

PRELIMINARY Health Assessment for

PRECISION PLATING
VERNON, TOLLAND COUNTY, CONNECTICUT
CERCLIS NO. CTD051316313
SEPTEMBER 18, 1991

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry



THE ATSDR HEALTH ASSESSMENT: A NOTE OF EXPLANATION

Section 104 (i) (7) (A) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, states "...the term 'health assessment' shall include preliminary assessments of potential risks to human health posed by individual sites and facilities, based on such factors as the nature and extent of contamination, the existence of potential pathways of human exposure (including ground or surface water contamination, air emissions, and food chain contamination), the size and potential susceptibility of the community within the likely pathways of exposure, the comparison of expected human exposure levels to the short-term and long-term health effects associated with identified hazardous substances and any available recommended exposure or tolerance limits for such hazardous substances, and the comparison of existing morbidity and mortality data on diseases that may be associated with the observed levels of exposure. The Administrator of ATSDR shall use appropriate data, risks assessments, risk evaluations and studies available from the Administrator of EPA."

In accordance with the CERCLA section cited, ATSDR has conducted this preliminary health assessment on the data in the site summary form. Additional health assessments may be conducted for this site as more information becomes available to ATSDR.

The conclusion and recommendations presented in this Health Assessment are the result of site specific analyses and are not to be cited or quoted for other evaluations or Health Assessments.

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PRELIMINARY HEALTH ASSESSMENT

PRECISION PLATING CORPORATION

VERNON, CONNECTICUT

CERCLIS NO. CTD051316313

Prepared by

Connecticut Department of Health Services

Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

SUMMARY

Precision Plating is located in the Hillside Industrial Park, in Vernon, Connecticut. Its operations consist of the chrome plating of metal parts and fixtures. In the winter of 1979, a snowplowing accident ruptured a tank and three drums containing chromium wastes. Wells at the Hillside Industrial Park and the adjacent High Manor Mobile Home Park were subsequently contaminated with chromium (for the purposes of this document the word contamination means any chromium levels above background).

Based on the information reviewed, ATSDR has concluded that this site is an indeterminate public health hazard. Exposures to chromium have occurred in the past but available data cannot document long-term exposures to levels that are expected to cause adverse health effects. In particular, the lack of chromium data from tapwater in High Manor Mobile Home Park between 1979 and 1985 prevent firm conclusions about the level of exposures and effects during that time. However, chromium exposure did occur at Hillside Industrial Park and parts of High Manor Mobile Home Park in the past due to groundwater contamination. There is no current exposure potential at High Manor Mobile Home Park and minimal exposure potential at Hillside Industrial Park.

Recommendations are made to assure that exposures of employees at the industrial park are limited from non-potable water sources. In addition, follow-up monitoring and sampling are recommended to identify the flow and migration of chromium contamination and identify any potentially affected populations. Appropriate follow-up with respect to health activities has also been evaluated. It is recommended that an environmental health education program to advise the public health professional and the local medical community of the nature and possible consequences of exposure to chromium at the Precision Plating site be performed.

BACKGROUND

A. SITE DESCRIPTION AND HISTORY

Precision Plating "National Priorities List" (NPL) site is located in the Hillside Industrial Park, 1050 Hartford Turnpike (Route 30) in Vernon (Rockville), Connecticut. The industrial park is comprised of three buildings. Precision Plating site is located in the east portion of the northernmost building of the park (see Appendix 1).

The industrial park was built on a vacant lot in the 1960's. Precision Plating occupied the building beginning in 1969. Prior to that, a television appliance warehouse was located on the property. The area surrounding the industrial park is primarily residential, along with some light industry and commercial property. The industrial park, which is the site perimeter, is bordered by Clark's Brook and the Hartford Turnpike on the west, power lines and woods to the north, woods and a large apartment complex to the east and the High Manor Trailer Park to the south and southeast.

Precision Plating's operations consist of the chrome plating of metal parts and fixtures. Waste waters are generated from the various processes of alkaline cleaning, chemical etching, chrome plating and rinsing, buffing and polishing procedures. Contaminants present in the wastewaters include heavy metals, spent alkaline cleaners and spent plating and etching acids. From 1973-1981, the company had no waste water treatment system and waste waters were discharged without a permit to a storm drain outside the facility, which emptied into Clark's Brook. Chromium wastes were stored in a 500 gallon tank outside of the building since approximately 1975, and plating acid wastes were stored adjacent to the tank in three to four drums. The storage area was approximately 50 feet from the well (well #HI-1), which supplied water to the other occupants of the industrial park.

A small 3 foot by 5 foot lagoon located behind Precision Plating was used for iron and chromium waste neutralization from 1976-1977. The metal hydroxide sludge accumulated to approximately 15 pounds, before the Connecticut Department of Environmental Protection required Precision Plating to cease this operation.

Other than the apartment complexes to the east of the site and west of the site along route 30, (which are supplied public water by the CT Water Company), the industrial park, the mobile home park, the adjacent residences and commercial establishments were all on water supplied via on-site bedrock wells until 1979, when the chromium spill occurred. The events surrounding and following the spill are described below.

Historical Sequence of Events:

May 1979 The State of Connecticut Department of Health Water Supplies Section was notified by the Vernon Health Department that the well serving the Hillside Industrial Park (well #HI-1) was contaminated with hexavalent and trivalent chromium at levels exceeding the .05 ppm (parts per million) maximum contaminant level established for

total chromium under the Federal Drinking Water Standards. The levels also exceeded the EPA's lifetime health advisory level of 0.12 ppm. Specifically, levels of 0.34-0.37 ppm were detected in this well. Further investigation by the CT State Department of Environmental Conservation uncovered that the source of contamination was due to a snowplowing accident that ruptured the tank containing chromium wastes and three drums containing plating acid wastes, located adjacent to the Precision Plating building in the winter of 1979. Bottled water was supplied to the tenants of the industrial park, due to the drinking water standard being exceeded.

- Dec. 1979 A new bedrock well (#HI-2) was approved by the State Department of Health Services for use by tenants of the industrial park. It was installed approximately 450 feet south of the original well. The well was deemed satisfactory, as total chromium levels were below recommended guidelines (Total Cr 0.01 ppm) and the remaining parameters were within prescribed limits (ref #10).
- Nov. 1982 Precision Plating was served another order from the CT DEP (HM18). The order required:
- removal and disposal of all toxic, hazardous and other industrial wastes stored on the property,
 - the company bring all waste handling procedures and facilities into compliance with CT hazardous waste management regulations.
- May 1985 Connecticut Department of Health Services Water Supplies Section sampled and analyzed five supply wells that serviced High Manor Trailer Park located to the south of Hillside Industrial Park (wells #HM-1, -3, -5, -6, -7). Elevated levels of chromium (.017-0.11 ppm) were found in #HM-1. The High Manor Trailer Park supply well #HM-1 was therefore removed from service after 1985. Water from the other four supply wells was mixed and provided potable quality water. No alternative water supply was needed.
- Mar. 1986 Additional orders were issued that required that potable water be supplied to Hillside Industrial Park and High Manor Trailer Park.
- Mar. 1988 The CT DOHS and the CT DEP agreed that the most acceptable alternative was to extend the public water supply line to the affected areas.

June 1988 Extensive soil removal near the spill site was conducted by Moffitt and Duffy, under the direction of the consulting firm of Fuss and O'Neill. All soil demonstrating total chromium concentrations .05 ppm and above by EP toxicity procedures were removed. The area was then backfilled with clean fill and contaminated soils were taken to Mid-Connecticut Landfill, in Hartford, CT. Chromium contamination was also identified under the Precision Plating building; however, removal of this soil would have entailed structural damage of the Precision Plating building. Additionally, it was judged that the pumping and treatment of the contaminated wells would "draw down" this zone. A number of remaining drums of soil were left on site. Soils and water in these drums were from the installation of monitoring wells. According to a consultant report, all soils left in drums showed only background levels of chromium contamination. However, the wastewater in two drums contain chromium contamination above drinking water standards. According to Mr. Goulet, the owner of Precision Plating, these drums have remained on site, as no firm will agree to take them.

Jan 1990 High Manor Mobile Home Park was put on public water supply. The entire Hillside industrial park remains on bottled water, supplied by the industrial park owner, but extension of the water main to the area is expected in 1991.

B. SITE VISIT

On April 26, 1990, a site visit was performed by the Brian Toal and Sandy Geschwind of the CT DOHS. Assisting in the site visit were Gregory Ulirsch of the Agency for Toxic Substances and Disease Registry (ATSDR) and representatives of the Vernon Health Department. The following observations were noted:

- ✓ Precision Plating is presently an operating facility. It is open and accessible to individuals within the industrial park.
- ✓ Barbed wire fencing separates the industrial park from the mobile home park; however, other parts of the industrial park were accessible.
- ✓ A pump and treat system for the groundwater contamination plume was hooked up, but is not presently in operation.
- ✓ There is clean backfill where the tank and drums were once stored adjacent to the Precision Plating Building.

- ✓ Drums containing the soil and wastewater drillings from installation of the monitoring wells were located behind (to the north) and to the east of the Precision Plating building. Drums were not sealed, but had lids loosely covering them.
- ✓ Pieces of industrial equipment were stored in the front and to the east of the building.

C. DEMOGRAPHICS, LAND USE, AND RESOURCE USE

The town of Rockville, (where Precision Plating is located), was incorporated by the city of Vernon in the 1960's. Vernon has a population of approximately 31,000 people.

The towns bordering the Precision Plating site include: Ellington to the north, Coventry and Tolland to the east, South Windsor to the west and Vernon to the south.

The population within one mile of the facility is calculated at 3,491 people. This calculation includes the 280 people living in the High Manor Mobile Home Trailer Park, which is located 0.15 mile due south of the facility. The population within a 2-mile radius of the site is approximately 13,732 residents and within three miles, there are 32,185 residents.

The site is located in the Standard Metropolitan Statistical Area #3280, County #060, and Census Tract #5304. Approximately 15 percent of the population in the census tract is over 60 years of age and another 8 percent is under five years old. Ninety-seven percent of the individuals are white and divided equally between males and females.

The Vernon Center Junior High School is located approximately one mile due southwest of the facility. The Northeast School is also located approximately one mile northeast of the site.

Groundwater drawn from within three miles of the facility is used for municipal, community supply and private residential wells. There are no known groundwater intakes for irrigation within a 3-mile radius.

A CT Water Company well field is located 1.7 miles southwest of the facility, and supplies 3,192 people. There are 1,937 residences, 7,361 individuals using private wells located in the specific aquifer of concern within three miles of the facility. When one considers the mobile home park residents, as well as 3,192 individuals on the CT Water Company wells, then there are 10,833 total individuals served by water wells located on the aquifer of concern (as previously described; all mobile home park residents were placed on public water supplies as of January 1990). The rest of the people receive their water from another CT water company source. This water supply comes from the Shenipisit Lake Reservoir, which is situated 1.8 miles northwest and upstream of Precision Plating. The nearest residence on private water is a private home located on Rt. 30, 500 feet north of the site.

Clark's Brook is located 500' west of Precision Plating. This brook feeds into the Tankerhoosen River, which is used for fishing. The nearest freshwater wetlands are located downstream along Clark Brook, approximately 3,238 feet due south of the facility. The wetlands encompass a 24-acre area. There are no surface water intakes for irrigation in the Vernon area. There are no critical habitats in the State of Connecticut.

COMMUNITY HEALTH CONCERNS

In order for mobile home park residents to express their concerns about living near a groundwater contamination site, a "drop-in" session was held on the afternoon of April 26, 1990. Signs advertising the upcoming session were posted around the mobile home park approximately one week prior to the meeting. Only one resident showed up at the meeting. Her complaints primarily related to the sewage problems she had been having for many years. Additionally, she stated that she had gastrointestinal problems (specifically diarrhea) allegedly due to the chromium exposure, until 1986, when she purchased her own supply of bottled water.

Another resident called after reading about the meeting in local newspaper accounts. This former resident had moved out of High Manor Mobile Home Park in 1968, prior to the contamination spill. No other health complaints were noted. A second caller inquired about the potential for chromium to cause pancreatic cancer. Research indicates that this is not a health outcome associated with chromium exposure.

Additionally, a citizen's concern regarding naturally occurring radium levels was investigated in 1989, even though it was not NPL site-related. Though one well had increased levels of combined Radium 226 and 228 above the 5 pci/l standard, results of radium contamination are judged in terms of a running annual average. Average radium levels for the blended wells were 4.45 pci/l, which was below the 5 pci/l standard. However, fourteen filters were installed to ensure that the annual average standard would be met. The levels were reduced and the wells were monitored and filters replaced as needed until December 1989 when the mobile home park residents were placed on public water.

A 30-day comment period was held beginning February 5, 1991, on the Precision Plating Corporation Preliminary Health Assessment. The public comment period was announced in a local newspaper and the health assessment was placed at the Rockville Public Library. The comments related to the health assessment and the response to these comments are shown in Appendix 2.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

A. ON-SITE CONTAMINATION

Extensive sampling has been conducted both on and off site. Contamination documented within the perimeter of the Hillside Industrial Park constitutes on-site contamination. All other contamination sources are considered to be

off site. Groundwater samples were collected from the two supply wells located at Hillside Industrial Park, both during the period of time that contamination was detected, and in 1988-present, during the monthly monitoring process.

In 1979, the consulting firm of Fuss and O'Neill Inc. installed five shallow sand packed monitoring wells on site, performed groundwater sampling and removed 20 cubic yards of contaminated soil. Results of their investigation indicated contamination in the overburden material and in bedrock. Groundwater samples collected from well #HI-1 contained elevated levels of chromium (1.03 ppm hexavalent, and 0.11 ppm trivalent chromium).

In 1985, water samples were collected and analyzed from well #HI-2 at Hillside Industrial Park by the CT DOHS. The analysis indicated chromium contamination was present. Well #HI-1 showed continuing contamination at 3.4 ppm and well #HI-2 had contamination ranging between 2.3-2.4 ppm.

A site investigation was performed by NUS/FIT in 1986. A water sample collected at supply well #HI-1 contained 3.01 ppm hexavalent and 0.43 ppm trivalent chromium. The background sample, collected from the turnpike, did not identify detectable levels of hexavalent or trivalent chromium. Groundwater concentration ranges reported on Table 1 represent minimum and maximum levels detected on the site between 1979 to the present.

Soil, sediment and surface water samples were taken from Hillside Industrial Park during various consultant inspections. Levels in soil naturally vary depending on the composition of the parent rock. Chromium levels in soil can range anywhere between 5-1500 ppm (1).

Chromium contaminated soil was identified and removed in four locations: 1) east of the Precision Plating facility, 2) adjacent to the parking lot drainage, 3) former leaching fields at Hillside Industrial Park, (one just NW of the Precision Plating facility), and 4) the Precision Plating parking lot storm drain located just south of the facility. Levels of 24-608 ppm were found in the first foot of soil downstream from the storm drain discharge area. However, it was decided between the consultants and CT DEP that remediation would cause more disturbance to the environment; the chromium is not migrating to lower levels and removal would not significantly reduce overall chromium levels.

The following volatile organic compounds were also detected in composite soil samples taken in 1986: benzene, trichloroethene, tetrachloroethene, chlorobenzene, and ethylbenzene. Quantification was not possible due to choice of instrumentation. No volatiles were detected in the groundwater, surface water or ambient air.

Air has been sampled on site during various inspections, including the 1986 inspection by NUS. No readings above background levels were obtained. Samples were taken with a Foxboro Century 128 Organic Vapor Analyzer. Particulate air contamination is minimal, based on available information.

Surface water samples were collected at Clarke's Brook during the 1986 NUS inspection. No metals above natural background levels were detected.

The concentration ranges of environmental contaminants of concern detected on-site are shown in Table 1.

Table 1

Contaminants of Concern
On-Site^a
Precision Plating NPL Site
Vernon, CT

<u>Contaminant</u>	<u>Range</u> (Parts per million)	<u>Sampling Date/Location</u>
Groundwater:		
Total Cr	0.24 - 3.4	May 1979-Nov. 1985/wells HI-1 and HI-2**
Total Cr	0.38 -15.0*	1988-present/wells HI-1 and HI-2**
Cr ⁺⁶	0.01 -15.0	
Soils and Sediments:		
Total Cr	20-1900	1988/removed from site
Total Cr	24- 608	1988/storm drain
Cr ⁺⁶	0.8-1.2	1988/under Prec. Plat. Bldg.
Surface Water:		
Total Cr	0.023-0.017	1979/stream 50' east of site

* Level of 15.0 ppm was detected once in 1988 during monthly monitoring. Average levels are approx. 5.0 ppm.

** HI-1 and HI-2 = Hillside Industrial Park wells

^a The data presented in this table document ranges of chromium levels found but do not necessarily indicate actual exposure levels.

B. OFF-SITE CONTAMINATION

There are five public water supply wells located at High Manor Mobile Home Park. The nearest off-site well to Hillside Industrial Park is well #HM-1, located approximately 125 feet southwest from the contaminated well #HI-2 at Hillside. This well was shut down in August 1985, due to high contamination levels. Since 1985, water from wells #HM-5, #HM-6 and #HM-7 were blended together and water from well #HM-3 was pumped directly into the distribution system and mixed with the blend which produced the potable water for the trailer park. Wells #HM-3, #HM-6, and #HM-7 have generally had low levels of chromium since 1985 but later contamination of well #HM-5 indicated further off-site migration of chromium.

The nearest residential well is located approximately 500 feet to the north, across Route 30. All private wells on Route 30 were sampled for chromium in 1988 and all were in compliance with drinking water standards. Twenty-seven homes were sampled--three residences had total chromium levels of .02 ppm, .02 ppm, and .03 ppm, respectively. The remaining homes were all less than .01 ppm and all residences had less than .01 ppm hexavalent chromium. Apartments to the east and northwest of the facility have been on a public water supply, even prior to the spill.

Contaminated waters from storm drains at Hillside Industrial Park were discharged into the wooded area adjacent to Clark's Brook. CT DEP has plans to begin monitoring Clark's Brook on a quarterly basis.

Results of soil sampling conducted in 1988 also indicated the presence of chromium (24-608 ppm) in the first foot of soil directly downstream from the storm drain discharge area. Other soil samples collected in the wooded area near Clark's Brook showed no soil contamination above background levels.

No follow-up sampling has ever been done on the volatile organics found in the soil and sediments. Also, no follow-up sampling has been done on the intermittent stream to the east of Precision Plating. Analytic sampling has not been conducted at the Tankerhoosen River.

Presently, the only known contaminated soil still present at Precision Plating is located under the facility itself, away from human exposure. No other soil remediation has been recommended.

The environmental contamination off-site (High Manor Mobile Home Park) is shown on Table 2. Chromium concentration ranges are reported for both the unblended water samples (individual mobile home park municipal wells) and the blended water samples (the combination of water from wells #HM-5, #HM-6, #HM-7 and #HM-3). The highest levels reported (.16 ppm) were found only in well #HM-1 which was taken out of service when contamination was discovered in 1985. Radium contamination levels are also given, though they are not site related.

Table 2

Contaminants of Concern
Off-Site^a

Precision Plating NPL Site
Vernon, CT

<u>Contaminant</u>	<u>Range</u>	<u>Medium</u>	<u>Date</u>
Individual Wells at High Manor:			
Total Cr	0.01-0.16 ppm	gw*	1985
Cr ⁺⁶	0.01-0.16 ppm	gw	1985
Blended Wells at High Manor:			
Total Cr	.01-.09**	gw	1988
Cr ⁺⁶	.01-.08**	gw	
Radium ^a 226	5 pci/l/yr	gw	1989
228	5 pci/l/yr	gw	

* groundwater abbreviation

** questionable lab result--all other readings less than 0.05 ppm

^a radium is not site-related

^a Data presented in this table document ranges of chromium levels found in well water but do not necessarily indicate actual exposure levels.

C. QUALITY ASSURANCE AND QUALITY CONTROL

The April 1986 study conducted by NUS/FIT had samples analyzed by an EPA contract lab and appears to be supported by adequate quality control. However, a background soil sample taken during this same investigation indicated the presence of volatiles, making the results of possible contamination somewhat questionable.

The monitoring done since January, 1988 has not included the standard QA/QC practice of submission of duplicate samples. A few samples taken from High Manor wells in 1988 appear inconsistent and slightly above the .05 ppm level. These levels have not been consistently observed on a monthly basis and are thought to have been due to laboratory inaccuracies, according to the CT Department of Environmental Protection (DEP).

D. PHYSICAL AND OTHER HAZARDS

No physical hazards were noted, except for those likely in the vicinity of industrial facilities.

E. TOXIC RELEASE INVENTORY REVIEW

To help identify other possible sources of contamination in the area of the site, a review of 1987 and 1988 Toxic Release Inventory (TRI) Data was conducted. TRI is an EPA sponsored database that contains data on all chemical releases from facilities over a certain size. The TRI did not contain any information on chemical releases from businesses in the area near Precision Plating.

PATHWAY ANALYSES

A. ENVIRONMENTAL PATHWAYS (Fate and Transport)

Chromium is a naturally occurring element. In its hexavalent state, chromium is a strong oxidizing agent that reacts readily with organic materials, thereby reducing it to its trivalent form. In soil, chromium may be aerosolized to the atmosphere, or leach into surface or groundwaters (1). The actual mobility of the metal in soils depends on its state of solubility. The residence time of chromium in lake water has been shown to range between 5-18 years. The half life of chromium in soils may be several years as well.

Groundwater--The principal overburden materials present throughout the area consist of glacial till and stratified drift deposits. These materials are composed of mixtures of fine sands, silt, clay and gravel. This was verified by site monitoring well logs prepared by a consultant (3). The overburden thickness in the area surrounding the site is 12 feet. This is inconsistent with the average overburden thickness in the Vernon area. Logs indicate that overburden in Vernon varies between 20-136 feet, with an average depth of 65 ft. (3).

Bedrock beneath the Precision Plating facility is part of the Glastonbury Foundation. The Glastonbury "Gneiss" is a grey, medium-to-course-grained, massive-to-well-foliated biotite gneiss. The rock is hard and impermeable, although fractures are numerous.

Water recovered from this type of formation is usually deep (300-800 ft.). Due to the depth of this water supply and heavily fractured nature of the bedrock, groundwater flow is relatively independent of surface topography.

There is no continuous confining layer present between the overburden and bedrock within three miles of the site. This is corroborated by the fact that groundwater samples collected from both the overburden and bedrock aquifers have detected chromium contamination. The residents of the industrial park and High Manor Trailer Park all obtained their water from bedrock wells. One well, (#HM-1) at High Manor Mobile Home Park was taken out of service when contamination was detected. However, Hillside Industrial Park still uses its

wells for all non-potable water supplies. Residents at the High Manor Mobile Home Park continued to use the blended water from the four remaining wells as their water source, until December 1989 when the mobile home park residents were hooked up to CT public water.

Piezometers installed in the overburden on site indicate that the groundwater gradient is to the north. However, pumping of the water has altered the northerly flow of the groundwater towards the direction of the High Manor wells.

Due to the shutdown of wells at High Manor Mobile Home Park, it is now apparent that groundwater flow is shifting back to its northerly direction. Plans for new monitoring wells are being put into effect to ensure that the contamination will be followed. According to a recent consultant report (3), it is unlikely that significant metal contamination will extend beyond the power line located to the north of Hillside Industrial Park. This opinion is based on maximum groundwater flow rates of 1 ft./day and the rates of metal uptake of glacial till soils that will reduce the contaminant levels to within acceptable drinking water limits. Evidence of this is already occurring, as indicated by changes detected in specific monitoring wells. Unfortunately, the flow in bedrock contamination is less easily predicted.

Contaminated water at Precision Plating will be pumped and treated according to requirements in their remediation plan. Pilot pump tests have been completed and an emergency authorization for pumping and treatment is presently being reviewed by the Industrial Permit Section of the DEP. Once in operation, the treated water will be discharged into the town sewer.

Surface water--The topography surrounding the industrial park is primarily rolling, ranging between 350-850 feet in altitude above mean sea level. Hillside Industrial Park has an average slope of close or or about 0 percent. The park is built on land that is cut into the west slope of a hill. The site's borders slope to the N.W. and S.E. and rises in elevation to the east. The western border of the facility is steeply sloped down to Route 30.

The nearest surface water body is Clark's Brook. This brook is a tributary of the Tankerhoosen River, which is located 3,238 feet from Precision Plating. There is a 2.2% average downhill slope of the terrain between the facility and Clark's Brook. A wooded hillside separates the brook from the facility.

Most surface water runoff drains into storm drains at Hillside Industrial Park, discharging into the hillside above Route 30 towards Clark's Brook. Any excess surface water runoff flows towards the west of the park and down the driveway to Route 30. According to a CT DEP report issued in 1978, this brook was classified as a receiving stream for Precision Plating wastewaters. Clark's Brook follows a southwesterly flow along Route 30. It then turns south into a marsh, and discharges into the Tankerhoosen River.

Another surface water body has been identified approximately 50 feet to the east of Precision Plating. This stream is most likely intermittent, because it has not been mapped by the U.S. Geological Survey. This small, spring fed stream is located in a wooded area to the east, and uphill from the facility.

The potential for surface water runoff from the site into the stream is unlikely. However, there is a consultant report that states that groundwater discharges into this stream. Levels of chromium, ranging from 0.023-0.017 ppm were detected in this stream in 1979. No sampling has been documented since this date.

Clark's Brook was sampled in 1986 and there was no indication of chromium concentrations above background levels. Additionally, no volatile organic compounds were detected.

Surface Soil--Two sources of soil contamination have been identified. The first is due to the discharge of dilute process rinses containing chromic acids into a storm sewer, between 1973-1981. Secondly, a tank with a more concentrated solution of chromic acid was ruptured in 1979. These two sources have contributed to the soil contamination located in the area of the manufacturing building.

Soil contamination downstream from the storm drain discharge area was not migrating to lower depths. Therefore, CT DEP and the consulting firms of Moffit and Duffy and Fuss and O'Neill decided that remediation was not necessary. They determined that removing the soil would actually cause "appreciable disturbance to the environment." Additionally, it was felt that this removal would not significantly reduce the overall chromium levels present on site.

Food Chain - Chromium was not detected above background levels in Clark's Brook, the tributary to the Tankerhoosen River. As previously stated, there are no known groundwater intakes for irrigation. Therefore, it is unlikely that there is contamination of the food chain via these pathways.

There exists the potential for animals to wander on the site property from the wooded areas. Presently, there is no contaminated surface soil or water accessible to animals. However, prior to cleanup of the contaminated soil, it is possible that animals could have been exposed to the chromium by drinking the contaminated surface water runoff or ingesting contaminated soil. The distribution of chromium in animals has been documented in the kidneys, lungs and spleen, following exposure via inhalation. Animals exposed to Chromium 6+ in drinking water show greater bioaccumulation in tissues than those exposed to Chromium 3+ (1). It is not possible to further characterize this potential route of contamination due to a lack of information.

B. HUMAN EXPOSURE PATHWAYS

Based on the available information, the following potential pathways for human exposure to chromium are of concern:

HILLSIDE INDUSTRIAL PARK/PRECISION PLATING:

Present Exposures:

- Dermal exposure to chromium from non-potable water use at the Precision Plating Facility and Hillside Industrial Park (exposure from this route would be low).
- Since there are warning signs on the taps, indirect ingestion of contaminated water is not likely occurring if the warnings are understood and followed.

Volatile Organics (VOC's):

No volatile organics have been detected in air, surface water or groundwater samples. The presence of volatiles was shown in one soil sample and coeluters were detected in three soil samples (SS-2, SS-4D, SS-5) and two soil sediment samples, including one background sample in 1986 (SD-1, SD-3). Please see Appendix 1 for the sample locations. Based on this one sampling event, there is not enough information to quantify potential contamination, though it appears that human exposure is minimal.

Past Exposures:

- Ingestion of chromium contaminated water for an unknown period between the time of the spill in February and May, 1979 until bottled water was supplied to the park and warning signs were placed on taps.
- Ingestion of chromium contaminated water from well #HI-2 for an unknown period of time between 1980-1985.
- Ingestion of potentially contaminated groundwater due to discharge of chromium containing rinse waters along the site towards the storm drain, during an approximate 7 year period prior to 1979. According to EPA calculations, approximately 33,600 gallons of wastewater were discharged during this time.
- Dermal exposure to chromium from potable and non-potable water sources.

HIGH MANOR MOBILE HOME PARK:

Present Exposures:

None indicated

Past Exposures:

- Exposure to chromium contaminated water from one supply well for an unknown period of time, (between December 1979-August 1985), until contamination was detected in well #HM-1 and residents were put on water that was blended from the four remaining wells. Based on the fact that well #HI-2 is situated between the contaminated well #HI-1 at Hillside and the ultimately contaminated well #HM-1 at High Manor Mobile Home Park, it is assumed that exposure does not date prior to December 1979, when well #HI-2 went on line. It may also be assumed that the groundwater flow moved the contamination towards the mobile home park sometime during this 5-year period. Since #HM-1 was only one of five wells supplying water to High Manor Mobile Home Park, it has been estimated by the Connecticut Department of Health Services, Water Supplies Section, that only a portion of the Park received water from that well.
- Dermal and inhalation exposure to chromium from water sources (e.g., showers) for some period of time between 1979-1985 (exposures via these routes would be low).
- Radium--Though naturally occurring radium was found in the water supply, these levels were below the 5 pci/l year standard and were not site related.

PUBLIC HEALTH IMPLICATIONS

Chromium

One contaminant of concern - chromium, has been identified at the Precision Plating facility in Hillside Industrial Park. Multiple routes of exposure have been identified, both on and off site. The public health implications for each of these pathways are addressed below:

1. Dermal exposure to chromium from potable and non-potable sources at both Hillside Industrial Park and potable water sources at High Manor Mobile Home Park.

The most prevalent effects of hexavalent chromium are dermatitis and allergic skin reactions. These compounds may also cause skin ulcerations, ulcerations in the mucous membranes, perforation of the nasal septum and allergic asthmatic reactions. A sensitization dermatitis may also be caused at concentrations below those causing a primary irritant reaction, after variable periods of exposure, but quantitative data on dose levels are not available (1). Though levels from the tap at Hillside Industrial Park and High Manor Mobile Home Park are likely to be lower than levels causing primary irritant reactions, there is still the potential for sensitization skin reactions. Additionally, health effects are more likely to be dependent on

individual immunologic characteristics, rather than on an actual dose response relationship (5).

2. Ingestion of chromium contaminated water at Hillside Industrial Park and High Manor Mobile Home Park between 1979-1985.

As indicated in Tables 1 and 2, chromium concentrations exceeded EPA's maximum contaminant level (MCL) of 0.05 ppm in both wells at Hillside Industrial Park and in one of five wells at High Manor Mobile Home Park (#HM-1). As a result of the removal from service of the highly contaminated well at High Manor, an official violation of the EPA MCL for chromium did not occur. This is because a MCL violation requires 4 repeated quarterly samples over the MCL level. It is important to note that the MCLs pertain only to drinking water, and that health effects resulting from chronic exposure to chromium in domestic water supplies are further compounded by incidental oral, dermal, and inhalation exposures as a result of activities such as showering, bathing, and cooking. Although exposures of this sort vary considerably depending on individual life-styles and situations, each of these exposure routes nonetheless contributes to the overall body burden of chromium and thus increases the potential for chronic, chromium-induced health effects.

No adverse effects have been reported from exposure to trivalent chromium, in part because of its non-corrosivity and poor membrane permeability. Trivalent chromium is an essential element for human glucose and lipid metabolism. The U.S. Food and Nutrition Board has recommended a safe and adequate dietary intake of 50-200 ug chromium/day for the average adult. Though the absorption of chromium through the gastrointestinal tract is minimal in either state, it is more readily absorbed in the trivalent form.

In contrast, hexavalent chromium compounds (chromates) are strong oxidizing agents, permeable to biological membranes and associated with varying degrees of human toxicity. Both acute and chronic adverse effects of chromium are mainly caused by hexavalent compounds. Based on available information, it appears that the potential effects on the kidney are the most likely response to chromium from exposure via drinking water. Low doses of hexavalent chromium produce a relatively specific necrosis of the proximal convoluted tubule of the kidney, leading to pronounced glucosuria (5). Increased absorption of hexavalent chromium has been observed in achylia patients, due to gastric juices not reducing the chromium to the trivalent state (5). However, it must be emphasized that the availability of human exposure data for intermediate or chronic exposures of chromium is quite limited (1). Further research needs to be done before definitive conclusions regarding health effects via this exposure pathway may be reached.

Transplacental transfer of chromium as the GTF (Glucose Tolerance Factor) has been demonstrated. Embryonic and fetal uptake of hexavalent chromium is presumed to be greater than the corresponding levels of trivalent chromium. However, it must be noted that the data regarding

the reproductive toxicity of chromium is not sufficient to conclude whether chromium is a hazard to human reproduction.

No data are available in the literature regarding the carcinogenic effects in humans following oral exposure to chromium. A few animal studies have been conducted with conflicting outcomes. One study detected a non significant increase in stomach tumors in rats exposed to 550 ppm chromium for 880 days. However, IARC (1980) concluded that "calcium chromate 6+ is carcinogenic in rats when given by several routes, producing tumors at the site of administration (1)." Therefore, the data remain inconclusive in terms of the human carcinogenicity potential of chromium via ingestion. Hexavalent chromium is also considered a mutagen but human data for this health outcome is sparse.

3. Inhalation exposure to chromium from potable and non potable water sources at High Manor Mobile Home Park.

Chromium can be absorbed via the inhalation route. It is associated with particulate matter, but it does not exist in a gaseous form. Because there are no known chromium compounds that can volatilize from water, transport from water to the atmosphere via this mechanism is not likely. However, chromium particles can aerosolize and become attached to water droplets, thereby producing respirable mists. Therefore, this route of exposure might have been possible during the period of time that High Manor residents were still using their contaminated well #HM-1. The potential force of shower sprays may have aerosolized the compound into inhalable droplets. Despite these facts it is thought that overall inhalation exposure was not significant relative to other exposure routes.

Chromium absorbed by various exposure pathways appears to be equally distributed among human tissue, with the exception of the lung. Chromium concentrations in lung tissues contain 2-3 times that of other tissue. Evidence indicates that chromium may be deposited in pulmonary tissue in an insoluble form.

Chromium containing aerosol particles with a diameter of 2 μm are deposited in the upper respiratory tract (nose, pharynx), while smaller particles penetrate the trachea, bronchial tubes and alveoli.

Smokers are a particularly exposed population. Tobacco grown in the U.S. has been reported to contain .24-6.3 μg chromium per kg tobacco (IARC), but neither the chemical form nor the amount of chromium in tobacco smoke is known. This is important because exposed individuals at Hillside Industrial Park or High Manor could be smokers and therefore could have increased risks.

Chromium is a known human carcinogen for the inhalation pathway. There is epidemiologic evidence that suggests the risk for respiratory cancer in chromate plant workers is 20 times that for the general public. Bronchogenic carcinoma is the principal lesion, with a latency period of

10-15 years (4). Bronchia asthma, induced by inhalation of chromate dust or chromic acid fumes has also been reported.

VOCs:

The presence of VOCs was detected in soil and sediment samples; however, specific chemicals and concentrations are unknown. Although these chemicals as a group can volatilize readily and are well absorbed orally, dermally and by inhalation, it appears that human exposures are minimal and do not pose a significant health concern.

Radium:

Naturally occurring radium was documented in one well above the 5 pci/1 yr standard. As previously described, water from this well was blended with other wells, so that overall human exposure was never exceeding this standard. Also, filters were installed to further ensure levels would be reduced. Therefore, exposure to radium at levels under the legal standards are not a health concern.

B. HEALTH OUTCOME DATA

Potential sources of health outcome data were considered for this study. Specifically, cancer of the lung is the only known health outcome that might be detected through use of standardized data sources, such as the CT Tumor Registry. However, it must be stressed that inhalation is the least likely route of exposure documented at High Manor Mobile Home Park. Given the latency period required for the onset and detection of this cancer (approximately 15 years), a review of this data will be considered after an appropriate period of time has elapsed from the time of initial exposure.

CONCLUSION

Based on the information reviewed, ATSDR has concluded that this site is an indeterminate public health hazard. Exposures to chromium have occurred in the past but available data cannot document long-term exposures to levels that are expected to cause adverse health effects. In particular, the lack of chromium data from tapwater in High Manor Mobile Home Park between 1979 and 1985 prevent firm conclusions about the level of exposures and effects during that time. However, as noted in the Human Exposure Pathways Section, chromium exposure did occur at Hillside Industrial Park and parts of High Manor Mobile Home Park in the past due to groundwater contamination. There is no current exposure potential at High Manor Mobile Home Park and minimal exposure potential at Hillside Industrial Park.

RECOMMENDATIONS

1. Individuals at the Hillside Industrial Park are presently exposed to chromium contaminated non-potable water supplies. Though contaminated water will be pumped and treated, levels of chromium have been detected

up to 15 ppm during the monthly monitoring process. Care should be taken to reduce dermal exposures to non-potable water supplies to a minimum until the public water line is extended.

- a. Workers at the Hillside Industrial Park should be educated regarding the potential health effects of chromium exposure and methods to keep such exposures to a minimum while they are still using the contaminated water for their non-potable water source. Warning signs currently in place are a primary source for worker education.
2. Monthly monitoring of the contaminated wells should be continued. Additionally, new monitoring wells should begin documenting the shift in the contaminated plume caused by the shutdown of the wells at High Manor Mobile Home Park and the future start up of the pump and treat operation at Precision Plating.
 - a. Perform routine monitoring of water from private wells in homes along Route 30 to determine whether these wells are contaminated with chromium (i.e., Cr⁺³ and Cr⁺⁶). This monitoring should continue until such time as it can be shown that either no contamination is likely or that its concentration does not pose a public health threat. Also, monitoring should be designed to ascertain the vertical or horizontal extent of chromium contamination.
 - b. A complete QA/QC program that follows standard EPA protocol should be put in place to ensure that precise and accurate contaminant levels are being reported for all wells. This should include requiring duplicate samples for each monthly sampling event, as well as confirmation by alternate laboratories on a quarterly or biannual basis.
 3. The intermittent stream to the east and uphill from Precision Plating was described as a groundwater discharge area. Prior samples taken in 1979 indicated levels of chromium between .017-.023 ppm. This stream should be resampled to document whether contamination of groundwater has occurred or is presently occurring in the vicinity of this discharge area.
 4. The presence and extent of volatile organic contamination should be further characterized and quantified. Soils and sediments should be resampled and potential sources of these chemicals should be identified.
 5. Wastewater and soil generated from the installation of monitoring wells should be disposed of in accordance with EPA and State regulations.
 6. Individuals with concerns regarding past potential chromium exposures should consult with their private physicians regarding specific questions relating to effects on kidneys. This may be addressed by notifying the residents of the mobile home park and the employees of the Hillside Industrial Park of this potential health impact. Concerned

individuals would be instructed to notify their physicians that they might have been exposed to low levels of chromium contamination from ingestion of the local groundwater and that appropriate tests should be conducted to document their level of kidney function.

7. In accordance with the Comprehensive Environmental Response, Compensation, and Liability Act as amended, the Precision Plating site, Vernon, Connecticut has been evaluated for appropriate follow-up with respect to health activities. ATSDR recommends that an environmental health education program to advise the public health professional and the local medical community of the nature and possible consequences of exposure to chromium at the Precision Plating Corporation site be established. The value of obtaining a complete and accurate exposure history will be stressed as part of this program. In addition, information that is provided on chromium may include, but not be limited to, the physical nature of the contaminant, potential exposure pathways (i.e., soil, water, air, food) and exposure routes (i.e., inhalation, ingestion, dermal), potential health effects, symptoms of exposure and testing and treatment, if known. This activity will be conducted by the Connecticut Department of Health Services in conjunction with the ATSDR Division of Health Education and the local medical community.
8. Given the latency period (approximately 15 years) required for the onset and detection of lung cancer, the Connecticut Department of Health Services recommends that a review of applicable health outcome data sources (e.g., CT Tumor Registry) be considered after an appropriate period of time has elapsed from the time of initial exposure.

CERTIFICATION

This Health Assessment was prepared by the Connecticut Department of Health Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health assessment was initiated.



Technical Project Officer, SPS, RPB, DHAC

The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this Health Assessment and concurs with its findings.



Division Director, DHAC, ATSDR

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REFERENCES

The following documents were provided to the CT DOH for review. These documents form the basis of this preliminary health assessment. Further information made available after the development of this preliminary health assessment will be addressed in any subsequent health assessment.

1. Agency of Toxic Substances and Disease Registry, "Toxicological Profile for Chromium," Doct. #ATSDR/TP-88/10, July 1989.
2. CT Department of Environmental Protection, Well Sampling Summary Table for Hillside Industrial Park and High Manor Mobile Home Park, 1988-Present.
3. Fuss and O'Neill, Inc., "Investigation of Chromium Contamination, Precision Plating/Hillside Industrial Park, Vernon, CT," July 1988.
4. Hammond, P. and Beliles, R., "Metals," in Casarett and Doull's: Toxicology, the Basic Science of Poisons, Chpt. 17, Klaassen, C., Amdur, M. and Doull, J., 2 eds., Macmillan Pub. Co., New York, NY, 1986, pp. 409-467.
5. Hook, J. and Hewitt, W., "Toxic Responses of the Kidney" in Casarett and Doull's: Toxicology, the Basic Science of Poisons, Chpt. 11, Klaassen, C., Amdur, M. and Doull, J., 2 eds., Macmillan Pub. Co., New York, NY, 1986, pp. 310-329.
6. Langard, S. and Norseth, T., "Chromium," in Handbook on the Toxicology of Metals, 2nd ed. Chpt. 8, Friberg, L., Nordberg, G., and Vouk, V., eds., Elsevier Science Pub., B.V., 1986, pp. 185-207.
7. NUS Corp., "Final Site Inspection Report, Precision Plating, Rockville, CT," TDD-No.-F1-8611-12, July 16, 1987.
8. Roy F. Weston, Inc., "Removal Program Preliminary Assessment for Precision Plating, Rockville, CT," TDD-No.-01-8907-10, August 1989.
9. Stokinger, Hubert, "The Metals", in Patty's Industrial Hygiene and Toxicology, 3rd. ed., chpt. 29, Clayton, G., and Clayton, F., eds., John Wiley and Sons, 1981, pp. 1589-1604.
10. U.S. Environmental Protection Agency, "Final Hazard Ranking System Package, Precision Plating, Rockville, CT," prep. by NUS Corp., Superfund Div., TDD-No.-F1-8706-16, Sept. 15, 1987.

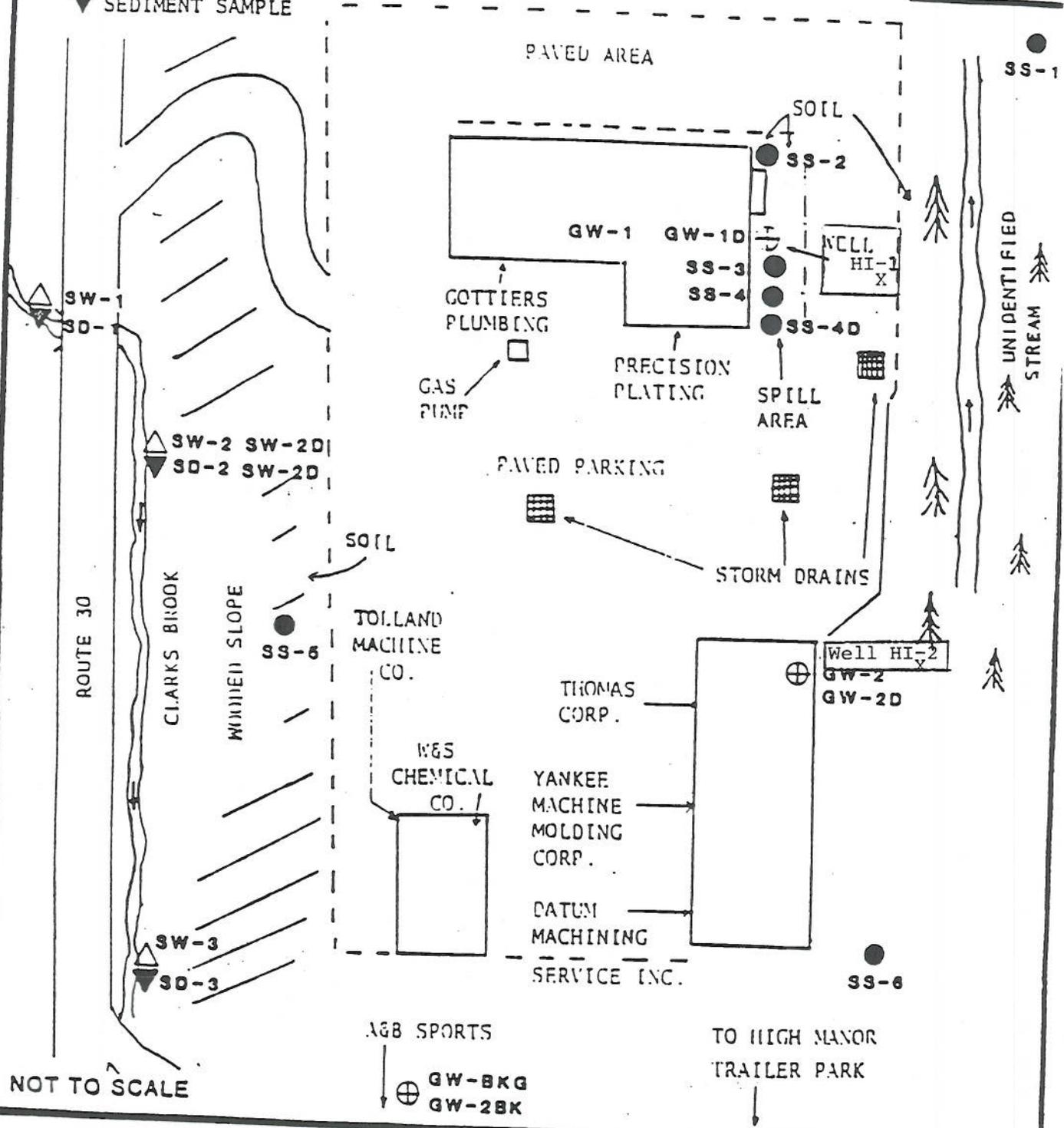
APPENDICES

Appendix 1. Sampling Locations and layout of Hillside Industrial Park.

Appendix 2. Response to Public Comments--Precision Plating Corporation site,
Vernon, Connecticut.

LEGEND:

- ⊕ GROUNDWATER SAMPLE
- SOIL SAMPLE
- △ SURFACE WATER SAMPLE
- ▼ SEDIMENT SAMPLE



NOT TO SCALE

SAMPLE LOCATIONS
PRECISION PLATING
ROCKVILLE, CT



25 APRIL 1986

APPENDIX 2

Response to Public Comments Precision Plating Corporation - NPL Site Vernon, Connecticut

Only one set of written comments was received during the comment period. Listed below is each comment and a response prepared by the Connecticut Department of Health Services, Division of Environmental Epidemiology and Occupational Health. All references to page numbers below correspond to the final draft health assessment that was sent for public comment. Attachments referred to in this appendix are not included; rather, the referenced attachments were sent in letters to the commentors by CT DOH.

Comment #1

It is indicated at the top of page 3 that well #HM-1 was found to be contaminated in May of 1985 and was removed from service without specifying when it was so removed. Please indicate here specifically when the well was removed from service.

Response

The HA was changed to indicate the well was taken out of service in August 1985.

Comment #2

A description of the well system at the Park is necessary. The water provided by well #HM-1, the only well at the Park that was contaminated at levels that made the water non-potable, did not supply all of the tenants at the Park. Certain wells supplied certain areas of the Park and we believe the Department of Health Services (DHS) has this information (You may want to contact Paul Ritsick at DHS) - but please contact me if it cannot be located. Any health effects which may be attributed to chromium exposure would only be applicable to those residents served by well #HM-1. The Human Exposure Pathways section of this Report should not include all of the residents of the park.

Response

Health effects are not predicted for any specific group in the report, but all potential exposures regardless of EPA violations are required in the report. Discussion of a specific toxic response does not imply that those effects are expected at this site. The report is required to enumerate all known toxic effects of agent of concern. The HA was changed to discuss the fact that water from #HM-1 likely resulted in more exposure to certain areas of the park than others.

Comment #3

The Report states that exposure to chromium at the Park could have occurred throughout the period of 1979 (when the spill occurred) through May of 1985. However, the time period of potential exposure is probably much shorter.

First, well #HI-2 (The commentor referenced well #HM-2 here. This appears to be a typo and was changed to #HI-2 here and in the response) upgradient of well #HM-1 was drilled in 1979 and showed levels of total chromium at less than .01 ppm. It is highly improbable that well #HM-1 experienced any chromium contamination before well #HI-2. It is suggested that water quality data for well #HI-2 be reviewed for the period 1979-1985.

Second, DHS has data on chromium levels in water at the Park for the years 1979 through 1985. The DHS, by agreement with High Manor, Inc. (or its predecessor in interest, Leisure Living, Inc.) monitored the water quality in the wells at the Park since at least 1979. (See attached testimony of Paul Ritsick given at deposition on March 21, 1990 at p. 111-112). According to the regulations governing water quality the water at the Park would have been tested for chromium annually and only when an elevated level was detected would quarterly monitoring be required. See Regulations of Connecticut State Agencies ("RCSA") S19-13-B102 and 40 CFR S141.23. We expect the DHS lived up to its agreement and monitored the Park wells for chromium several times between 1979 and 1985 and did not discover contamination until 1985 when the affected well was removed from service. We request that you thoroughly review all of DHS' records concerning water quality at the Park for the period 1979 through 1985.

The Conclusion and Recommendations in the report with regard to exposures at the Park should be substantially altered if data during the 1979-1985 period show no elevated level of chromium in #HM-1.

Response

No data is available from HI-2 from 1979-1985. Data from 1979-May 1985 from High Manor did not have any chromium measures for #HM-1. Therefore it is not possible to estimate how long residents were exposed to chromium from the well. Only data on blends of wells #HM-5, 6, and 7 are available during this period.

Comment #4

The report fails to mention that the only time the water quality at the Park was detected to be in violation of drinking water standards was in May of 1985 when well #HM-1 was found to have an elevated level of chromium. (See Ritsick deposition March 21, 1990 at p. 100, attached). The immediate response of the water

supplier was to take the well out of service. Other than this one instance, the DHS has determined that no violations of the State or Federal drinking water standards for chromium occurred. The report should highlight this information since the State and Federal drinking water standards are health based and it is assumed that exposure below these levels is safe.

Response

The levels of exposure which would violate State and Federal standards will be indicated. But the Health Assessment is required to list all possible and completed pathways regardless of level of chromium elevation over background. The report does not predict health effects for any of the exposures but does indicate areas of uncertainty.

Comment #5

The report on page 9 indicates that monitoring of wells at the Park did not commence until 1988. Attached you will find data compiled by Steve Klobukowski of DHS showing data on chromium levels in the Park's water supply from 1985 through 1988. This data, as well as that mentioned in #3 above, should be reviewed and the Conclusion and Recommendations in the report should be revised accordingly. A review of the "References" at page 20 of the report indicates that no DHS data was reviewed. This is truly a shocking omission as it is the DHS which is responsible for regulating drinking water quality in the State of Connecticut. This report is hardly reliable without careful consideration of this data.

Response

The statement that well monitoring began in 1988 was placed out of context and will be removed. All DHS well data from High Manor was reviewed prior to drafting the HA.

Comment #6

The conclusions on pages 14 and 15 regarding past exposures at the Park should be revisited after consideration of DHS data. Additionally, there is no mention of ingestion as an exposure pathway. Since this pathway is discussed in the "Public Health Implications" section the report, it should specifically state whether or not ingestion was a past exposure pathway for residents of the Park. The report should also state whether health effects from a past dermal exposure could continue beyond the exposure period. It seems dermal exposures are acute and would only have occurred prior to May or June of 1985, if at all.

With regard to exposure through inhalation when showering, the report should specifically state that no air monitoring was done

at the Park and neither was any done with a shower running. Therefore, this potential exposure pathway is not confirmed with any data as to whether or not chromium ever became dispersed in a respirable mist. While the report at page 16 admits that this is an unlikely route for exposure it should also be emphasized that there is no factual data to support the notion that chromium, at the level detected for the Park's well #HM-1, could be inhaled while showering.

Response

DHS data was reviewed prior to preparation of conclusion on pages 14 and 15. Ingestion is discussed as a past exposure at the bottom of page 14. The dermal toxicity of chromium is discussed on page 15. Inhalation is discussed as a potential exposure pathway and is a required part of the HA.

Comment #7

The health effects of exposure identified on page 15 through 17 should be related to the level of contamination (i.e., two times drinking water standards, ten times drinking water standards, one hundred times drinking water standards, etc.) and to duration of exposure (e.g., do these health effects result from one year of exposure at three times drinking water standards?, etc.). Without some point of reference, the conclusions of possible health effects from exposure are meaningless.

Response

Insofar as possible, the report now does this. Note that the likelihood of the action is mentioned when there is data to quantitate the exposure. In most cases there is simply mention of possible actions of chromium as is required for completeness.