Public Health Assessment for

PLATING INC. SITE
GREAT BEND, BARTON COUNTY, KANSAS
EPA FACILITY ID: KSD065735912
FEBRUARY 27, 2009

For Public Comment

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

Comment Period Ends:

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THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment-Public Comment Release was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate. This document represents the agency's best efforts, based on currently available information, to fulfill the statutory criteria set out in CERCLA section 104 (i)(6) within a limited time frame. To the extent possible, it presents an assessment of potential risks to human health. Actions authorized by CERCLA section 104 (i)(11), or otherwise authorized by CERCLA, may be undertaken to prevent or mitigate human exposure or risks to human health. In addition, ATSDR will utilize this document to determine if follow-up health actions are appropriate at this time.

This document has previously been provided to EPA and the affected state in an initial release, as required by CERCLA section 104 (i) (6) (H) for their information and review. Where necessary, it has been revised in response to comments or additional relevant information provided by them to ATSDR. This revised document has now been released for a 30-day public comment period. Subsequent to the public comment period, ATSDR will address all public comments and revise or append the document as appropriate. The public health assessment will then be reissued. This will conclude the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared by:

The U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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Summary

The Agency for Toxic Substances and Disease Registry (ATSDR) conducted a public health evaluation of the Plating Inc. site in Great Bend, Kansas in response to the agency's congressional mandate to conduct a public health assessment for all sites on the National Priorities List (NPL). The U.S. Environmental Protection Agency (EPA) added the Plating Inc. site to the NPL in March 2008.

Plating Inc., a former chromium and zinc plating facility, is located in an industrial area near the Great Bend Airport approximately 4 miles southwest from the center of Great Bend, Kansas. The site is surrounded by light industrial, commercial, and agricultural land. Total chromium, hexavalent chromium, and dissolved chromium were detected in the groundwater under the site as a result of a leaking chromium tank inside the facility. Concentrations of chromium in private wells, monitoring wells, and remedial wells exceeded EPA's Maximum Contaminant Level (MCL). The associated groundwater plume, approximately 2 ¼ miles long and 1/3 mile wide, extends from the facility in a northeasterly direction [Tetra Tech 2008].

The purpose of this public health assessment (PHA) is to review available environmental data to assess the possible heath implications of exposures to chromium in the groundwater. Both private wells and public water supply wells provide drinking water to the Great Bend area. For this site, the primary route of human exposure is ingestion of chromium in the drinking water.

ATSDR reviewed available sampling data for 11 private wells and four public water supply wells that were tested for chromium in the affected groundwater plume area. Of note, ATSDR recognizes that some private wells near and within the chromium plume did not participate in the monitoring program. ATSDR cannot evaluate the public health implications of potential private well water exposures for these wells because data were not available.

Of the 11 private wells tested, eight serve area businesses and three are domestic wells. Chromium was not detected in the three domestic wells. Seven of the eight wells serving areas businesses detected chromium at least once, although not all wells were monitored regularly. In the past, two of the wells serving area businesses (PW-1 and PW-2) have exceeded regulatory guidelines, but these businesses currently receive bottled water and do not use their wells for drinking water. Prior to receiving bottled water, chromium levels in these two wells were below levels of health concern. The levels of chromium detected in the other five wells serving area businesses were below levels of health concern as well.

Chromium was not detected in three of the four public water supply wells. Chromium levels in one public water supply well (PWS-8) are below levels of health concern, as well as below regulatory guidelines for public drinking water.

ATSDR determined that exposures to chromium detected in seven private wells serving area businesses and one public water supply well are not expected to result in harmful health effects. Therefore, ATSDR concludes these exposures represent No Apparent Public Health Hazard[1].

However, chromium levels detected in monitoring wells near the Plating Inc. facility indicate that chromium exposures would be of health concern if people were to drill private wells in this area for use as a drinking water source. In addition, quarterly monitoring data were not available for all 11 private wells, including a private well (PW-11) located near PW-1 and PW-2.

In general, ATSDR considers reducing or minimizing exposures to hazardous chemical contaminants a prudent public health measure. ATSDR makes the following recommendations.

1. Continue remedial efforts to reduce chromium levels in groundwater.
2. Continue to provide bottled water to the two affected businesses currently receiving bottled water.
3. Regularly monitor affected private wells and public water supply wells to ensure that chromium concentrations remain below levels of health concern.
4. Monitor additional private wells that are found to be within and near the chromium plume area.
5. Restrict the installation of private wells for use as a drinking water source in areas within and near the chromium plume.
6. Consider additional investigations to characterize the horizontal and vertical extent of the chromium groundwater plume.

1 “No Apparent Public Health Hazard” is one of ATSDR’s five conclusion categories. This category applies to sites where exposure to site-related chemicals might have occurred in the past or is still occurring, but the exposures are not at levels likely to cause adverse health effects.

Background

Plating Inc. is located at 8801 West 6th Street in Great Bend, Barton County, Kansas in an industrial park known as the Westport Addition. The site is near the Great Bend Airport, which is surrounded by land used for a mix of light industrial, commercial, and agricultural purposes. The City of Great Bend consists of approximately 15,500 people according to 2007 estimates [Census Bureau 2009]. Most homes within the city limits of Great Bend are connected to the public water supply (PWS); however, there may be some homes that have not connected to the PWS [City of Great Bend 2008]. There are also a few homes and businesses outside of the city limits that use a private well as a source of water.

Plating Inc. began chromium plating operations in 1968. Twenty years later, in 1988, the Kansas Department of Health and Environment (KDHE), Bureau of Waste Management (BWM) conducted a site inspection at the facility and found soil contaminated with chromium. In January 1989, KDHE executed an Order Assessing an Administrative Penalty that required Plating Inc. to address violations of state and federal laws for handling and storage of hazardous wastes; the order also required Plating Inc. to remove the contaminated soil found at the site [Tetra Tech 2008].

In May 1990, the contaminated soil was excavated under supervision of KDHE/BWM. The following August, a chromium fume scrubber was installed on the process exhaust to prevent further chromium contamination of the soil surrounding the Plating Inc. facility [Tetra Tech 2008].

In 1991, an inspection report from KDHE/BWM noted a problem with the "deep chrome tank" [Tetra Tech 2008]. Twenty-two feet of the deep chrome tank were below grade and two feet of the tank were above grade. The outer, corrugated liner for the tank was rusted and cracked. KDHE sent letters (dated October 10, 1990 and March 5, 1991) to the owner of the site requiring a retrofit of the deep chrome tank to stop the seepage. Subsequently, KEJR Science Group, Inc. performed soil and groundwater sampling to characterize the soil and groundwater contamination at the site. The investigation found that the groundwater was contaminated with chromium.

In 1993, a KDHE/BWM inspection report noted the space between the original chromium tank and the new chromium tank insert had been filled with concrete. The tank was presumed to be sealed from groundwater contact at that time. The site was transferred from the KDHE/BWM to KDHE Bureau of Environmental Remediation (BER) in 1993 [Tetra Tech 2008].

In 1994, Plating Inc. signed a Consent Order with KDHE to conduct a Comprehensive Investigation/Corrective Action Study and Corrective Action Plan that included investigation and remediation of the chromium contamination from the facility. KEJR Science Group was contracted by Plating Inc. to prepare and implement the work plan upon KDHE approval. KDHE approved the work plan in the summer of 1994 [Tetra Tech 2008].

From 1994 to 2000, Plating Inc. investigated the extent of the groundwater contamination. Results indicated that the contamination extended into the aquifer at least 60 feet below ground surface (bgs). In general, there are three different contaminated water bearing zones that were identified: (1) the first aquifer is located 10 – 25 feet bgs, (2) the second aquifer is located 30 – 40 feet bgs, and (3) the third aquifer is 45 – 60 feet bgs. The depth, thickness, and presence of the three water bearing zones vary across the study area. Contaminated groundwater is migrating from the site in a northeasterly direction [Tetra Tech 2008]. Figures 1 and 2, Appendix A, show the general location and flow direction of the chromium groundwater plume.

Field data from 2004 indicated the contamination plume in the first water bearing zone was approximately 2 ¼ miles long and extended from the site to the area of 10^{th} and Patton Road. The contamination in the second water bearing zone was about one mile long and extended close to the area where the flood control ditch intersects SW 30 Avenue to the southwest of Great Bend. The contamination in the third water bearing zone was at least 1.75 miles long extending to the area of the intersection of SW 2 Road and SW 26 Avenue [KDHE 2006]. At this time, it is not known whether the contamination extends into water bearing zones deeper than 60 feet bgs.

In 1998, Plating Inc. installed a shallow remedial well, RW-1, in the area of 10^{th} and Patton Road to contain the shallow plume. In 2001, it was discovered that RW-1 was not fully containing the plume. In 2002, a new shallow remediation well, RW-1a, was installed at a location south of RW-1 [Tetra Tech 2008].

In 2004 and 2005, KDHE/BER conducted several field events at the site to profile groundwater for chromium concentrations. KDHE/BER took samples from 56 direct push wells (DPW) and installed six small diameter wells [Tetra Tech 2008].

On November 4, 2005, Plating Inc. ceased operations leaving several vats of electroplating solutions on the site.

In March 2006 and January 2007, KDHE conducted inspections at the site to determine whether the facility was in compliance with waste management regulations. Chrome plating wastes and other hazardous and non-hazardous wastes were identified on the site [Tetra Tech 2008].

In July 2006, KDHE referred the site to EPA for a Hazard Ranking System (HRS) evaluation.

In January 2007, KDHE referred the site to EPA Region VII Enforcement/Fund-Lead Removal (EFLR) Branch of the Superfund Division, with a recommendation for a time-critical removal action. EPA approved an Action Memorandum in the fall of 2007 to remove the wastes from the facility. During October and November of 2007, all wastes were removed from the site and transported to appropriate facilities for disposal, after which a decontamination of the interior of the facility was conducted. Additionally, further soil sampling was conducted. The results showed that remaining chromium concentrations in the soil were all below risk-based standards and similar to background levels in Kansas [Tetra Tech 2008].

In March 2008, EPA added the Plating Inc. site to the NPL of uncontrolled hazardous waste site based on its evaluation under HRS.

Community Health Concerns

As part of the public health assessment process, ATSDR staff reviewed site documents and spoke with key stakeholders. These stakeholders included two businesses with private wells near and within the chromium groundwater plume area and representatives from local government agencies. At this time, ATSDR has not identified any concerns from community members regarding environmental health issues. However, during this document's public comment period, ATSDR and EPA will hold joint public availability sessions. ATSDR will address community health concerns expressed by Great Bend residents during these sessions and will include those concerns, without attribution, in the final version of this document.

Exposure Pathway Analysis

To determine whether people are being exposed to contaminants or whether they were exposed in the past or will be exposed in the future, ATSDR examines the path between a contaminant and a person or group of people who could be exposed. Completed exposure pathways have five required elements. ATSDR evaluates each pathway at a site to determine whether all five factors exist. These five factors or elements must exist for a person to be exposed to a contaminant:

(1) a source of contamination
(2) transport through an environmental medium
(3) a point of exposure
(4) a route of human exposure, and
(5) an exposed population.

ATSDR classifies exposure pathways in one of the following three categories [ATSDR 2005].

- *Completed Exposure Pathway*. A completed pathway exists when there is direct evidence or a strong likelihood that people have in the past or are presently coming in contact with site-related contaminants.
- *Potential Exposure Pathway.* Potential pathways indicate that exposure to a contaminant could have occurred in the past, could be occurring currently, or could occur in the future. A potential pathway exists when information about one or more of the five elements is missing or uncertain.
- *Eliminated Exposure Pathway*. Suspected or possible exposure pathways can be ruled out (i.e., eliminated) if the site characteristics make past, current, and future exposures extremely unlikely.

Use of the City of Great Bend public water supply wells and private wells represents a completed exposure pathway. Exposure can occur by dermal contact, but ATSDR considers ingestion of the water the primary route of exposure. Inhalation exposures from indoor water use (showering and washing) are not considered because chromium is not volatile and therefore an inhalation exposure is not expected. Figure 1, Appendix A, shows the locations of the public water supply wells and private wells.

Past, current and future exposure to the soil at the site is considered an eliminated exposure pathway. Because the Plating Inc. site is in an industrial park and not near residences, community members are unlikely to be exposed to the soil. Furthermore, soil contamination was limited to the area surrounding the Plating Inc. facility and was removed during the 1990 soil removal action.

Environmental Data

ATSDR's approach to evaluating a potential health concern has two components. The first component involves a screening process that could indicate the need for further analysis. The second component involves a weight-of-evidence approach that integrates estimates of likely exposure with information about the toxicology and epidemiology of the substances of interest. Screening is a process of comparing appropriate environmental concentrations and doses to health-based comparison values. The comparison values used to screen the chromium data in this PHA are ATSDR's Reference Dose Media Evaluation Guides (RMEGs) for hexavalent chromium and EPA's Maximum Contamination Level (MCL) for total chromium.

Appendix B contains the definitions of these values. These health-based comparison values are media-specific concentrations considered safe using default conditions of exposure. Default conditions are typically based on estimates of exposure in most (i.e., the 90th percentile or more) of the general population. Comparison values are not thresholds of toxicity. When a level is above a comparison value, it does not mean that health effects could be expected—it does, however, represent a point at which further evaluation is warranted.

Groundwater sampling data provided are from 1996 through 2007. Results from public water supply wells and some private wells are presented as quarterly results, although samples were not collected every quarter. In some cases, there may be as few as five samples between 1996 and 2007. In other instances, there are gaps in the sampling from one quarter or up to a period of several years. Tables 1 and 2, Appendix A, contain the results for public water supply wells and private wells, respectively [EPA 2008].

A location map of the chromium plume was released in 1997 (see Figures 1 and 2, Appendix A). Since 1997, the plume most likely has continued to move in a northeasterly direction, following the flow of local groundwater, and has moved in the vicinity of the City of Great Bend public water supply wells (PWS-8 and PWS-5). From 1996 through 2007, quarterly sampling results from the City of Great Bend PWS-8 show that chromium levels have not steadily increased or decreased, but have fluctuated at levels just above the chromium detection limit. Although the data are limited for PWS-5, chromium has not been detected. Generally speaking, most monitoring wells are showing some decline in chromium levels. To further delineate the plume, ATSDR recommends additional investigations to characterize the extent of chromium contamination (horizontal and vertical) from the site.

ATSDR evaluated the available environmental sampling information by focusing on available groundwater data for total chromium and hexavalent chromium. The information included sampling data for public water supply wells, private wells, monitoring wells, and remedial wells in the affected area. Overall, ATSDR's review of the available data indicated that concentrations of chromium in private water wells serving area businesses exceeded ATSDR's child RMEG (0.030 milligrams per liter (mg/L)) and adult RMEG (0.1 mg/L) for hexavalent chromium, as well as EPA's MCL (0.1 mg/L) for total chromium. Chromium levels in monitoring wells and remedial wells also exceeded ATSDR's RMEGs and EPA's MCL. Chromium was detected in one public water supply well (PWS-8), but at levels below ATSDR's RMEGs and EPA's MCL. ATSDR did not review Quality Analyses or Quality Control processes or procedures (QA/QC) for the data. However, it is assumed that the data are acceptable for the purpose of a health evaluation.

Discussion

In this section, ATSDR addresses the question of whether exposure to total chromium and hexavalent chromium at the concentrations detected would result in adverse health effects. While the relative toxicity of a chemical is important, the human body's response to a chemical exposure is determined by several additional factors. These factors include

- the concentration (how much) of the chemical the person was exposed to,
- the amount of time the person was exposed (how long), and
- the way the person was exposed (through breathing, eating, drinking, or direct contact with something containing the chemical).

Lifestyle factors (for example, occupation and personal habits) have a major impact on the likelihood, magnitude, and duration of exposure. Individual characteristics such as age, sex, nutritional status, overall health, and genetic constitution affect how a human body absorbs, distributes, metabolizes, and eliminates a contaminant. A unique combination of all these factors will determine the individual's physiologic response to a chemical contaminant and any harmful health effects the individual may suffer as a result of the chemical exposure.

For completed exposure pathways where chemical levels are above screening values, two key steps in ATSDR's analysis involve (1) comparing the estimated site-specific exposure doses with observed effect levels reported in critical studies and (2) carefully considering study parameters in the context of site exposures [ATSDR 2005]. This analysis requires the examination and interpretation of reliable substance-specific health effects data. This includes reviews of epidemiologic (human) and experimental (animal) studies. These studies are characterized within ATSDR's toxicological chemical-specific profiles. Each peer-reviewed chemical profile identifies and reviews the key literature that describes a hazardous substance's toxicologic properties. Appendix C contains chromium information from ATSDR's toxicological profile.

The following text provides ATSDR's public health evaluation.

Public Water Supply Wells

ATSDR reviewed City of Great Bend well sampling data collected June 25, 1996, to December 3, 2007, for Public Water Supply (PWS) wells PWS-5, PWS-8, Airport PWS-3, and Airport PWS-4 (see Table 1, Appendix A).

Because PWS-8 appears to be located within the general groundwater flow direction of the chromium plume, it has been sampled more frequently than the other PWS wells. PWS-8 was sampled during 33 of 38 quarterly sampling events and analyzed for total chromium. One of the 33 samples was not preserved properly. Ten of the 33 samples reported total chromium at levels less than 0.01 mg/L (i.e., total chromium was not detected in these samples). Of the remaining 22 samples, total chromium ranged from 0.01 mg/L to 0.027 mg/L, with an average of 0.016 mg/L. These data indicate that total chromium levels were consistently below EPA's MCL (0.1 mg/L) for total chromium. EPA's MCLs are the maximum allowable concentration for specific chemicals in public drinking water. MCLs are considered protective of public health over a lifetime of exposure. Because all total chromium levels in PWS-8 were below this protective guideline, ATSDR determined that exposure to total chromium would not be expected to result in harmful health effects.

PWS-8 was also sampled during 23 of 38 quarterly sampling events and analyzed for hexavalent chromium. Twenty-one of the 23 samples reported hexavalent chromium at levels less than 0.01 mg/L or less than 0.02 mg/L (i.e., not detected). Hexavalent chromium was detected in only two samples at a level of 0.02 mg/L. These data indicate that hexavalent chromium levels were consistently below ATSDR's child RMEG (0.030 mg/L) and adult RMEG (0.1 mg/L) for hexavalent chromium. ATSDR's RMEGs are estimates of daily human exposure to a chemical that are not likely to result in harmful health effects over a lifetime of exposure. As such, ATSDR determined that exposure to hexavalent chromium would not be expected to result in harmful health effects.

However, as stated previously, PWS-8 appears to be located within the general groundwater flow direction of the chromium plume and therefore is threatened by the release of chromium into the groundwater. To date, the chromium data for PWS-8 have not indicated levels of health concern and detected chromium levels are below EPA's MCL. ATSDR recommends quarterly sampling of this well continue to ensure chromium levels remain below levels of health concern.

Because they are less likely to be affected by the chromium plume, PWS-5, Airport PWS-3, and Airport PWS-4 were sampled with much less frequency. PWS-5 was sampled during 8 of 38 quarterly sampling events and analyzed for total chromium; however, all eight sampling events reported total chromium at levels less than 0.01 mg/L (i.e., not detected). Hexavalent chromium analysis for three samples from PWS-5 reported levels of less than 0.01 mg/L or less than 0.02 mg/L (i.e., not detected). Of the four sampling events that occurred for Airport PWS-3 and Airport PWS-4, samples were analyzed for total chromium during each event, but only once for hexavalent chromium. Results of the sampling events for Airport PWS-3 and Airport PWS-4 were all less than 0.01 mg/L for total chromium and less than 0.02 mg/L for hexavalent chromium (i.e., not detected). Because total chromium and hexavalent chromium have not been detected in PWS-5, Airport PWS-3, and Airport PWS-4, no harmful health effects from chromium exposure are expected.

Private Wells

ATSDR reviewed total chromium and hexavalent chromium results collected from 11 private wells in the general plume area. Eight of these wells serve area businesses and three are used for domestic supply to area homes. Of note, during ATSDR's site visit, staff noticed a mobile home directly across SW 40 Avenue from the industrial park and south of SW 10th Road that contained a private well head in the yard [ATSDR 2008]. Although based on the available chromium plume location map, it does not appear the plume has impacted this well, no data are available to confirm that the well does not contain chromium. It is also not known whether this well is currently being used for drinking water purposes. Further investigation of this well is recommended.

Total chromium, hexavalent chromium, or both, were detected in seven private wells that serve area businesses. For 5 of the 7 private wells (PW-1, PW-2, PW-3, PW-4 and PW-5), samples were collected about every quarter from June 1996 to December 2007 and analyzed for total chromium (see Table 2, Appendix A). Hexavalent chromium was analyzed for less frequently in these five wells. For private well 6 (PW-6), 12 samples were analyzed for total chromium and eight samples were analyzed for hexavalent chromium. Only two samples were analyzed for total chromium and one sample was analyzed for hexavalent chromium in PW-11. Of these seven wells, PW-1 and PW-2 have detected chromium in the past at levels an order of magnitude (10-fold) above levels found in the other private wells. ATSDR notes that PW-11 did not participate in the quarterly monitoring program, yet it is near PW-1 and PW-2 (see Figure 1, Appendix A). If the owners of PW-11 had agreed to participate in the quarterly monitoring program, PW-11 might have detected higher chromium levels in the past. Overall, results for these seven wells indicated total chromium ranged from less than 0.01 mg/L to 0.232 mg/L and hexavalent chromium ranged from less than 0.01 mg/L to 0.22 mg/L.

Although only tested sporadically, total chromium and hexavalent chromium were not detected in the other four wells (PW-7, PW-8, PW-9, and PW-10). Of note, PW-7, PW-8, and PW-10 are domestic private wells, and PW-7 is no longer in use. PW-9 serves an area business.

For most private wells that supply area businesses, total chromium and hexavalent chromium levels were below ATSDR's adult RMEG for hexavalent chromium and EPA's MCL for total chromium. Although a few detections exceeded ATSDR's child RMEG for hexavalent chromium, children are not expected to be drinking water from area businesses on a daily basis.

However, two private wells (PW-1 and PW-2) that supply water to area businesses showed total chromium and hexavalent chromium levels above ATSDR's RMEGs for hexavalent chromium and EPA's MCL for total chromium. KDHE placed these businesses on bottled water for drinking water purposes before their levels exceeded EPA's MCL [ATSDR 2009b]. The maximum total chromium level detected was 0.232 mg/L in October 2001; this same sample was also analyzed for hexavalent chromium and found to be at a level of 0.2 mg/L. As stated previously, ATSDR notes the potential for PW-11 to have had elevated chromium levels in the past, but routine monitoring data were not available for this well.

Based on available data for all seven private wells that detected chromium, the maximum total chromium and hexavalent chromium levels found in water that people drank were 0.094 mg/L and 0.09 mg/L, respectively. These levels were found in PW-1 just before the business was placed on bottled water. ATSDR estimated worst case exposure doses for adults and children using these maximum levels. Estimating an exposure dose requires identifying how much, how often, and how long a person may come in contact with some concentration of the contaminant in a specific medium (like water). Exposure doses help determine the extent to which an exposure might be associated with harmful health effects.

In the absence of complete exposure-specific information, ATSDR applied several conservative exposure assumptions to define site-specific exposures as accurately as possible. For example, ATSDR assumed adults drink 2 liters of water every day and weigh 70 kilograms and children drink 1 liter of water every day and weigh 10 kilograms. Based on these assumptions, the estimated adult exposure dose is 0.003 milligrams per kilogram per day (mg/kg/day) for both total chromium and hexavalent chromium; the estimated child exposure dose is 0.009 mg/kg/day. These estimated exposure doses are about two orders of magnitude (100-fold) below ATSDR's benchmark dose[2] for intermediate oral effects (0.52 mg/kg/day) and one order of magnitude (10-fold) below ATSDR's benchmark dose for chronic oral effects (0.09 mg/kg/day) (see Appendix C for further information on chromium). All other total chromium and hexavalent chromium levels found in private wells would result in lower estimated doses because their chromium levels were lower than the chromium levels ATSDR used to estimate exposure doses. Therefore, ATSDR determined that exposure to the detected total chromium and hexavalent chromium levels in these seven private wells serving area businesses would not be expected to result in harmful health effects. Furthermore, based on the data available to ATSDR, no one is drinking water from these seven private wells with total chromium or hexavalent chromium above EPA's regulatory guideline (MCL).

However, as stated previously, these private wells are within and near the chromium groundwater plume and routine monitoring data were not available for PW-11 in the past. Although ATSDR's evaluation did not find that the chromium levels detected in these wells were of health concern, these wells are threatened by the release of chromium into the groundwater and quarterly monitoring data were not available for all 11 private wells. ATSDR recommends regular sampling of these wells to ensure chromium levels remain below levels of health concern. Because PW-1 and PW-2 have exceeded EPA's MCL for total chromium in the past, as a prudent public health measure, ATSDR recommends these well owners continue to be provided bottled water for drinking water purposes. In addition, ATSDR recommends monitoring of additional private wells that are found to be within and near the plume area, such as the well ATSDR noted that is across the street from the industrial park.

Of note, ATSDR cannot evaluate the public health implications of potential private well water exposures that may have occurred before monitoring of the chromium groundwater plume began in 1996 because data are not available for that timeframe.

Monitoring Wells

Although there is no exposure to monitoring well water, ATSDR reviewed data for these wells to further understand areas where well water might be affected. In general, monitoring wells can help investigators define the horizontal and vertical extent of groundwater contamination.

2 The benchmark dose is usually defined as the lower confidence limit on the dose that produces a specified magnitude of change in a specified adverse response. The benchmark dose is determined by modeling the dose response curve in the region of the dose response relationship where biologically observable data are feasible.

Although monitoring wells and private wells are different in their intended purpose, their construction is very similar.

Currently, groundwater samples from 45 monitoring wells have been collected and analyzed for total chromium, hexavalent chromium, and dissolved chromium. Some of the monitoring wells existed prior to the investigation of the Plating Inc. site. Other monitoring wells were installed specifically for the Plating Inc. site. Of the 45 monitoring wells sampled, 22 well samples had results with chromium levels greater than the ATSDR's RMEGs for hexavalent chromium and EPA's MCL for total chromium. Monitoring well 33 (MW-33) had the highest levels of chromium with a maximum detected level of 85 mg/L and an average of 29.2 mg/L from 7 samples taken from August 1997 to May 2006. The results were greatest in 1999 and dropped to 3.32 mg/L by 2006. MW-33 is located northeast of the Plating Inc. facility, across the road from the facility and very near the source of the contamination. Overall, chromium levels detected in monitoring wells near the facility indicate that chromium exposures would be of health concern if people were to drill private wells in this area for use as a drinking water source.

Remedial Wells

Although there is no exposure to remedial well water, ATSDR also reviewed data for these wells. Remedial wells are installed to extract contaminants from below the ground surface in groundwater. In the case of the Plating Inc. site, the contaminated water that is extracted from the ground is discharged directly into the City of Great Bend's storm water/wastewater collection system, continues to the local wastewater treatment facility, and is properly treated prior to discharge back into the environment. Sampling results from both RW-1 and RW-1a show a slight fluctuation in chromium levels, but neither an increase nor decrease over the time that the two wells have been in operation. Some total chromium and hexavalent chromium levels were greater than the ATSDR's RMEGs for hexavalent chromium and EPA's MCL for total chromium.

Child Health Considerations

ATSDR considers children in its evaluations, and we use health guidelines that are protective of children. In general, a child's lower body weight results in a greater dose of hazardous substance per unit of body weight.

For the Plating Inc. site, ATSDR considers the public water supply wells and private wells to be a completed exposure pathway for children. Children are not expected to be exposed to the contaminated groundwater from area businesses' private wells because the businesses are industrial in nature. However, as a protective measure, ATSDR assumed children were exposed daily to the businesses' well water. Overall, ATSDR determined that exposures to chromium detected in seven private wells serving area businesses and one public water supply well are not expected to result in harmful health effects (see Discussion section).

However, as stated previously, routine monitoring data were not available for PW-11. Although ATSDR's evaluation did not find that the chromium levels detected in these wells were of health concern for children, these wells are threatened by the release of chromium into the groundwater and quarterly monitoring data were not available for all 11 private wells. ATSDR recommends regular sampling of these wells to ensure chromium levels remain below levels of health concern.

Conclusions

ATSDR reviewed available sampling data for wells in the affected groundwater plume area. ATSDR determined that exposures to chromium detected in seven private wells serving area businesses and one public water supply well are not expected to result in harmful health effects. Therefore, ATSDR concludes these exposures represent No Apparent Public Health Hazard[3].

However, elevated chromium levels have been documented in groundwater. Chromium levels detected in monitoring wells near the Plating Inc. facility indicate that chromium exposures would be of health concern if people were to drill private wells in this area for use as a drinking water source. In the past, two private wells serving area businesses (PW-1 and PW-2) have exceeded regulatory guidelines; of note, these two wells serve businesses that receive bottled water and do not use their wells for drinking water. In addition, quarterly monitoring data were not available for all 11 private wells, including a private well (PW-11) located near PW-1 and PW-2. Also, there could be private wells potentially in the affected groundwater plume area that have never been tested.

Recommendations

ATSDR considers reducing or minimizing exposures to hazardous chemical contaminants a prudent public health measure.

1. Continue remedial efforts to reduce chromium levels in groundwater.
2. Continue to provide bottled water to the two affected businesses currently receiving bottled water.
3. Regularly monitor affected private wells and public water supply wells to ensure that chromium concentrations remain below levels of health concern.
4. Monitor additional private wells that are found to be within and near the chromium plume area.
5. Restrict the installation of private wells for use as a drinking water source in areas within and near the chromium plume.
6. Consider additional investigations to characterize the horizontal and vertical extent of the chromium groundwater plume.

3 “No Apparent Public Health Hazard” is one of ATSDR’s five conclusion categories. This category applies to sites where exposure to site-related chemicals might have occurred in the past or is still occurring, but the exposures are not at levels likely to cause adverse health effects.

Public Health Action Plan

The purpose of the public health action plan is to ensure that this evaluation not only identifies potential and ongoing public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. EPA and KDHE are aware of ATSDR's public health conclusions and recommendations. Additional follow-up activities are currently being planned.

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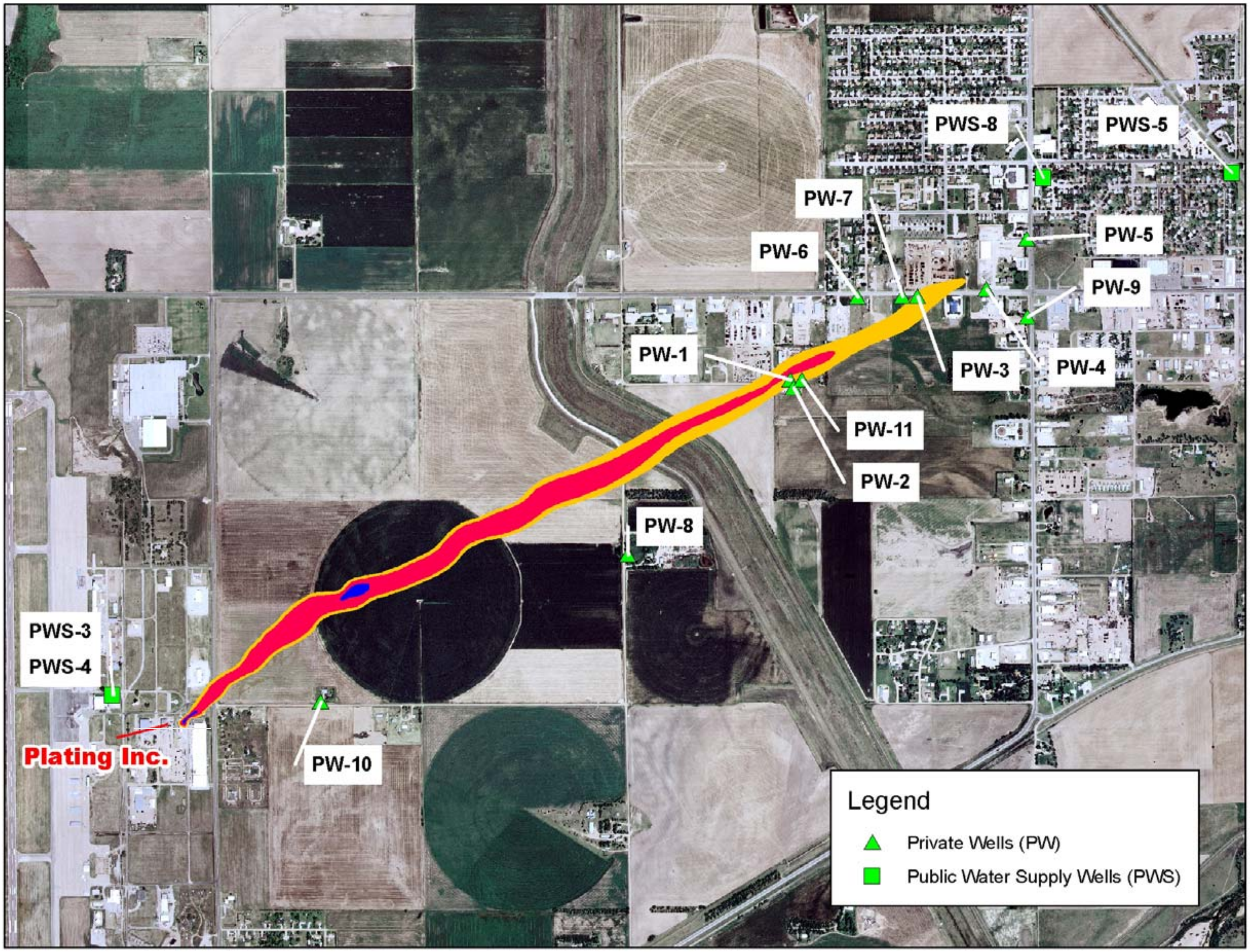
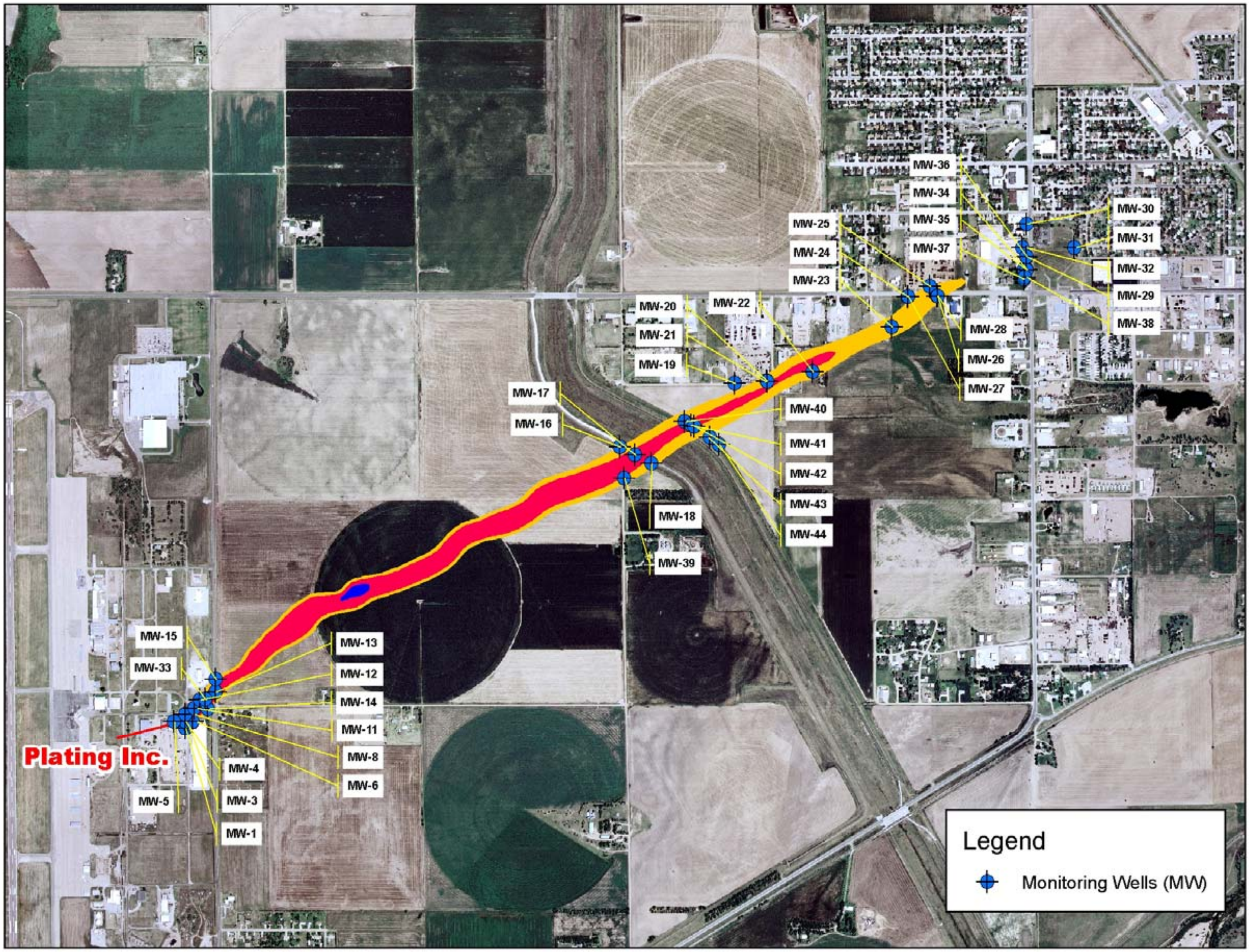
Appendix A. Figures and Tables

Figure 1. Location of Public Water Supply Wells and Private Wells



*Of note, the estimated chromium groundwater plume boundary is based on 1997 data.

Figure 2. Location of Monitoring Wells



*Of note, the estimated chromium groundwater plume boundary is based on 1997 data.

Table 1. Summary of City of Great Bend Public Water Supply Well Data 1996–2007

	PWS-5		PWS-8		Airport PWS-3		Airport PWS-4	
Sample Date	**Cr (Total)**	**Cr 6+**	**Cr (Total)**	**Cr 6+**	**Cr (Total)**	**Cr 6+**	**Cr (Total)**	**Cr 6+**
June 25 to 27, 1996	NS	NS	NS	NS	NS	NS	NS	NS
October 30, 1996	NS	NS	NS	NS	NS	NS	NS	NS
March 24, 1997	NS	NS	NS	NS	NS	NS	NS	NS
April 24, 1997	< 0.01	< 0.02	< 0.01	< 0.02	NS	NS	NS	NS
July 7, 1997	NS	NS	< 0.010	< 0.02	NS	NS	NS	NS
October 14, 1997	NS	NS	0.014 Y	< 0.02	NS	NS	NS	NS
January 29, 1998	NS	NS	0.013	< 0.02	NS	NS	NS	NS
May 28, 1998	NS	NS	0.026	0.02	NS	NS	NS	NS
July 28, 1998	NS	NS	0.017	< 0.02	NS	NS	NS	NS
October 15, 1998	NS	NS	0.014	< 0.02	NS	NS	NS	NS
January 20-26, 1999	NS	NS	0.013	< 0.02	NS	NS	NS	NS
April 28, 1999	NS	NS	0.01	< 0.02	NS	NS	NS	NS
July 20, 1999	NS	NS	0.01	< 0.02	NS	NS	NS	NS
October 20,1999	NS	NS	< 0.01	< 0.02	NS	NS	NS	NS
January 20, 2000	NS	NS	< 0.01	< 0.02	NS	NS	NS	NS
April 3, 2000	NS	NS	< 0.010	< 0.02	NS	NS	NS	NS
August 30, 2000	NS	NS	< 0.010	< 0.02	NS	NS	NS	NS
November 8, 2000	NS	NS	< 0.010	< 0.02	NS	NS	NS	NS
January 10, 2001	NS	NS	0.013	< 0.02	NS	NS	NS	NS
April 18, 2001	NS	NS	0.012	< 0.02	NS	NS	NS	NS
August 15, 2001	NS	NS	0.027	< 0.02	NS	NS	NS	NS
October 30, 2001	NS	NS	0.016	< 0.02	NS	NS	NS	NS
February 13, 2002	< 0.010	< 0.02	0.02	< 0.02	NS	NS	NS	NS
May 29, 2002	NS	NS	0.017	< 0.02	NS	NS	NS	NS
September 18, 2002	NS	NS	0.027	0.02	NS	NS	NS	NS
February 27, 2003	< 0.010	NA	0.017	NA	NS	NS	NS	NS
May 13, 2003	NS	NS	NS	NS	NS	NS	NS	NS
September 12, 2003	NS	NS	0.022	NA	NS	NS	NS	NS
November 6 and 13, 2003	NS	NS	NS	NS	< 0.01	< 0.02	< 0.01	< 0.02
December 29, 30, 2003	NS	NS	< 0.01	NA	NS	NS	NS	NS
March 31, 2004	< 0.010	NA	0.014	NA	NS	NS	NS	NS
July 7, 2004	NS	NS	0.021	NA	NS	NS	NS	NS
Jan 3, 2005	NS	NS	0.013	NA	NS	NS	NS	NS
July 2005	NS	NS	0.012	NA	NS	NS	NS	NS
May 3, 2006	< 0.01	< 0.01	0.014	< 0.01	NS	NS	NS	NS
October 30, 2006	< 0.01	NA	< 0.01	NA	< 0.01	NA	< 0.01	NA
May 8, 2007	< 0.01	NA	< 0.01	NA	< 0.01	NA	< 0.01	NA
December 3, 2007	< 0.01	NA	0.01	NA	< 0.01	NA	< 0.01	NA

NS - Not Sampled

NA - Not Analyzed

Cr (Total) - Total chromium

Cr 6+ - Hexavalent chromium

All samples are reported in milligrams per liter (mg/L)

Y = Sample was not properly preserved

Source: EPA 2008

Table 2. Summary of Private Well Sampling Data 1996–2007 (page 1 of 3)

	PW-1		PW-2		PW-3		PW-4	
Sample Date	**Cr (Tot)**	**Cr 6+**	**Cr (Tot)**	**Cr 6+**	**Cr (Tot)**	**Cr 6+**	**Cr (Tot)**	**Cr 6+**
June 25 to 27, 1996	0.05	0.04	< 0.01	< 0.02	0.03	< 0.02	0.02	< 0.02
October 30, 1996	0.03	< 0.02	NS	NS	NS	NS	NS	NS
March 24, 1997	0.094	0.09	< 0.01	< 0.02	0.043	0.03	0.034	< 0.02
April 24, 1997	NS	NS	NS	NS	NS	NS	NS	NS
July 7, 1997	0.102	0.1	< 0.010	< 0.02	0.042	0.04	0.025	0.02
October 14, 1997	0.081 Y	0.07	NS	NS	0.04 Y	0.02	0.044 Y	0.02
January 29, 1998	0.127	0.13	0.014	< 0.02	0.038	0.03	0.039	0.03
May 28, 1998	0.153	0.16	NS	NS	0.042	0.04	0.03	0.02
July 28, 1998	0.102	0.04	0.056	< 0.02	0.041	< 0.02	0.052	0.03
October 15, 1998	0.047	0.04	NS	NS	0.034	0.03	0.052	0.05
January 20-26, 1999	0.107	0.07	0.038	0.02	0.034	0.03	0.058	0.02
April 28, 1999	0.134	0.12	NS	NS	0.038	0.03	0.059	0.05
July 20, 1999	0.127	0.15	0.052	0.04	0.034	0.04	0.056	0.06
October 20,1999	0.084	0.05	NS	NS	0.031	< 0.02	0.03	0.02
January 20, 2000	0.09	0.09	0.085	0.09	0.028	0.03	0.02	0.03
April 3, 2000	0.11	0.11	0.091	0.05	0.028	0.03	0.02	< 0.02
August 30, 2000	0.049	0.05	0.141	0.16	0.023	0.02	0.024	0.02
November 8, 2000	0.038	0.04	0.146	0.1	0.022	0.03	0.014	< 0.02
January 10, 2001	0.062	0.05	0.16	0.12	0.02	< 0.02	0.019	< 0.02
April 18, 2001	0.072	0.07	0.173	0.16	0.018	< 0.02	0.014	< 0.02
August 15, 2001	< 0.010	0.02	0.162	0.17	0.016	< 0.02	0.014	< 0.02
October 30, 2001	0.021	0.02	0.232	0.2	0.019	< 0.02	0.017	< 0.02
February 13, 2002	0.032	0.03	0.185	0.22	0.019	< 0.02	0.012	< 0.02
May 29, 2002	0.038	0.03	NS	NS	0.014	< 0.02	< 0.010	< 0.02
September 18, 2002	0.016	< 0.02	0.203	0.06	0.018	< 0.02	0.013	< 0.02
February 27, 2003	NS	NS	NS	NS	< 0.010	NA	< 0.010	NA
May 13, 2003	0.035	0.03	0.151	0.15	NS	NS	NS	NS
July 16, 2003	NS	NS	NA	0.16	NS	NS	NS	NS
September 11, 2003	NS	NS	NS	NS	NS	NS	< 0.010	NA
November 13, 2003	NS	NS	NS	NS	NS	NS	NS	NS
December 29, 2003	0.017	NA	NS	NS	< 0.010	NA	NS	NS
March 31, 2004	NS	NS	NS	NS	0.01	NA	< 0.010	NA
July 7, 2004	0.028	NA	0.115	NA	< 0.010	NA	NS	NS
Dec 30 2004, Jan 2005	0.034	NA	0.106	NA	< 0.010	NA	NS	NS
July 7, 2005	0.039	NA	0.122	NA	0.011	NA	NS	NS
May 2 and 3, 2006	0.057	0.058	0.106	0.106	0.015	NA	NS	NS
October 30, 2006	0.027	NA	0.10	NA	0.011	NA	< 0.01	NA
May 8, 2007	0.065	NA	0.14	NA	NS	NS	< 0.01	NA
December 3, 2007	< 0.01	NA	0.17	NA	0.014	NA	0.024	NA

NS - Not Sampled
NA - Not Analyzed
All results are reported in milligrams per liter (mg/L)
Cr (Tot) - Total chromium
Cr 6+ - Hexavalent chromium

* - PW-7 is no longer used
† - PW-11owners would not agree to participate in a monitoring program.
Irrigation wells were sampled July 21, 2005:
West irrigation well contained 0.066 mg/L dissolved chromium
East irrigation well contained < 0.01 mg/L dissolved chromium
Source: EPA 2008

Table 2. Summary of Private Well Sample Data 1996–2007 (page 2 of 3)

	PW-5		PW-6		PW-7 *		PW-8	
Sample Date	**Cr (Tot)**	**Cr 6+**	**Cr (Tot)**	**Cr 6+**	**Cr (Tot)**	**Cr 6+**	**Cr (Tot)**	**Cr 6+**
June 25 to 27, 1996	0.01	< 0.02	< 0.01	< 0.02	< 0.01	< 0.02	NS	NS
October 30, 1996	NS	NS	NS	NS	NS	NS	NS	NS
March 24, 1997	NS	NS	< 0.01	< 0.02	NS	NS	NS	NS
April 24, 1997	NS	NS	NS	NS	NS	NS	NS	NS
July 7, 1997	< 0.010	< 0.02	< 0.010	< 0.02	< 0.010	< 0.02	NS	NS
October 14, 1997	0.013 Y	< 0.02	NS	NS	NS	NS	NS	NS
January 29, 1998	0.011	< 0.02	NS	NS	NS	NS	NS	NS
May 28, 1998	0.015	< 0.02	NS	NS	NS	NS	NS	NS
July 28, 1998	< 0.01	< 0.02	< 0.01	< 0.02	< 0.01	< 0.02	NS	NS
October 15, 1998	< 0.01	< 0.02	NS	NS	NS	NS	NS	NS
January 20-26, 1999	< 0.01	< 0.02	NS	NS	NS	NS	NS	NS
April 28, 1999	0.012	< 0.02	NS	NS	NS	NS	NS	NS
July 20, 1999	0.01	< 0.02	< 0.01	< 0.02	< 0.01	< 0.02	NS	NS
October 20,1999	< 0.01	< 0.02	NS	NS	NS	NS	NS	NS
January 20, 2000	0.011	< 0.02	NS	NS	NS	NS	NS	NS
April 3, 2000	0.013	< 0.02	NS	NS	NS	NS	NS	NS
August 30, 2000	< 0.010	< 0.02	< 0.010	< 0.02	< 0.010	< 0.02	NS	NS
November 8, 2000	< 0.010	< 0.02	NS	NS	NS	NS	NS	NS
January 10, 2001	0.01	< 0.02	NS	NS	NS	NS	NS	NS
April 18, 2001	< 0.010	< 0.02	NS	NS	NS	NS	NS	NS
August 15, 2001	0.011	< 0.02	0.031	< 0.02	< 0.010	< 0.02	NS	NS
October 30, 2001	< 0.010	< 0.02	NS	NS	NS	NS	NS	NS
February 13, 2002	< 0.010	< 0.02	NS	NS	NS	NS	NS	NS
May 29, 2002	< 0.010	< 0.02	NS	NS	NS	NS	NS	NS
September 18, 2002	< 0.010	< 0.02	< 0.010	< 0.02	< 0.010	< 0.02	NS	NS
February 27, 2003	< 0.010	NA	NS	NS	NS	NS	NS	NS
May 13, 2003	NS	NS	NS	NS	NS	NS	NS	NS
July 16, 2003	NS	NS	NS	NS	NS	NS	NS	NS
September 11, 2003	< 0.010	NA	< 0.010	NA	NS	NS	NS	NS
November 13, 2003	NS	NS	NS	NS	NS	NS	< 0.01	NA
December 29, 2003	NS	NS	NS	NS	NS	NS	NS	NS
March 31, 2004	< 0.010	NA	NS	NS	NS	NS	NS	NS
July 7, 2004	NS	NS	NS	NS	NS	NS	NS	NS
Dec 30 2004, Jan 2005	NS	NS	NS	NS	NS	NS	NS	NS
July 7, 2005	NS	NS	NS	NS	NS	NS	< 0.01	NA
May 2 and 3, 2006	NS	NS	NS	NS	NS	NS	NS	NS
October 30, 2006	< 0.01	NA	< 0.01	NA	NS	NS	< 0.01	NA
May 8, 2007	< 0.01	NA	0.012	NA	NS	NS	< 0.01	NA
December 3, 2007	< 0.01	NA	0.013	NA	NS	NS	NS	NS

NS - Not Sampled
NA - Not Analyzed
All results are reported in milligrams per liter (mg/L)
Cr (Tot) - Total chromium
Cr 6+ - Hexavalent chromium

* - PW-7 is no longer used
† - PW-11 would not agree to participate in a monitoring program.
Irrigation wells were sampled July 21, 2005:
West irrigation well contained 0.066 mg/L dissolved chromium
East irrigation well contained < 0.01 mg/L dissolved chromium
Source: EPA 2008

Table 2. Summary of Private Well Sample Data 1996–2007 (page 3 of 3)

	PW-9		PW-10		PW-11 †	
Sample Date	**Cr (Tot)**	**Cr 6+**	**Cr (Tot)**	**Cr 6+**	**Cr (Tot)**	**Cr 6+**
June 25 to 27, 1996	< 0.01	< 0.02	< 0.01	< 0.02	NS	NS
October 30, 1996	NS	NS	NS	NS	0.08	0.07
March 24, 1997	NS	NS	NS	NS	NS	NS
April 24, 1997	NS	NS	NS	NS	NS	NS
July 7, 1997	NS	NS	NS	NS	NS	NS
October 14, 1997	NS	NS	NS	NS	NS	NS
January 29, 1998	NS	NS	NS	NS	NS	NS
May 28, 1998	NS	NS	NS	NS	NS	NS
July 28, 1998	NS	NS	NS	NS	NS	NS
October 15, 1998	NS	NS	NS	NS	NS	NS
January 20-26, 1999	NS	NS	< 0.01	< 0.02	NS	NS
April 28, 1999	NS	NS	NS	NS	NS	NS
July 20, 1999	NS	NS	NS	NS	NS	NS
October 20,1999	NS	NS	NS	NS	NS	NS
January 20, 2000	NS	NS	NS	NS	NS	NS
April 3, 2000	NS	NS	NS	NS	NS	NS
August 30, 2000	NS	NS	NS	NS	NS	NS
November 8, 2000	NS	NS	NS	NS	NS	NS
January 10, 2001	NS	NS	NS	NS	NS	NS
April 18, 2001	NS	NS	NS	NS	NS	NS
August 15, 2001	NS	NS	NS	NS	NS	NS
October 30, 2001	NS	NS	NS	NS	NS	NS
February 13, 2002	< 0.01	< 0.02	NS	NS	NS	NS
May 29, 2002	< 0.01	< 0.02	NS	NS	NS	NS
September 18, 2002	< 0.01	< 0.02	NS	NS	NS	NS
February 27, 2003	< 0.01	NA	NS	NS	NS	NS
May 13, 2003	NS	NS	NS	NS	NS	NS
July 16, 2003	NS	NS	NS	NS	NS	NS
September 11, 2003	< 0.01	NS	NS	NS	NS	NS
November 13, 2003	NS	NS	NS	NS	NS	NS
December 29, 2003	< 0.01	NS	NS	NS	NS	NS
March 31, 2004	NS	NS	NS	NS	NS	NS
July 7, 2004	< 0.01	NA	NS	NS	NS	NS
Dec 30 2004, Jan 2005	< 0.01	NS	NS	NS	NS	NS
July 7, 2005	NS	NS	NS	NS	NS	NS
May 2 and 3, 2006	NS	NS	< 0.01	NA	0.052	NA
October 30, 2006	< 0.01	NA	< 0.01	NA	NA	NA
May 8, 2007	< 0.01	NA	< 0.01	NA	NA	NA
December 3, 2007	< 0.01	NA	< 0.01	NA	NA	NA

NS - Not Sampled
NA - Not Analyzed
All results are reported in milligrams per liter (mg/L)
Cr (Tot) - Total chromium
Cr 6+ - Hexavalent chromium

* - PW-7 is no longer used
† - PW-11 would not agree to participate in a monitoring program.
Irrigation wells were sampled July 21, 2005:
West irrigation well contained 0.066 mg/L dissolved chromium
East irrigation well contained < 0.01 mg/L dissolved chromium
Source: EPA 2008

Appendix B. Comparison Values and Definitions

Comparison Values and Definitions

ATSDR comparison values (CVs) are media-specific concentrations considered safe under default exposure scenarios. ATSDR uses them as screening values to identify contaminants (site-specific substances) that require further evaluation to determine the potential for adverse health effects.

Generally, a chemical at a site requires further evaluation when its maximum concentration in air, water, or soil exceeds one of ATSDR's comparison values. Comparison values are *not*, however, thresholds of toxicity. While concentrations at or below the relevant comparison value may reasonably be considered safe, it does not automatically follow that any environmental concentration that exceeds a comparison value would be expected to produce adverse health effects. Indeed, the purpose behind these highly conservative, health-based standards and guidelines is to enable health professionals to recognize and resolve potential public health problems *before* they become actual health hazards. The probability that adverse health outcomes will actually occur as a result of exposure to environmental contaminants depends on individual lifestyles and genetic factors and site-specific conditions that affect the route, magnitude, and duration of actual exposure, and not on environmental concentrations alone.

ATSDR derives MRLs (minimal risk levels) on the basis of noncancerous effects by dividing a NOAEL (no observed adverse effect level) or LOAEL (lowest observed adverse effect level) by a safely margin. The NOAELs and LOAELs stem from animal or human studies. MRLs include cumulative safety margins (variously called safety factors, uncertainty factors, or modifying factors) that typically range from 10 to 1,000 or more.

By contrast, cancer-based screening values come from linear extrapolations from animal data obtained at high doses because human cancer incidence data for very low levels of exposure simply do not exist.

Listed below are the definitions for some of the comparison values that ATSDR may use to select chemicals for further evaluation, along with the abbreviations for the most common units of measure.

kg = kilogram (1,000 gram)

mg = milligram (0.001 gram)

µg = microgram (0.000001 gram)

L = liter

acute exposure: exposure to a chemical for a duration of 14 days or less.

cancer risk evaluation guide (CREG): estimated contaminant concentration in water, soil, or air that would be expected to cause no more than one excess case of cancer in a million persons exposed over a lifetime. CREGs are calculated from EPA's cancer slope factors.

chronic exposure: exposure to a chemical for 365 days or more.

environmental media evaluation guide (EMEG): concentration of a contaminant in water, soil, or air unlikely to produce any appreciable risk of adverse, non-cancer effects over a specified duration of exposure. EMEGs are derived from ATSDR minimal risk levels by factoring in default body weights and ingestion rates. ATSDR computes separate EMEGs for acute (≤14 days), intermediate (15–364 days), and chronic (>365 days) exposures.

intermediate exposure: exposure to a chemical for a duration of 15–364 days.

lowest observed adverse effect level (LOAEL): The lowest exposure level of a chemical in a study or group of studies that produces statistically or biologically significant increase(s) in frequency or severity of adverse health effects between the exposed and control populations.

minimal risk level (MRL): estimate of daily human exposure to a hazardous substance that is not likely to pose an appreciable risk of adverse noncancer health effects over a specified route and duration of exposure.

maximum contaminant level (MCL): The MCL represents contaminant concentrations in drinking water that EPA deems protective of public health (considering the availability and economics of water treatment technology) over a lifetime (70 years) at an exposure rate of 2 liters of water per day.

no observed adverse effect level (NOAEL): The dose of a chemical at which no statistically or biologically significant increases in frequency or severity of adverse health effects were seen between the exposed population and its appropriate control**.** Effects may be produced at this dose, but they are not considered to be adverse.

reference dose media evaluation guide (RMEG): The concentration of a contaminant in air, water, or soil that corresponds to EPA's RfD for that contaminant when default values for body weight and intake rates are taken into account.

reference dose (RfD): An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is not likely to cause harm to humans.

uncertainty factor (UF): a factor used in deriving the MRL or reference dose or reference concentration from exposure data.

Appendix C. Chromium

Chromium

As reported in ATSDR's *Toxicological Profile for Chromium*[4] [ATSDR 2009a], chromium is a naturally-occurring element found in rocks, animals, plants, and soil. The three main forms of chromium are chromium, trivalent chromium, and hexavalent chromium. Small amounts of trivalent chromium are considered to be a necessity for human health. Chromium can be found in many consumer products such as wood treated with copper dichromate, leather tanned with chromic sulfate, and stainless steel cookware.

Chromium can be found in air, soil, and water after release from the manufacture, use, and disposal of chromium-based products, and during the manufacturing process. Chromium does not usually remain in the atmosphere, but is deposited into the soil and water. Chromium can change from one form to another in water and soil, depending on the conditions present.

You can be exposed to chromium by breathing air containing it or drinking water containing chromium. Releases of chromium into the air can occur from industries using or manufacturing chromium, living near a hazardous waste facility that contains chromium, and cigarette smoke. Chromium is occasionally detected in groundwater, drinking water, or soil samples. Some ways to be exposed to chromium found in groundwater include drinking water containing chromium and bathing in water containing chromium. The general population is most likely to be exposed to trace levels chromium in the food that is eaten. Low levels of trivalent chromium occur naturally in a variety of foods, such as fruits, vegetables, nuts, beverages, and meats.

A small percentage of ingested chromium will enter the body through the digestive tract. When your skin comes in contact with chromium, small amounts of chromium will enter your body. Hexavalent chromium is changed to trivalent chromium in the body. Most of the chromium leaves the body in the urine within a week, although some may remain in cells for several years or longer.

The main health problems seen in animals following ingestion of hexavalent chromium compounds are to the stomach and small intestine (irritation and ulcer) and the blood (anemia). Trivalent chromium compounds are much less toxic and do not appear to cause these problems. Sperm damage and damage to the male reproductive system have also been seen in laboratory animals exposed to hexavalent chromium.

There are no studies that have looked at the effects of chromium exposure on children. It is likely that children would have the same health effects as adults. We do not know whether children would be more sensitive than adults to the effects of chromium. There are no studies showing that chromium causes birth defects in humans. In animals, some studies show that exposure to high doses during pregnancy may cause miscarriage, low birth weight, and some changes in development of the skeleton and reproductive system. Birth defects in animals may be related, in part, to chromium toxicity in the mothers.

4 Information provided in this appendix was compiled from ATSDR's toxicological profile, unless otherwise indicated.

Because chromium is a required nutrient in the body and is normally present in food, chromium is normally present in blood, urine, and body tissues. Higher than normal levels of chromium in blood or urine may indicate that a person has been exposed to chromium. However, increases in blood and urine chromium levels cannot be used to predict the kind of health effects that might develop from that exposure.

The International Agency for Research on Cancer (IARC) has determined that hexavalent chromium compounds are carcinogenic to humans. The National Toxicology Program 11th Report on Carcinogens classifies hexavalent chromium compounds as known to be human carcinogens. Under EPA's current guidelines, hexavalent chromium is classified as Group A - known human carcinogen by the inhalation route of exposure [EPA 2009]. Carcinogenicity by the oral route of exposure cannot be determined and is classified as Group D by EPA [EPA 2009].

With regard to oral exposure, the focus of ATSDR's evaluation of the Plating Inc chromium groundwater plume, ATSDR's intermediate oral minimal risk level (MRL[5]) of 0.005 milligrams per kilogram per day (mg/kg/day) is based on hematological effects in male rats exposed to sodium dichromate dihydrate in drinking water for 22 days. The benchmark dose[6] used for the derivation of the intermediate oral MRL was 0.52 mg/kg/day. ATSDR's chronic oral MRL of 0.001 mg/kg/day is based studies of rats and mice exposed to sodium dichromate dihydrate in drinking water that resulted in microcytic, hypochromic anemia and nonneoplastic lesions of the liver, duodenum, mesenteric and pancreatic lymph nodes, pancreas and salivary gland. The benchmark dose used for the derivation of the chronic oral MRL was 0.09 mg/kg/day.

The EPA has determined that exposure to chromium in drinking water at concentrations of 1 milligram per liter (mg/L) for 1 day or 10 days is not expected to cause any adverse effects in a child. The U.S. Food and Drug Administration (FDA) has determined that the chromium concentration in bottled drinking water should not exceed 0.1 mg/L.

5 An MRL is an estimate of daily human exposure to a hazardous substance that is likely to be without an appreciable risk of adverse noncancer health effects over a specified route and duration of exposure.

6 The benchmark dose is usually defined as the lower confidence limit on the dose that produces a specified magnitude of change in a specified adverse response. The benchmark dose is determined by modeling the dose response curve in the region of the dose response relationship where biologically observable data are feasible.