

Received 1/3/11



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

Keld Lauridsen, Hydrogeologist
Wisconsin Department of Natural Resources
2984 Shawano Ave.
Green Bay, WI 54313

REPLY TO THE ATTENTION OF: SR-6J

Re: Better Brite

Dear Mr. Lauridsen:

Attached is a memorandum further evaluating Issue 2 from the 2009 Five-Year Review Report for the Better Brite Superfund site. Implementation of Options 2 or 3 (hydraulic containment) would be most consistent with the 1996 Record of Decision (ROD) for Better Brite. Option 1 (no action) would be inconsistent with the ROD, but it is possible that it would be acceptable if the Wisconsin Department of Natural Resources is willing to approve an exemption (WAC NR140.28) from its Preventive Action Level and Enforcement Standard for chromium.

Feel free to call me at (312) 886-4740 to discuss.

Sincerely,

A handwritten signature in cursive script that reads "Richard E. Boice".

Richard Boice
Remedial Project Manager

United States Environmental Protection Agency

DATE: December 15, 2010

SUBJECT: Further evaluation of effectiveness of soil stabilization and potential for off-site migration of chromium contaminated groundwater at the Better Brite, Chrome Shop

FROM: Warren Layne, Ph.D. Chemist, EPA
Bob Kay, Geologist, USGS
Richard Boice, Remedial Project Manager, EPA

WLM
REB

TO: Keld Lauridsen, State Project Manager, WDNR

Summary of Issue 2

To initiate discussions to address the recommendation for Issue 2 from the 2009 *Third Five-Year Review Report*, we have more thoroughly reviewed: the groundwater data; the *Remedial Action Documentation Report*, HSI Geotrans, December 12, 1999; *Focused Feasibility Study Ground-Water Operable Unit*, Hydro-Search, Inc., March 13, 1996 (FS); the soil boring logs; and monitoring well diagrams. In addition, some guidance documents on hexavalent chromium (Cr^{+6}) remediation were reviewed especially *In Situ Treatment of Soil and Groundwater Contaminated with Chromium*, EPA/625/R-00/005, October, 2000.

The effectiveness of the soil stabilization is being questioned because, chromium and Cr^{+6} in groundwater from the only well installed within the stabilized area (MW-116) has increased from less than 500 ug/l in 2000, to over 20,000 ug/l between 2004 and 2009, even though the stabilized soil had less than 10 ug/l of chromium in leachate samples collected immediately after stabilization. It is unclear whether the data from MW-116 represents conditions in the shallow groundwater throughout the stabilized mass, or represents a localized aberration.

Chrome Shop history

Chrome plating operations started in 1978. The first spill of chrome plating solution was reported to WDNR in February 1979. In addition in 1979, it was reported that three 55-gallon drums of cyanide waste and zinc sludge were dumped behind the Chrome Shop building. In response to an August 1979 WDNR order, the Better Brite owner installed a French drain (see attached Figure 7-3 from *Remedial Action Documentation Report*) with a 500 gallon sump, and withdrew ground and surface water from it until 1986. Better Brite also removed contaminated soil in a garden on an adjacent property to a three foot depth and consolidated it onto their property.

In 1985 it was estimated that from 20,000 to 60,000 gallons of chrome plating solution had leaked from underground storage tanks. During the spring thaw of 1988, chrome contaminated water surfaced on adjacent properties apparently

because Better Brite had discontinued withdrawal from the French drain because of bankruptcy. In response to this situation, EPA initiated pumping the French drain as an emergency measure in March 1988.

In 1993, EPA excavated the following areas:

1. The sump area (see approximate limits of excavation are shown by the sump boundary on Figure 7-3). Soil was excavated to a depth of approximately 20 feet below ground surface (bgs). Soil samples collected from the bottom of the excavation confirmed that the soil left in place was not impacted with metals.
2. sand fill beneath the foundation.
3. surface soil from around the Chrome Shop and on properties adjacent (see attached Figure 2-13 from *Remedial Investigation Better Brite Plating, Inc.*, Hyrdo-Search, March 13, 1996). Surface soil was excavated to depths of approximately 1.0 to 1.5 feet. Analytical data for surface (0 to 0.5 feet bgs) and subsurface (2.5 to 3.0 feet bgs) soil samples collected from across the Chrome Shop and adjacent properties were used to define the extent of surface soil impacts and direct the excavation activities. This data along with the removal of garden soil by Better Brite in 1980 indicates that contamination from surface run-off extended well beyond the Chrome Shop property.

Outside the sump area, the excavated contaminated soils were replaced with clean soils. Within the sump area where soils were excavated to 20 feet bgs, the excavation was filled as follows: pea gravel overlain by a filter fabric was placed at the bottom around perforated pipes for the sump; 3/4-inch diameter washed limestone gravel from the pea gravel to approximately 6 feet bgs; filter fabric was then placed on top of the limestone gravel; and a clean clay cap was placed above the filter fabric to ground level.

The sump that EPA installed in 1993 was meant to replace an older sump and the French drain, but it is unclear whether groundwater withdrawal continued at the older sump and French drain. The sump was pumped until 1999 when the soil stabilization occurred, and all piping and wells within the stabilized area were removed. Contaminated ground water from the Chrome Shop was piped to the on-site pre-treatment plant for removal of chromium before being discharged to the City of De Pere sanitary sewer. The FS indicates that pumping of the sump was containing groundwater up to the former location of the French drain.

In 1999, natural soils and fill soils and gravel within the area of groundwater contamination (see Figure 7.3) were treated to a 20 foot depth by mixing with a proprietary reagent primarily consisting a blend of iron sulfates. The intention of the treatment was to reduce Cr^{+6} to insoluble and less toxic trivalent chromium (Cr^{+3}), so that Wisconsin groundwater standards would be achieved quickly and no further groundwater withdrawal or treatment would be required. In addition in 1999, the Chrome Shop groundwater treatment plant was relocated to the Zinc

Shop where removal and treatment of chromium contaminated groundwater continues.

Site hydrogeology

Outside areas disturbed by the plating operation and site remedial actions, the geology at the Chrome Shop is comprised of approximately 30 feet of unconsolidated glacial deposits overlying bedrock. The unconsolidated deposits are primarily silty clay to lean clay with lenses and seams of silt, silty sand, sandy clay, and clayey sand. The unconsolidated deposits are not a productive aquifer in this region because of the high clay content. The water table is located within 10 feet of the ground surface within the unconsolidated deposits.

The bedrock consists of dolomite, and an underlying sandstone aquifer. The dolomite bedrock is of low permeability and does not appear to be usable as a water supply at the Chrome Shop. The sandstone aquifer is the main aquifer for this region and is noted for its high productivity for water supply purposes. The top of the sandstone is estimated at 170 feet bgs based on a nearby well log.

Hydraulic conductivities of the natural unconsolidated deposits measured during the RI, ranged from 4.0×10^{-5} cm/sec (MW-107A) to 2.4×10^{-7} cm/sec (MW-111). The RI demonstrated that the contamination was limited to the upper 25 feet or less of the surficial unit, and presented little threat to the bedrock aquifer.

Hydrogeologic conditions in the contaminated area have been highly disturbed by anthropogenic activities. Sandy fill was emplaced by the site owner. In removal actions, EPA replaced some contaminated natural soils with sandy fill, removed highly contaminated sandy fill deposits, and replaced natural soils to 20 feet bgs within the sump area. As previously explained, in 1999 within the area of ground water contamination, a WDNR contractor excavated natural and added soils (including some clean soils added by EPA, but excluding the top soil) and gravels to 20 feet bgs, mixed it with a stabilizing reagent, and then compacted the mixture along with some clean soil from outside the excavated area back into the excavation. The sump area, which included gravel from 6 to 20 feet bgs, made up about one-third of the soil treatment area.

Addition of the reagent probably had no impact on the hydraulic properties of the shallow soil because the reagent to soil ratio was in the range of 1%, and was highly soluble (reagent was a proprietary blend of iron sulfates and called Enviro-Blend Hx, and has a solubility of 48.6 g / 100 g water, according to the Material Safety Data Sheet). It appears possible that the large volume of gravel incorporated into the mixture resulted in a pocket or pockets with relatively high permeability surrounded by low permeability clay.

The only data on groundwater and soils within the treated zone is from MW-116. The boring for MW-116 is 20 feet deep. The boring log indicates that most of the soil below the top 1.5 feet of topsoil is silty clay, but seams of gravel were

identified at 11.5 -12 feet bgs, at 13.5 bgs, and gravel caught in the auger prevented sample collection at 18 – 20 feet bgs. MW-116 is screened from 7.6 feet to 20 feet bgs. The monitoring well development report states that no water was present in MW-116 96 hours after construction. Based on the development report, it appears that data from MW-116 represents an isolated low hydraulic conductivity zone even though it is located within the former sump area and gravel seams were observed.

Chromate Chemistry

The groundwater data indicates that most if not all of the chromium detected at MW-116 is Cr⁺⁶. The presence of sulfide indicates that groundwater at MW-116 has a very low oxidation-reduction potential. Based on Figure 2-2 of EPA625, Cr⁺⁶ is not the most thermodynamically stable form of chromium under site conditions. However, experience has shown that Cr⁺⁶ can migrate and persist for many years in groundwater without attenuation. Reduction of Cr⁺⁶ to Cr⁺³ can occur in soils by reaction with MnO, organic matter, soluble ferrous iron, and reduced sulfur compounds (EPA625, p. 7). For sulfides to reduce Cr⁺⁶, ferrous iron must be present to act as a catalyst (EPA625, p. 20). One study stated that Cr⁺⁶ would only remain mobile in groundwater if its concentration exceeds both the adsorbing and reducing capacities of the soil.

Under environmental conditions, Cr⁺⁶ can exist in solution in the form of hydrochromate (HCrO₄⁻) at lower pHs, and chromate (CrO₄⁻) at higher pHs. These anions are adsorbed and retarded in groundwater by anion exchange mechanisms, and can exchange with chloride, nitrate, sulfate, and phosphate anions. Studies have indicated that adsorption of Cr⁺⁶ anions is highly pH dependent, and decreases as pH increases. As Cr⁺⁶ groundwater concentrations decrease, it becomes more difficult to remove Cr⁺⁶ anions from adsorption sites (EPA625, p. 12). One study found that chromate binding was depressed in the presence of dissolved sulfate, which competes for adsorption sites. Thus the presence of sulfate can result in desorption of chromate, and keeping chromate in the mobile phase (EPA625, p. 10). This was the explanation for an initial increase in Cr⁺⁶ after injection of a ferrous sulfate reduction solution at a site in South Carolina (EPA625, p. 28).

Under some conditions, Cr⁺³ can migrate to the surface and reoxidize to Cr⁺⁶ in the presence of MnO₂ (EPA625, p. 10).

Hypothesis

Considering the slow rate of groundwater movement, that the French drain started in operation only one year after start of the Chrome Shop operation, and that the area of soil contamination includes the area of groundwater contamination (compare attached figures), it appears that the groundwater contamination by chromium outside of the property boundaries (about 50 feet to

the west and 10 feet to the south) resulted from overland flow of spillage at the Chrome Shop, and not groundwater migration.

The MW-116 data represents a hydraulically isolated portion of the stabilized soil. However, it is possible that more permeable pockets consisting primarily of treated gravel exist. It is also possible that gravel pockets are hydraulically interconnected by fractures in the clay. It appears to be possible for these gravel pockets to fill with water and result in ponding – possibly bringing contaminants to the surface.

It is apparent that in the vicinity of MW-116, over the years untreated Cr^{+6} leached out of the soils and/or gravel. Untreated Cr^{+6} may have resulted from incomplete contact between the Cr^{+6} and the reagent. Documentation available in the *Remedial Action Documentation Report* includes a number of indications that contact between the Cr^{+6} and the reagent may have been incomplete:

- The photographs indicate that the procedure used did not assure a uniform distribution of reagent prior to mixing.
- In general, excavated clay soils are clumpy and difficult to thoroughly mix in natural conditions. The presence of “big clumps of soil in the treated piles” was noted for the 9/13/99 Status Report (Appendix C). It was also noted in a number of the Status Reports that the soil needed to be dry to ensure adequate mixing, and wet conditions were identified from 9/27/99 – 10/13/99. In addition, water sprinklers were used when conditions were dry to limit dust generation. Cr^{+6} inside the clay lumps may not have been treated.
- Some Cr^{+6} may have diffused into gravels, and not been treated.
- Yellow liquid, likely unreacted Cr^{+6} puddled on the bottom of the excavation;
- Initially for treatment of the shallow soils, two foot lifts were mixed with reagent in place using something like a rototiller, and then removed. During the removal process, it would have been easy to mix treated and untreated soils.
- Retreatment was frequently necessary after initial treatment and consolidation into a pile. In this case, the rototiller was not used, and the soil piles were mixed with additional reagent using a backhoe and endloader (see photograph).
- On 10/4/99, the contractor combined three treatment batches from Quad II together for retreatment and resampling.
- Starting on 10/6/99, the contractor discontinued use of the rototiller. The Status Report states that the soil is too wet for it to be effective. Instead soils were mixed either in-situ or in piles using an excavator and end loader.
- Instead of mixing and testing in two foot lifts, starting on 10/6/99, the contractor mixed and tested four to six foot lifts.
- Some Cr^{+6} may have remained beyond the limits of the excavation.

- Collection of unbiased representative samples for leachate testing would have been difficult when clumps of clay and gravel were present.

The reagent used primarily consisted of ferrous sulfate. The presence of reagent at MW-116 is indicated by the high sulfate concentrations in groundwater samples from well MW-116 (up to 2700 mg/l). The high sulfate in groundwater near MW116 may have caused desorption of Cr⁺⁶ from anion exchange sites in the clay soils and gravel.

There is also concern that the soil treatment will result in increased mobility of contaminants. It is possible that the high sulfate will prevent attenuation of the Cr⁺⁶ via adsorption onto soils as the contaminated groundwater migrates downgradient. Ferrous sulfate is used to reduce pH in garden soils, and may result in more leaching of metals, although this effect may have been buffered within the reagent, and by the presence of the limestone gravel. pH has not been measured at MW-116, but will be in the future.

It is reported that excess reagent was used, and, for that reason, it could be expected that Cr⁺⁶ would be treated as it leaches out of soils and comes in contact with unreacted reagent. However, the large and increasing concentrations of Cr⁺⁶ at MW116 indicates that this is not occurring at least near that well. The aqueous ferrous iron concentration at MW116 is only a very small fraction of what is necessary to treat the Cr⁺⁶ detected.¹ The low ratio of ferrous iron to sulfate suggests that the ferrous sulfate added has been almost fully reacted.² Sulfide is present at MW-116 (maximum 2.9 mg/l) and is reported to have potential to cause reduction of Cr⁺⁶ but needs ferrous iron as a catalyst.

Evaluation of options

Regardless of the explanation for the high chromium in groundwater at MW-116, the following appear to be reasonable options for addressing site conditions. Options 2 and 3 are consistent with EPA's expectation that Alternative C would be a likely alternative to be implemented if the soil stabilization proves to be unsuccessful (see 1996 ROD, p. 36). Estimates of incremental costs in this evaluation are preliminary.

It should be kept in mind that according to EPA625 (p. 17):

No technology may be able to remove 100 percent of the contaminants that are present at a site. Consequently, it is important to determine the benefits of partial mass removal and relate this to risk reduction.

Ferrous sulfate, which is included in the reagent used for soil stabilization at this site is used as an example geochemical fixing reagent in EPA625 (p. 18), and

¹ At MW-116 iron is present and is probably in the ferrous state based on the presence of sulfide. However, the iron is at a relatively low concentrations (up to 0.95 mg/l) compared to the Cr⁺⁶ concentrations (up to 54 mg/l since 2004). This is a molar ratio of 1.6%. Considering that it takes 3 moles of ferrous iron to reduce one mole of Cr⁺⁶, the normal ratio of iron to Cr⁺⁶ is 0.5%.

² The iron to sulfate molar ratio is about 0.06%, which indicates that about 99.94% of the ferrous iron reacted.

this technology is described as: *Gaining acceptance*. Natural attenuation is described as:

Beginning to gain regulatory acceptance in general. Uncertain for Cr remediation – highly dependent on site characteristics.

Because of the low permeability of at least much of the stabilized zone, injection of reagent, and flushing appear to be impractical.

Option 1 - No action except continued monitoring:

Description: Option 1 reverts to FS Alternative A, the No Action alternative for the Chrome Shop. The No Action alternative includes periodic monitoring, including the monitoring improvements suggested in the 2009 Five-Year Review, as do the other alternatives.

Effectiveness: The ROD determined that Option 1 did not meet threshold criteria (protection of human health and the environment, and achieving ARARs). The ARARs of concern for cleanup of the groundwater are the State of Wisconsin Enforcement Standards and Preventive Action Levels.

The FS describes the no action alternative as follows (Section 6, p. 4 / 24):

The No Action alternative would rely on natural processes such as dilution, dispersion, adsorption, precipitation, and degradation to attenuate the impacted ground water. The time to fully attenuate the plumes as a result of these natural processes is difficult to predict for several reasons. The attenuation is dependent on a host of soil properties such as cation exchange capacity, effective porosity, and other parameters defining the subsurface geochemistry. All of these properties would also be expected to change with soil type. The actual geochemical processes which work to attenuate the chrome are also subject to much uncertainty. Thus further definition of the downgradient soils and testing of the pertinent soil properties would be helpful but still would not eliminate some of the considerable uncertainty in predicting the attenuation. Additionally the impermeable nature of the soil makes travel times through the aquifer extremely lengthy. Appendix G includes calculations projecting the time required for the No Action alternative to comply with ARARs. Estimates indicate this will likely take in excess of 20,000 years. Thus, under this alternative, the plume would spread considerably before the concentrations are reduced to within allowable limits.

On the other hand, based on the following factors suggest that it is possible to demonstrate that the No Action Alternative could be considered protective of human health and the environment:

- the contamination is contained within the upper 20 feet of soil, and is unlikely to impact a useable aquifer;
- to date groundwater data has not identified any horizontal expansion of the chromium contamination;
- since completion of the soil treatment in 1999, contaminated groundwater (yellow) has not been observed ponding on the surface of the site, and a few surface soil samples could be collected to confirm that contaminants have not been brought to the surface;
- if chromium migrates beyond the monitoring network, there would be time to study the situation and implement remedial measures because groundwater movement is very slow;
- if chromium contamination (yellow) is observed in the surface, a fence could be installed quickly to restrict access to that area; and
- institutional controls are in place to prevent development that could result in exposure to contaminants.

Implementability: Option 1 is readily implementable if WDNR is willing to approve a NR 140.28 exemption from its groundwater standards. EPA would issue a ROD Amendment to explain that high concentrations of Cr⁺⁶ may be present in groundwater at the site, to change the remedy to containment with monitoring and a contingency for further actions, and document the WDNR exemption. Availability of funding in case contingency actions are needed in the future is uncertain.

Incremental Costs (not including long-term monitoring costs): Investigation: \$3,000³; Construction - \$0; O&M - \$0.

Option 2 - Further investigation of the effectiveness of the soil treatment and off-site migration potential, using temporary groundwater monitoring points, and following up with installation of additional monitoring wells, and installation and operation of groundwater sumps if needed to hydraulically contain the groundwater contamination (as an alternative to use of sumps Option 3 could be implemented following the investigation):

Description: Further investigation could confirm that the ROD remedy is generally effective and that containment/attenuation of some Cr⁺⁶ in groundwater is acceptable. Alternatively, further investigation could be used to justify and design a remedy equivalent to Alternative C of the FS except that groundwater would be contained and cleaned up using a series of sumps instead of a French drain. The investigation could be performed using a Geoprobe to determine whether data from MW-116 is representative of the treatment area, to detect any

³ Collection and analysis of 10 surface soil samples for metals and Cr⁺⁶.

spreading of the chromium contamination in groundwater, to evaluate the soil attenuation capacity, and to find locations where groundwater withdrawal using a sump may be effective.

EPA Region 5's Geoprobe could be used to perform and log soil boring at up to 20 feet bgs, and to sample shallow groundwater. For cost estimating, we assumed ten borings within the treated zone, and seven borings just beyond the treated zone. If data shows it to be necessary, the investigation could be used to locate additional shallow monitoring wells (the cost estimate assumes three), and groundwater sumps (the cost estimate assumes five). The groundwater recovered from the sumps would be pumped out periodically and transported to the Zinc Shop for treatment.

Effectiveness: If the results indicate that groundwater contamination at MW-116 is isolated and the Cr^{+6} is not migrating, then no further action would be necessary. However, it is possible that there are pockets of gravel that are acting like a sump collecting Cr^{+6} contaminated groundwater. Groundwater sumps could be used to contain and gradually remove this contamination. Water level measurement surveys would need to be performed to evaluate the effectiveness of the hydraulic containment. The sumps may not be as reliable in containing the contaminated groundwater as the French drain in option 3.

Implementability: Option 2 is readily implementable. EPA may be able to perform the Geoprobe sampling using in-house staff and analyses using the Contract Laboratory Program without requiring a project specific contract. If necessary, EPA could fund installation of sumps through RA funds, subject to availability. EPA would issue a ROD Amendment to document that the soil stabilization was not fully successful and to add containment/attenuation with monitoring, or groundwater withdrawal to EPA's Selected Remedy as appropriate.

Incremental Costs: Investigation: \$21,000⁴; Construction - \$94,000⁵; O&M - \$27,000⁶

⁴ 3 man crew for 6 days = 3 X \$100 /hr X 6 days X 8 hours/day) = \$14,400; analysis of 17 groundwater samples for VOCs - 17/12 X \$1,200 (mean for SOM1.2) = \$1,700; for 11-17 metals 17/12 X \$1000 (mean ILM05.4) = \$1400; filtered metals = \$1400; hexavalent chromium = \$100 X 17 = \$1,700; analysis of total Cr+6 reducing capacity = 10 X 300 = \$3000; assume that waste water can be disposed at the Zinc Shop and contaminated soil under the existing top soil cap, both at minor cost.

⁵ 3 PVC monitoring wells = 3 X \$5000 = \$15,000; 800 feet of 6 foot chain link fence = \$10,000; 5 sumps adjusted from FS Table 6-4) = \$68,600:

- Mobilization = \$1000;
- Excavation = \$5000;
- Soil disposal under existing top soil cap \$5000;
- Backfill = 18 y³ X 5 X \$10/y³ = \$900;
- Sump construction = 5 X \$6000 = \$18,000;
- Pump = 5 X \$500 = \$2500;
- Electrical = \$4000;
- Follow up 10 surface soil samples for metal and hexavalent chromium = \$3000
- Total construction = 39,400
- Design = 5,000

Option 3 - Installation of a French drain:

Description: Option 3 is to evaluate whether it would be reasonable to forgo further investigation and simply implement a measures that will control any contaminant migration. Option 3 reverts to FS Alternative C, enhanced groundwater recovery, for the Chrome shop. Conceptually a 20 foot deep, approximately 300 foot length French drain and sump would be installed. Ideally, the French drain would be installed within the area of groundwater contamination, but close enough to the downgradient boundary of the contamination to assure that it is hydraulically captured. The French drain could be installed along the western and southern boundaries of the property (similar to the original French drain), or outside the property boundary (if property owners provide permission). The sump would be added to the monitoring program, and the sump would be pumped out periodically and treated using the existing Zinc Shop treatment facility, if necessary. If the sump water is consistently clean, then the water would not need to be pumped out.

Effectiveness: According to the FS, Alternative C meets the threshold criteria using an established technology. A French drain within the stabilization area would also provide an indication of the overall effectiveness of the stabilization. If the French drain is installed within the stabilization area, and the sump water is clean, then we could conclude that the groundwater at MW-116 is isolated. Option 3 provides more assurance that the contaminated groundwater is being contained by: providing a composite monitoring point that groundwater cannot migrate past; and providing a continuous barrier to off-site migration of contaminated groundwater.

Implementability: If funding is available, it appears that EPA could fund French drains through RA funds. EPA should change the ROD to identify that stabilization was not fully successful, and to add groundwater removal and treatment at the Chrome Shop.

Incremental Costs: Construction - \$66,000⁷; annual - \$27,000 (assuming withdrawal from sump is necessary and operating costs are similar to Option 2).

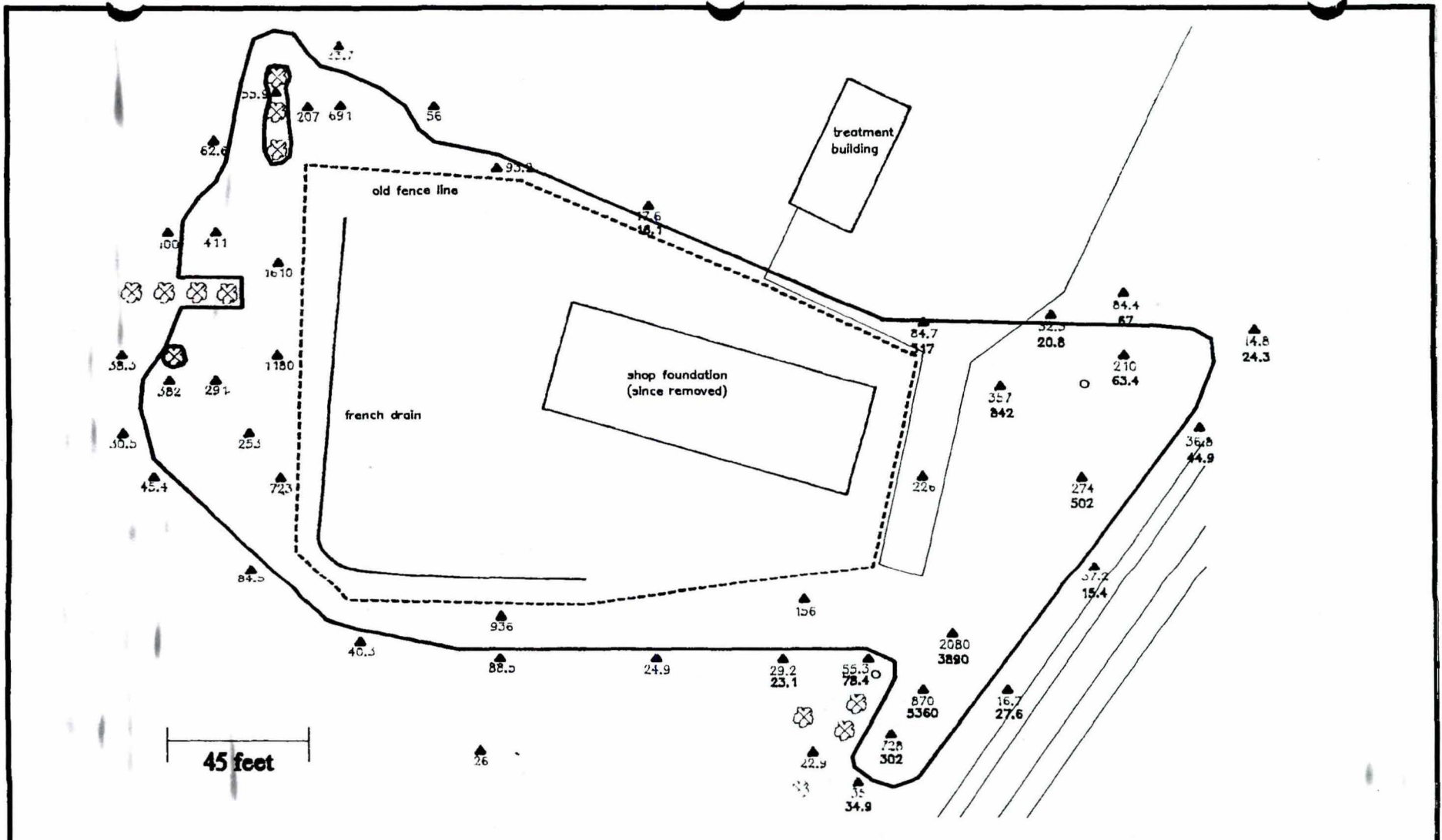
-
- Oversight = \$2,000;
 - Insurance = \$2,300;
 - Documentation = \$12,000;
 - Contingency = \$7,900;
 - Total = \$68,600.

⁶ Use ½ the estimates from FS Table 6-4 excluding groundwater monitoring, and including all transport costs = \$20,000, plus sampling and analysis of 7 additional monitoring points for metals = 7 X \$1000 = \$7,000.

⁷ Estimate from Table 6-4 of the FS adjusted for 300 instead of 100 foot drain and soil disposal under the top soil cover instead of off-site, plus \$10,000 for 800 feet of 6 foot chain link fence and \$3000 for post construction surface soil sampling:

- mobilization - \$1000;
- clear and grub - \$500;
- trench excavation - \$1000 X 3 = \$3000;
- soil disposal under the existing top soil cover = \$10,000
- backfill - \$2000 X .5 X 3 = \$3000;

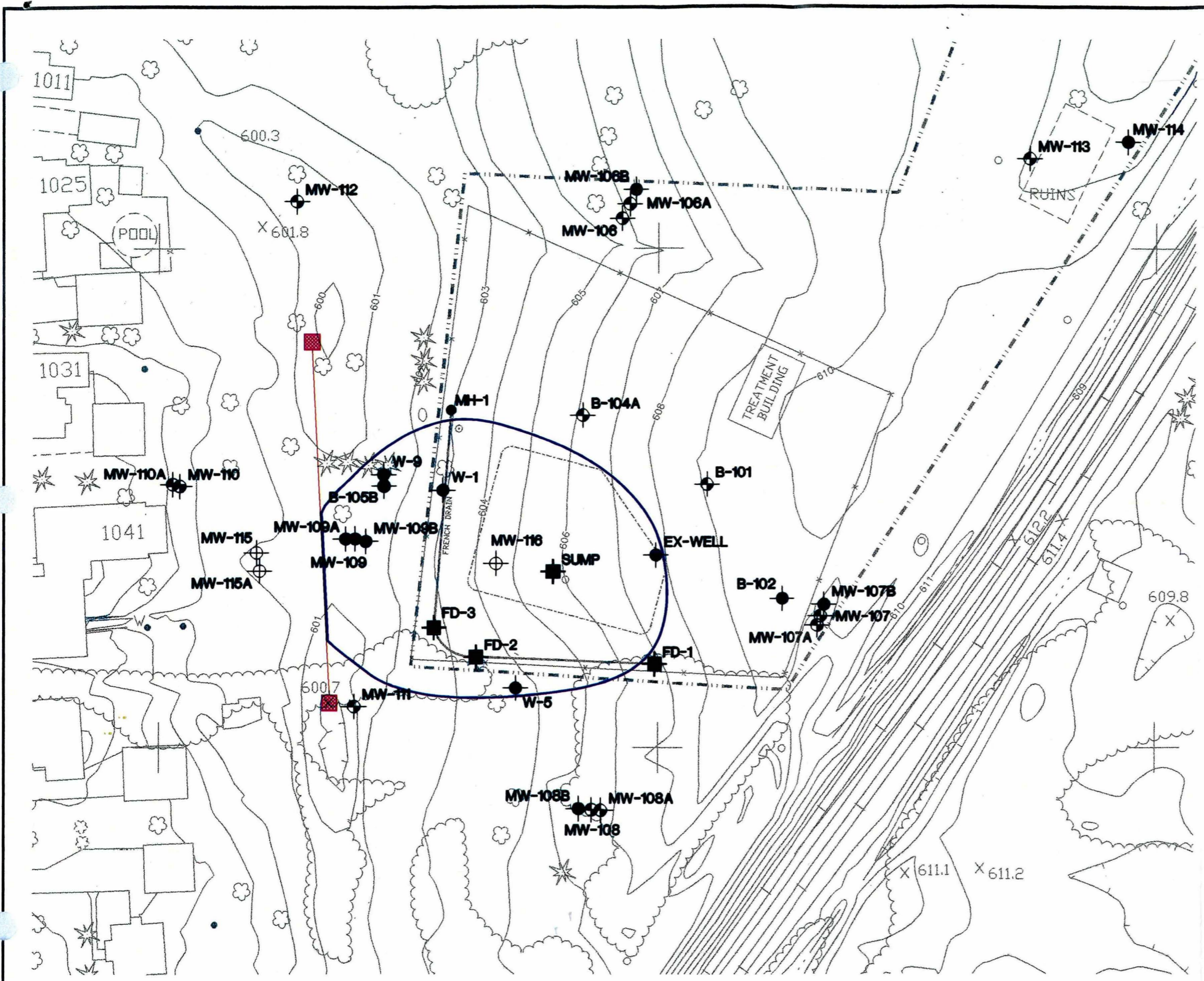
-
- clay cap - $\$260 \times 3 = \780 ;
 - sump construction - $\$6,000$;
 - pump - $\$1,000$;
 - piping excavation - $\$1000$;
 - yard piping - $\$2,300$;
 - instrumentation - $\$2,000$;
 - electrical - $\$4,000$;
 - follow up 10 soil samples for metals and hexavalent chromium = $\$3000$
 - total construction = $\$37,600$
 - design - $\$5,000$;
 - oversight - $\$2,000$;
 - bonding - $\$2,300$;
 - documentation - $\$12,000$;
 - contingency - $\$7,000$



LEGEND

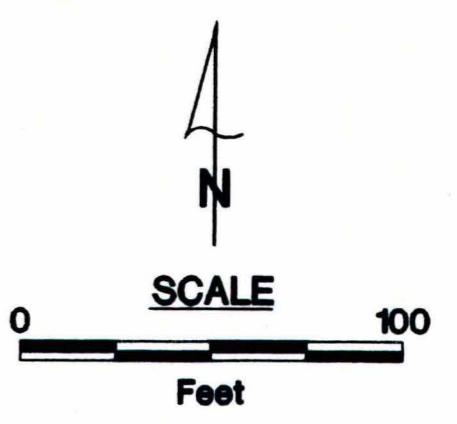
- 156 total chromium (ppm)
- 3890 total lead (ppm)
- ▲ triangulated sample
- extent of surface soil removed

BETTER BRITE DePERE, WISCONSIN		DATE: 05/18/95
CHROME SHOP SURFACE SOIL EXCAVATION EXTENT 1993		DESIGNED: RAG
		CHECKED: JEN
		APPROVED: JLF
		DRAWN: RAG
		PROJ: 301483158
 HYDRO-SEARCH INC A Tetra Tech Company		Figure 2-13



EXPLANATION

- MW-113 MONITOR WELL LOCATION AND DESIGNATION
- B-101 MONITOR WELL LOCATION AND DESIGNATION
- W-5 MONITOR WELL LOCATION AND DESIGNATION
- SUMP FORMER SUMP ACCESS LOCATION AND DESIGNATION
- FD-3 FORMER FRENCH DRAIN ACCESS LOCATION AND DESIGNATION
- EX-WELL FORMER EXTRACTION WELL LOCATION AND DESIGNATION
- MH-1 MANHOLE LOCATION
- SUMP BOUNDARY
- PROPERTY LINE
- SOIL STABILIZATION AREA
- MW-11 ABANDONED MONITOR WELL LOCATION AND DESIGNATION
- MW-115 PROPOSED MONITOR WELL LOCATION AND DESIGNATION



BETTER BRITE DePERE, WISCONSIN PROPOSED WELL LOCATIONS CHROME SHOP	DATE: 12/1/99
	DESIGNED: BOB
	CHECKED: KEB
	APPROVED: JLF
	DRAWN: BOB
	PROJ: F119
Figure 7-3	

Base map from Aero-Metric Engineering, date of photography 11/17/91.