange for chromium removal and carbon adsorption for solvent removal were chosen as being able to best meet agency criteria for the groundwater treatment alternatives considered for this site. A detailed review and evaluation of these treatment technologies are presented in the FS.

Various options for disposal of treated groundwater were also considered and evaluated against agency criteria. These options include:

1. Discharge into the city of Vancouver's sanitary sewer
2. Construction of and discharge to a pumping system and pipeline to the Columbia River
3. Reinject into the aquifer

Reinjection into the aquifer was eliminated because of technical difficulties in injecting the treated water back into the aquifer and because of the potential to unintentionally spread the zone of contamination. The city of Vancouver and Ecology have indicated their opposition to reinjection of the treated water into the aquifer.

Discharge into the city of Vancouver sewer system was eliminated for basic alternatives two and three, because the sewer system could not handle their large flows. Discharge into the Vancouver sewer system is a viable option for alternative four.

SUMMARY OF THE COMPARATIVE ANALYSIS OF ALTERNATIVES

Four basic alternatives were compared and evaluated according to the following criteria:

1. Overall protection of human health and the environment;
2. Cost;
3. Compliance with applicable or relevant and appropriate requirements;
4. Long-term effectiveness and permanence;
5. Short-term effectiveness;
6. Reduction of toxicity, mobility, or volume of hazardous substances;
7. Implementability;
8. State acceptance; and
9. Community acceptance

Table 1 on pages 14 and 15 compares the strengths and weaknesses of each alternative with respect to the nine criteria.

As indicated in Table 1, state and local government officials expressed the opinion that the alternatives which cleaned up the aquifer in the shortest timeframes (alternatives #2 and #3) are not worth the additional expense. For

Fund-financed remedial actions, CERCLA/SARA requires the state to pay ten percent of the costs. Additionally, the law requires EPA to consider public and state comments. Thus, comments received from the public and state and local officials and the state's unwillingness to fund more costly remedies weighed heavily in EPA's decision-making process.

After evaluating the four alternatives according to the above nine criteria, EPA has determined that alternative number four, treatment of the hot spot, represents the best balance among the evaluation criteria.

TABLE I

Summary of Remedial Alternatives

Alternative	No Action	Treat Level A & B	Treat Level A	Treat Hot Spot
Description	No further action monitoring only.	Treats Level A & B groundwater zones to drinking water standards. Essentially removes all chromium in groundwater.	Treats only the Level A groundwater zone to drinking water standards.	Treats only the highly contaminated hot spot around the dry well (chromium levels above 50 ppm).
Cost (present worth)	$238,000	about $93 million	$13 million	$3.8 million
Protection of Public Health and the Environment	Leaves a large area of a productive aquifer contaminated with chromium levels above health standards for about 300 years.	Restores the aquifer to drinking water standards in about 15 years.	Restores the upper zone of the aquifer to drinking water standards in about 15 years and restores the lower zone in about 40 years.	Removes most of the chromium in groundwater by treating the hot spot. Restores lower zone to drinking water standards in 40 years and upper zone in 100 years.
ARARs	No attempt to meet regulations.	Meets ARARs in 15 years.	Meets ARARs in 15 years for Level A zone and 40 years for Level B zone.	Meets ARARs in 40 years for Level B zone and 100 years for Level A zone.

Alternative	No Action	Treat Level A & B	Treat Level A	Treat Hot Spot
Short-term effectiveness	Not effective.	Restores the entire aquifer to drinking water standards in shortest time possible - 15 years.	Restores upper portion of aquifer to drinking water standards in shortest time possible - 15 years. Lower portion of aquifer will not be restored for about 40 years.	Removes most of the chromium in the groundwater: eliminates the highly contaminated hot spot in 2 to 5 years. Lower aquifer will not be restored for 40 years and upper aquifer for 100 years.
Long-term effectiveness and performance	Does nothing. Large section of aquifer not usable for next 300 years. All chromium in groundwater slowly discharges to the river over the next 300 years.	Best alternative - entire aquifer restored in 15 years. Reduces chrome load. Reduces chromium load to Columbia River by almost 100%.	Second best alternative - upper portion of aquifer restored in 15 years. Reduces chromium load to Columbia River by almost 80%.	Upper portion of aquifer meets drinking water standard in 100 years and lower aquifer meet standards in 40 years. Reduces chromium load to the Columbia River by 65-70%.
Reduction of toxicity, mobility, and persistence	Does nothing in this regard.	Removes essentially all contaminants within 15 years. All treatment options may recycle the chromium into a useful product. The removed solvents will be handled according to RCRA requirements.	Removes essentially all contaminants from the Level A zone within 15 years.	Removes about 70% of the contaminants in the Level A zone within 2 to 5 years.

Alternat	No Action	Treat Level A & B	Treat Level A	Treat Hot Spot
Technical feasibility and implement-ability		All actions involve the same technology which is proven and easily implemented.		
State acceptance	The state has recommended that treatment of the hot spot be done.	The state has indicated that these two treatment options are too costly to implement.		The state has recommended this alternative to EPA.
Community acceptance	Comments at the public hearing in November 1987 indicate that no action is needed.	Other than the site owners, former operators, a few neighboring businesses, and officials from the city of Vancouver and Clark County, only two comments were received from the community. The site owners and former operators have indicated no action is needed. The city of Vancouver and Clark County have indicated that cleanup of the hot spot should be done. One comment from the community indicated support of the proposed alternative, and one indicated no objections to the proposed alternative.		

THE SELECTED REMEDY

The selected remedy will use a series of groundwater extraction wells to pump groundwater from the most contaminated area of the Level A zone, the area around the dry well. This area is about 300 feet by 150 feet and contains chromium levels above 50 ppm (see Figure 7). The water will be treated using selective media ion exchange to remove the chromium. As the water passes through a column of resin beads, the chromium chemically beads and is removed from the water. This process yields a stream of treated water and a waste stream of chromium and spent resin. The chromium is then removed from the resin and and may be recycled for use in the chrome plating industry. The process is called selective media ion exchange because chromium is selectively removed from the water. Ion exchange is often used for metal removal and is a proven, highly effective technology. Selective media ion exchange is a more sophisticated form of this technology.

The water will be further treated using carbon adsorption to remove the organic solvents that were found in the groundwater. Carbon adsorption refers to a treatment process that uses carbon particles to absorb contaminants from a liquid. Adsorption is a natural process in which molecules of a gas or liquid are attracted to and are held at the surface of a solid. The organics concentration will be reduced to a level that is protective of aquatic life in the Columbia River or to a level that is specified by the city of Vancouver's sanitary sewer pretreatment program, depending on the discharge location. The details of this treatment process will be further defined when the source and extent of the organic solvent contamination is identified in the Remedial Design phase of the project.

The extracted groundwater will be treated to a level that would protect aquatic life in the Columbia River (0.011 mg/l hexavalent chromium) or to a level acceptable for discharge to the Vancouver sanitary sewer system, depending on which is cost effective. The specific method of treated water disposal will be determined during design. A direct discharge to the Columbia River will necessitate construction of a pipeline and pumping system from the site to the Columbia about 1/2 mile away. Discharge to the Vancouver sanitary sewer system will require a much shorter pipeline, as the site is served by the sanitary sewer system. The treatment system will operate until the concentration of chromium in the extracted groundwater falls below 10 mg/l after the extraction pumps are shut down for a period, allowing the groundwater system to stabilize. This is estimated to take from two to five years. After the treatment is completed, natural flushing action of the aquifer will slowly remove the remaining chromium contamination, and the groundwater will be monitored until chromium concentrations meet drinking water standards. This is estimated to take about 40 years for the Level B groundwater zone and about 100 years for the Level A groundwater zone.

EPA, Ecology, the city of Vancouver, and Clark County will jointly develop institutional controls that will restrict the use of groundwater in and around the contaminated plume of groundwater. The area where groundwater use will be restricted is shown in Figure 1 and is described as the area south of Fifth Street to the Columbia River, bounded by Reserve Avenue to the west and Grove Avenue to the east. These controls will be designed to last until chromium levels reach drinking water standards.

As discussed in the "Summary of Site Risks," the main risk at the site is development of new wells in and around the contaminated plume of groundwater. It is likely that there will be increased need for groundwater from this area sometime in the future. Although the selected remedy will not clean up groundwater as quickly as the more costly alternatives, it will eliminate the

highly contaminated hot spot within a few years, thereby lessening the risk to anyone exposed to the contaminated groundwater despite the institutional controls that will be put into effect. The selected remedy will also substantially reduce the time required to cleanse the aquifer to drinking water standards, thereby lessening the dependency on long-term institutional controls to protect public health.

STATUTORY DETERMINATIONS

The selected remedy will provide adequate protection for human health and the environment through the combination of treatment and institutional controls. The remedy will remove an estimated 65 to 70 percent of the chromium in groundwater by cleaning up the area of highest contamination. Institutional controls will prevent use of the contaminated groundwater until contaminant levels reach drinking water standards. The groundwater extraction and treatment system will not pose any unacceptable short-term risks. Contaminants removed from the groundwater will not be transferred to any other media, such as surface water or the air.

The selected remedy will attain all Applicable or Relevant and Appropriate Requirements (ARARs) of the federal and state environmental and public health laws and regulations. The laws and regulations of concern include the following:

- Safe Drinking Water Act (SDWA) (42 U.S.C. 300); Primary Drinking Water Standards (40 CFR 141).

The selected remedy prevents exposing the public to drinking water which exceeds the Maximum Contaminant Levels. These levels are 0.05 mg/l for hexavalent chromium; 0.005 mg/l for trichloroethylene; and 0.2 mg/l for 1,1,1 trichloroethane.

[This requirement is relevant and appropriate.]

- Clean Water Act (33 U.S.C. 1251); National Pollution Discharge Elimination System (40 CFR 122), NPDES Permit Program (WAC 173-220), State Waste Discharge Permit Program (WAC 173-216).

The selected remedy treats the extracted water before discharge to the Columbia River or to the Vancouver sanitary sewer system and will meet all substantive requirements of the NPDES program. If treated water is discharged to the Columbia, it will meet EPA Water Quality Criteria for the protection of freshwater aquatic life. If it is discharged to the Vancouver sanitary sewer system, the treated water will meet or exceed the city's pretreatment requirements.

[This requirement is applicable.]

- State of Washington Water Well Construction Act (RCRW 18.104); Minimum Standards for Construction and Maintenance of Water Wells (WAC 173-160).

The requirements govern the design of extraction and monitoring wells.

[This requirement is applicable.]

- Resource Conservation and Recovery Act (RCRA) (42 U.S.C. 6901); RCRA regulations (40 CFR 261 to 280); Washington State Dangerous Waste regulations (WAC 173-303).

The spent activated carbon used in the treatment process will be handled in accordance with all substantive requirements of the above.

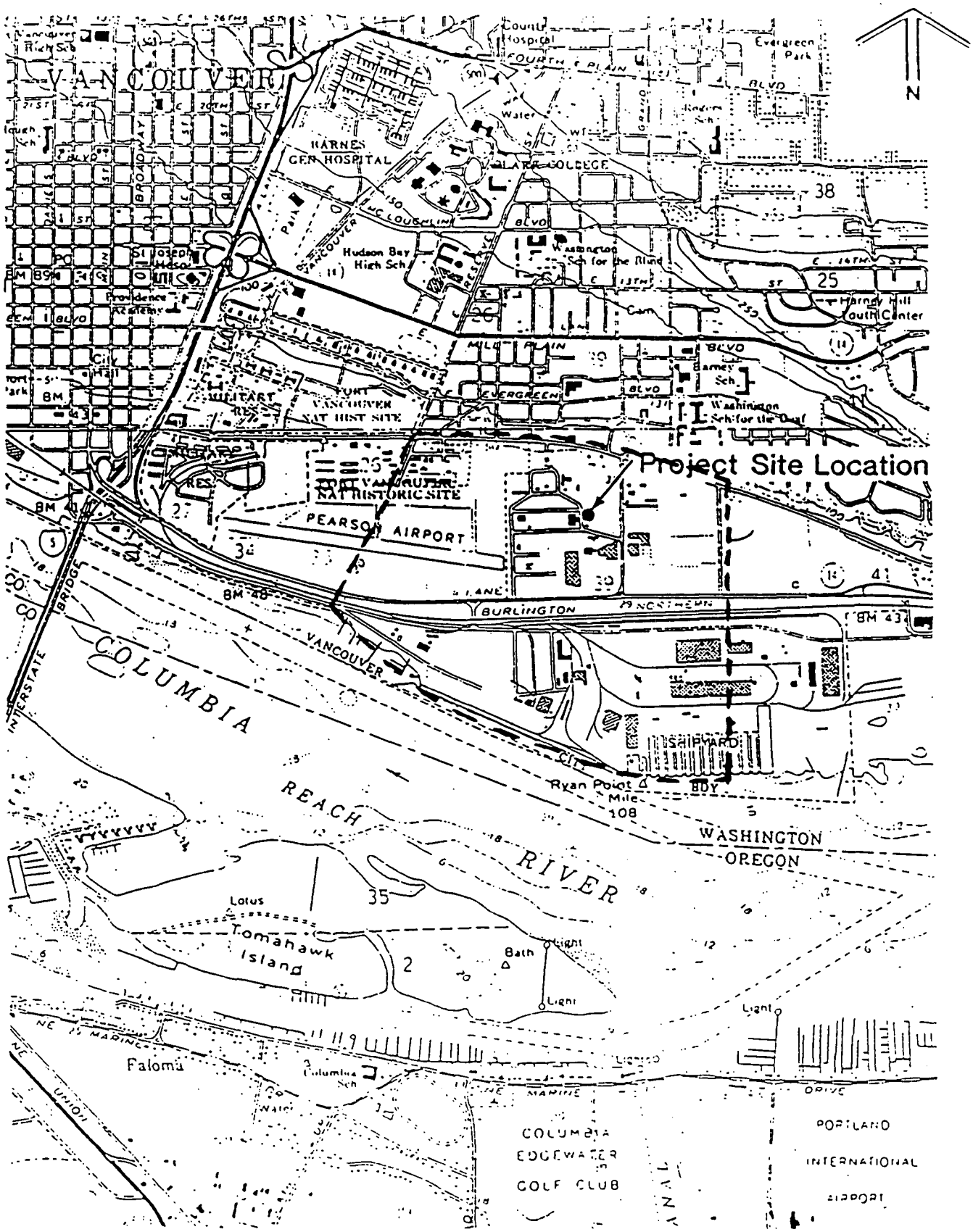
[This requirement is relevant and appropriate.]

The selected remedy affords overall effectiveness in protecting human health and the environment proportional to its cost. The remedy will remove an estimated 65 to 70 percent of the chromium in the groundwater and prevent use of the contaminated groundwater until safe levels are reached through natural flushing. The selected remedy has an estimated present worth cost of $3.8 million, compared to $13 million for the alternative that reduces the chromium concentrations to drinking water standards throughout the Level A zone, and $93 million for the alternative that reduces chromium concentrations to drinking water standards in both the Level A and B zones. The alternatives that reduce chromium concentrations to drinking water standards within either the Level A or Level A and B zones will shorten the estimated time until the groundwater meets drinking water standards; however, in light of public and state and local government comments and the need for the state to provide a ten percent cost share for the remedial action, EPA has determined that these remedies do not represent the best balance among the CERCLA/SARA cleanup criteria. The alternative that consists of no groundwater treatment represents unacceptable future public risks, does not meet CERCLA/SARA requirements, and thus its costs cannot be compared to these other alternatives.

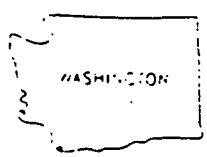
The selected remedy utilizes permanent solutions and alternative treatment or resource recovery technologies to the maximum extent practicable. The remedy removes an estimated 65 to 70 percent of the chromium in the groundwater and recycles it into chromic acid which can then be used in the plating industry. Although some chromium contamination will remain in the groundwater, it is determined that the cost and amount of time needed to extract the remaining chromium are not necessary to adequately protect public health and the environment and meet CERCLA/SARA cleanup criteria. During the two public comment periods, no one expressed a view that more chromium should be removed from the groundwater. However, the city of Vancouver indicated that the chromium hot spot in the groundwater should be cleaned up. The state of Washington and the city of Vancouver indicated that they could not support an alternative that removed all chromium from either the Level A or Level A and B zones because of the high cost.

The selected remedy satisfies the statutory preference for remedies employing treatment that permanently and significantly reduces toxicity, mobility, or volume of hazardous substances.

Because this remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection for human health and the environment. This review will include a look at the contaminated plume of groundwater through a groundwater monitoring network to ascertain whether the plume is moving as predicted. It will also include a review of land use around the site, changes in need for water from the aquifer and the effectiveness of institutional controls used to prohibit use of contaminated groundwaters. If the review shows the need for additional action to protect human health or the environment, the ROD will be revised as necessary.



Approx. Scale: 1" = 2000'

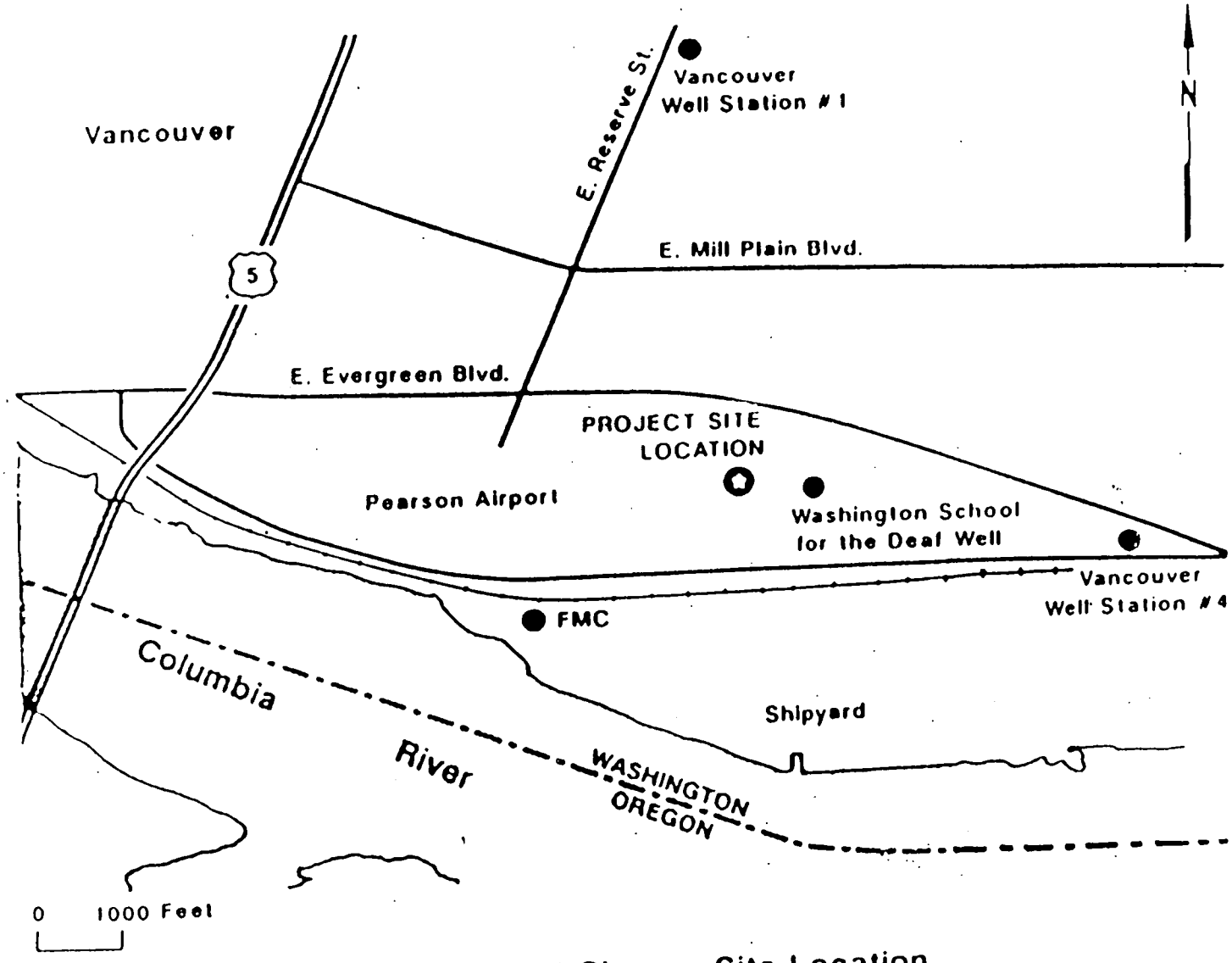


Vicinity Map

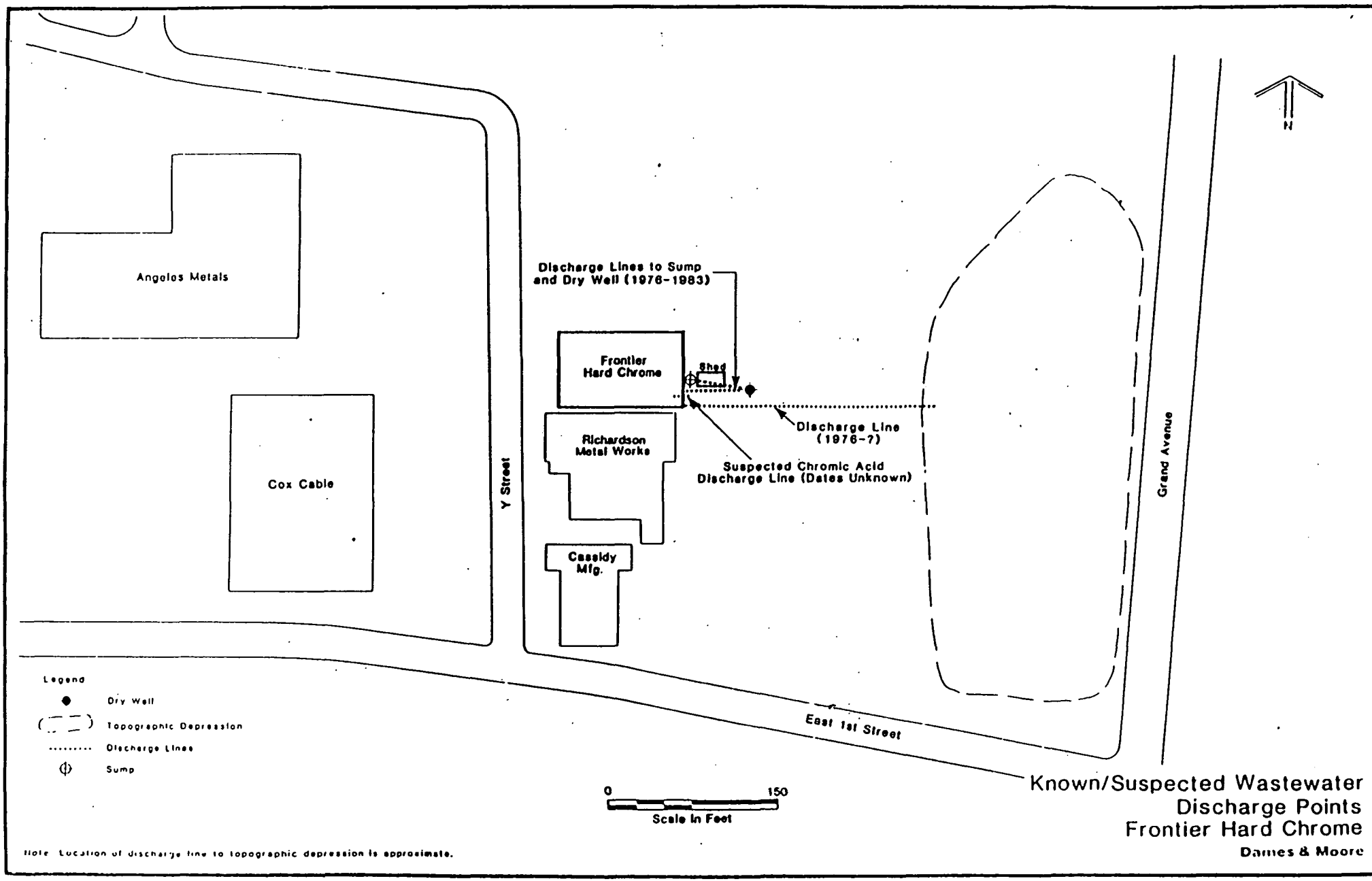
Location Map
Frontier Hard Chrome

Dames & Moore

Figure 1

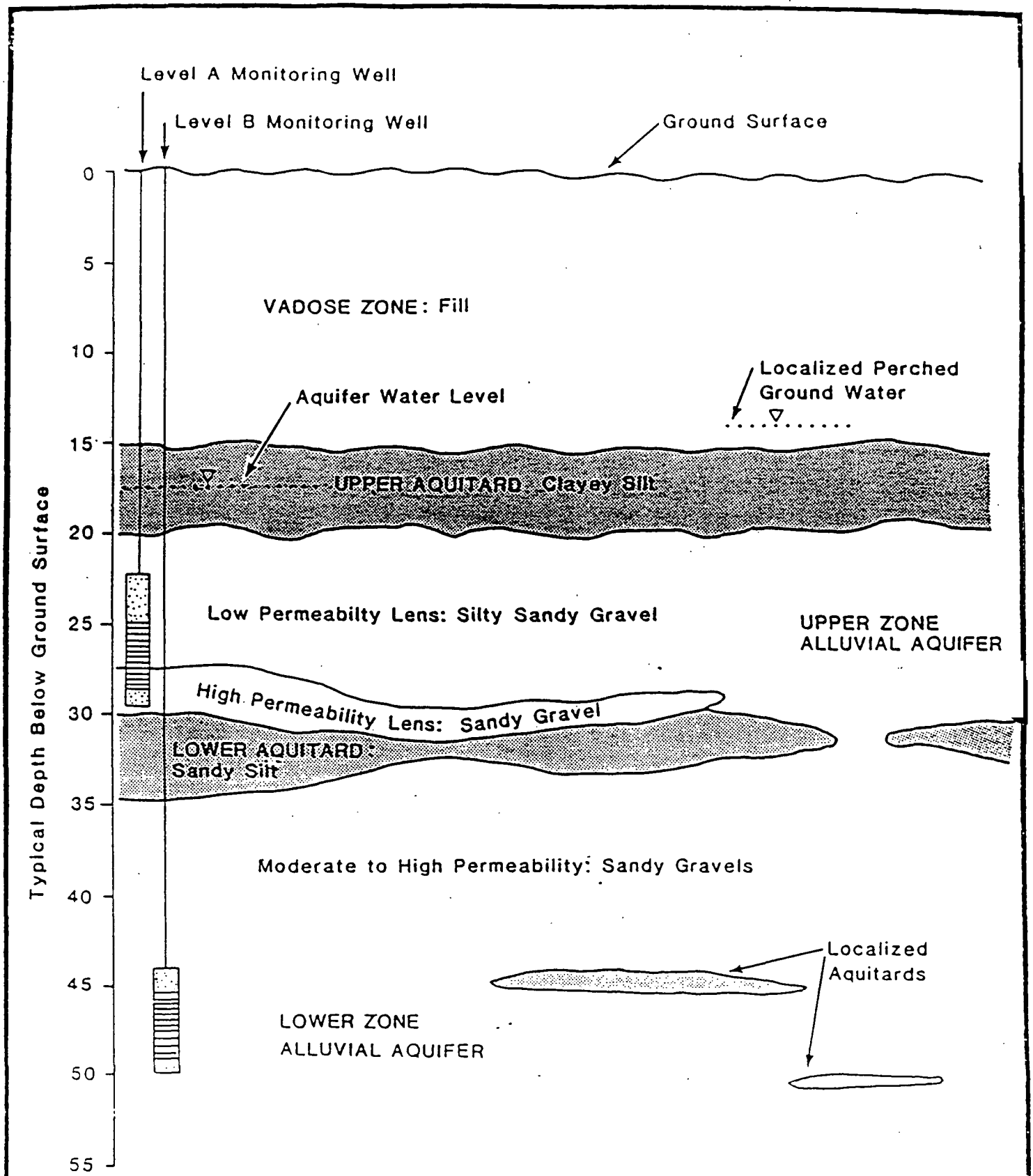


Frontier Hard Chrome Site Location



Job No. 7927-004

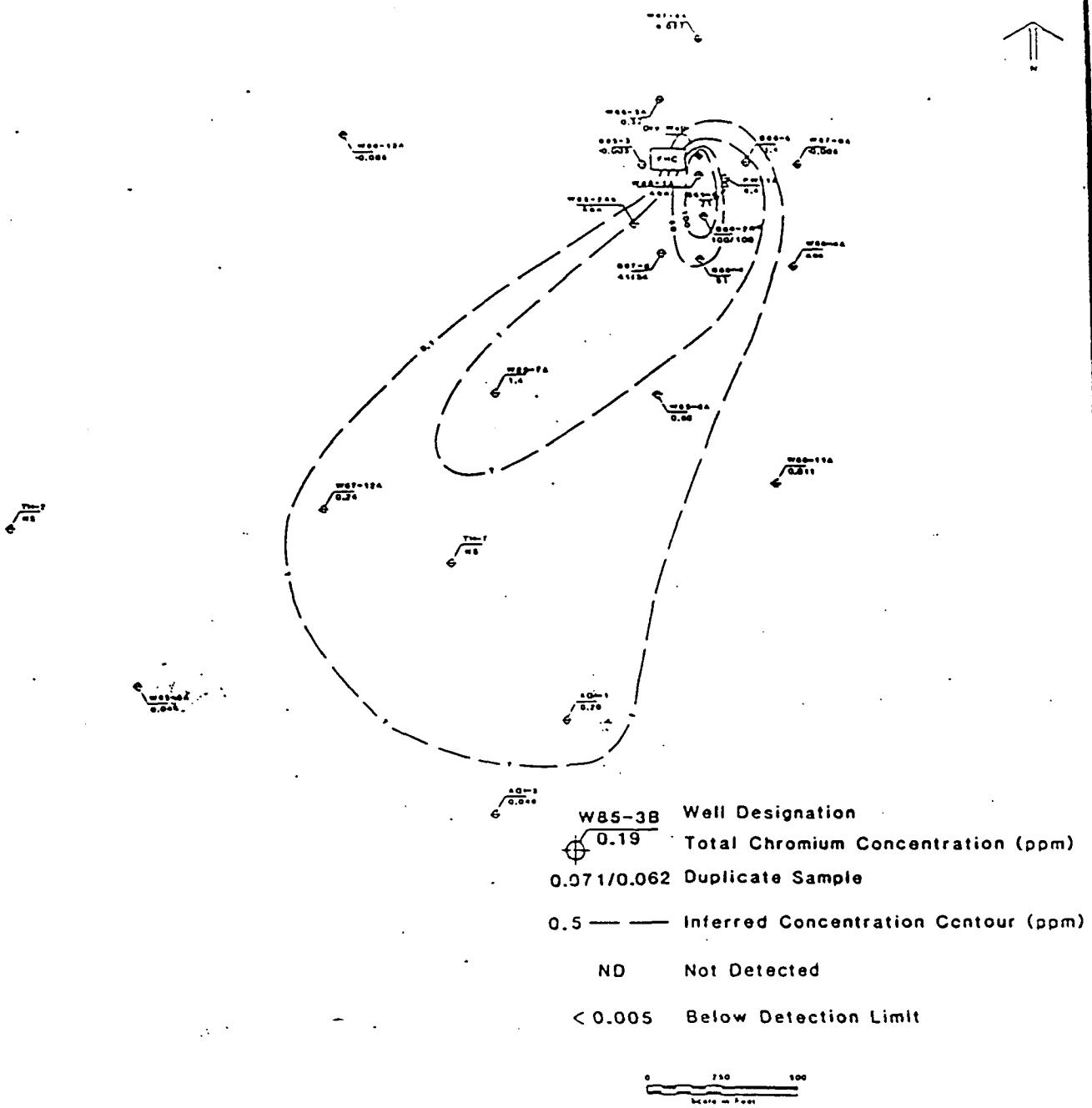
Figure 1-2



Conceptual Diagram of Site Area Hydrostratigraphy Frontier Hard Chrome

Dames & Moore

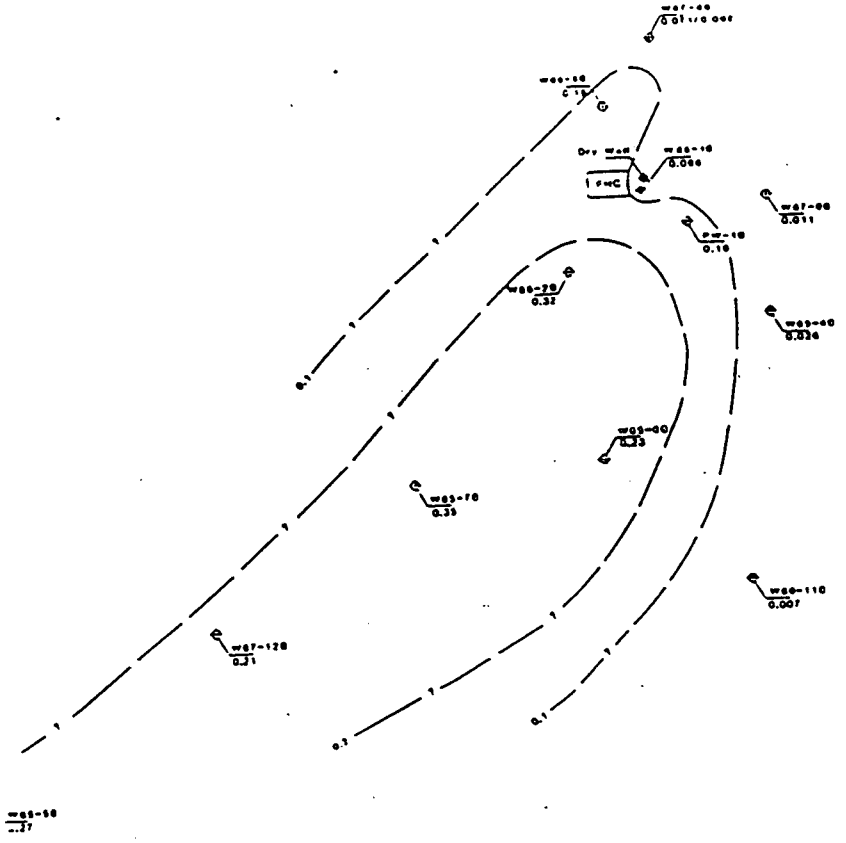
Figure 4



Inorganic Water Analysis
Level A Monitoring Wells Total Chromium
Frontier Hard Chrome

· Dames & Moore

Figure 5



WBS-38 Well Designation

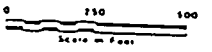
0.19 Total Chromium Concentration (ppm)

0.071/0.062 Duplicate Sample

0.5 Inferred Concentration Contour (ppm)

ND Not Detected

< 0.005 Below Detection Limit



Inorganic Water Analysi
Level B Monitoring Wells Total Chromiur
Frontier Hard Chr

Dames & M

Figure 6

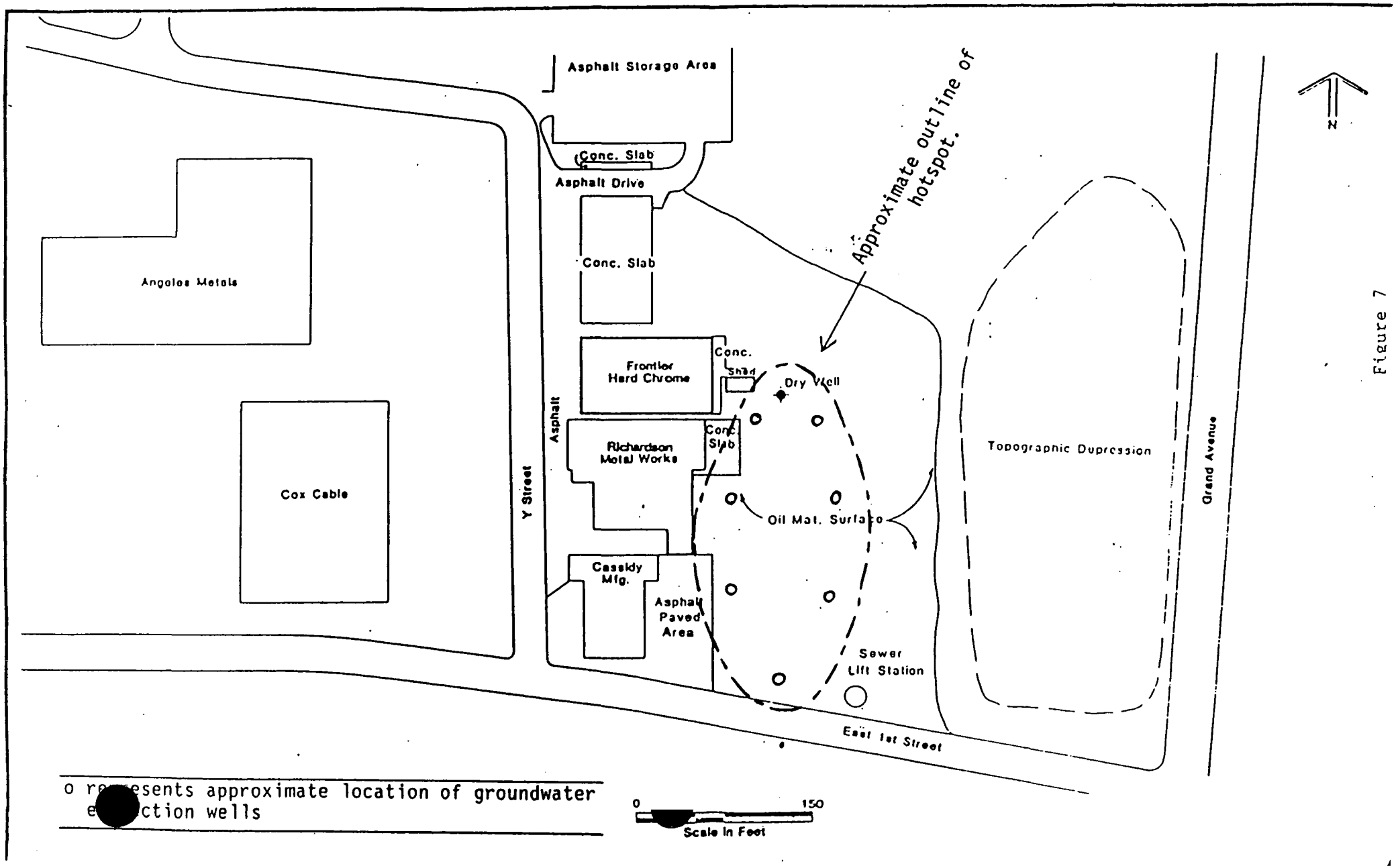

Asphalt Storage Area
Conc. Slab
Asphalt Drive
Conc. Slab
Angeles Metals
Approximate outline of hotspot.
N
Frontier Hard Chrome
Conc. Slab
Dry Well
Richardson Metal Works
Conc. Slab
Asphalt
Y Street
Cox Cable
Topographic Depression
Grand Avenue
Oil Mat. Surface
Cassidy Mfg.
Asphalt Paved Area
Sewer Lift Station
East 1st Street
o represents approximate location of groundwater extraction wells
0
150
Scale in Feet

Figure 7

Frontier Hard Chrome Site

Responsiveness Summary

Overview

This responsiveness summary discusses issues raised by the public regarding contaminated groundwater at the site. The selected remedy is to pump and treat groundwater from the area of greatest chromium contamination and to prevent anyone from using contaminated groundwater until concentrations are reduced to drinking water standards. A Record of Decision (ROD), including a responsiveness summary addressing contaminated soils, was issued on December 30, 1987.

A review of both responsiveness summaries will give a more complete picture of public sentiment concerning the site. The majority of public comments indicate a belief that no groundwater cleanup is necessary. Comments received from local officials indicate that they support a partial groundwater cleanup.

Background on Community Involvement and Concern

The public interest at the site has been limited. There have been two public meetings about the site. One was held in October 1984, at the start of the Remedial Investigation (RI), and one was held in November 1987, at the completion of the Remedial Investigation/Feasibility Study (RI/FS). The meetings were attended mostly by the site owners, former operators of Frontier Hard Chrome (FHC), and adjacent property owners.

The site owners and former operators have expressed the view that no groundwater cleanup is needed, since no one is currently using water from the contaminated plume. The adjacent property owners were concerned about the effects of the contamination on their businesses and about whether the proposed cleanup actions will interfere with their businesses.

Meetings with local officials have taken place periodically. The last two meetings held were in November 1987 and April 1988. Local officials have expressed their displeasure over the length of time the investigations have taken, but have generally expressed support for the proposed plans.

The following public concerns have been raised:

Question: What will be the disposition of the FHC property?

Agency Response: The on-site soil stabilization project will take approximately two years to complete, and the groundwater pump and treat project will take from two to five years to complete. Site activity will be restricted to cleanup activities during this period. After the cleanup is completed, land use will be restricted to those activities that will not disturb the stabilized soils. Some examples of activities that may disturb the stabilized soils are heavy loadings or underground structures. The restrictions will be developed during the design phase of the project. Additionally, monitoring wells on the site will have to be maintained until groundwater meets drinking water standards, which is estimated to take approximately 100 years. The monitoring wells will not cause a significant restriction in the use of the site.

Question: What will be done to ensure that no one is exposed to the contamination left on site when the cleanup is concluded?

Agency Response: The stabilized soil will be covered with a relatively impermeable cap to prohibit human contact with the soils. Future site activities will be limited to those activities that will not disturb the stabilized soils.

Institutional controls will prohibit anyone from constructing a groundwater well in or near the contaminated plume. The main control will be the city of Vancouver plumbing code, which requires any new construction to have the approval of the local health department for the building's water system. The health department will not approve a building for occupancy if it plans to obtain groundwater from the zone in or near the contaminated plume. This zone is described as the area south of Fifth Street to the Columbia River, bounded by Reserve Avenue to the west and Grove Avenue to the east. Additionally, the U.S. Environmental Protection Agency (EPA) will conduct a review every five years after cleanup has been completed to ensure that the remedy continues to provide adequate protection for human health and the environment.

Question: What effects will the contamination have on the Columbia River before, during, and after cleanup?

Agency Response: Modeling done during the RI indicates that there will be no measurable increase of chromium in the Columbia River either before or after the cleanup. If treated wastewater is discharged directly to the Columbia River during the cleanup, this water will meet standards designed to protect freshwater aquatic life.

In summary, the contamination is not expected to have a measurable impact on the Columbia River.

Question: What about adjacent properties? Will they be safe to use?

Agency Response: As long as the owners of adjacent properties do not attempt to extract and use groundwater from their properties, they should be safe to use. There may be temporary impacts on one or two adjacent businesses during the soil stabilization project or during the construction of groundwater extraction wells, but the possibility or extent of those impacts are not yet known and will be investigated during the design phase of the project.

EPA will try to avoid or at least limit any impacts on adjacent properties. There may be a need to place groundwater monitoring wells on adjacent properties, but the impact of a monitoring well should be very limited.

Question: Are there any other health concerns citizens should be aware of?

Agency Response: The main concern at the FHC site is the possible contact with or use of contaminated groundwater. Even with the cleanup of the hot spot centered around the dry well, groundwater will remain contaminated with chromium above drinking water standards for about 100 years in the upper zone and about 40 years in the lower zone. The groundwater will not be safe to use for that period of time.

Summary of Public Comments and Agency Responses

A public notice and comment period took place in May and June of 1988 to present information and to receive comments on the proposed plan for groundwater cleanup. An opportunity for a public meeting was given; however, no one from the public requested one. During this time, three written comments were received on the proposed plan for groundwater cleanup. One comment indicated support for the proposed plan. The second comment, from the owner of property located above the contaminated plume about 1/4 mile from the FHC site, indicated no objection to the proposed plan. The owner of the FHC site indicated that the only action needed is to construct a building over the heavily contaminated area and to blacktop the remainder of the site. He also indicated that the dry well could possibly be backflushed and the contaminated water discharged directly to the Columbia River through a storm sewer.

Agency Response: Construction of a building and placing blacktop over the contaminated area would place a barrier between the public and the contaminated soils. However, the highly contaminated soils around the dry well would continue to release chromium to the groundwater and cause further contamination of the aquifer. This groundwater would remain contaminated and would be unsuitable for drinking, irrigation and other domestic uses for hundreds of years. Groundwater in this area is an extremely important resource.

Groundwater currently provides nearly all domestic water supplies, most industrial and municipal supplies, and more than half the irrigation supplies in Clark County. Groundwater supplies near the Columbia River are particularly important, as large volumes of water are available at relatively shallow depths. Although there are no existing wells being used in the contaminated plume, future growth in the Vancouver area will create the need to develop additional groundwater resources. Although the amount of growth over the next few hundred years is impossible to predict, it is reasonable to assume that Vancouver will grow and additional groundwater resources will be needed.

The selected remedy was chosen to limit the spread of contamination, remove the majority of the contamination while most of it is still concentrated in a hot spot around the dry well, and reduce the time it will take the aquifer to naturally cleanse itself.

The groundwater in the area of the dry well is highly contaminated and contains chromium that is almost 30,000 times the water quality standard for the protection of freshwater aquatic life. This contaminated water could cause significant harm to aquatic life if discharged directly to the Columbia River. According to federal and state law, dilution of contaminated water cannot be used as a substitute for treatment. Even if dilution was allowed to substitute for treatment, it would take 30,000 gallons of clean water to dilute one gallon of contaminated water down to a level that would be protective of aquatic life in the river. Any contaminated groundwater that is extracted must be treated before disposing it.

Additionally, there are no storm sewers available to discharge to in the area. The city of Vancouver had preliminarily planned to construct storm sewers and dispose of the collected water in dry wells in the area. However, the contamination of groundwater in the area has prohibited the construction of dry wells, as the dry wells would create the opportunity to exacerbate the existing contamination problem by spreading the chromium-contaminated plume even further.