Letter Health Consultation

NEW KENT WOOD PRESERVATIVES

PROVIDENCE FORGE, VIRGINIA

Prepared by
Virginia Department of Health

JUNE 16, 2015

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

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LETTER HEALTH CONSULTATION

NEW KENT WOOD PRESERVATIVES

PROVIDENCE FORGE, VIRGINIA

Prepared By:

Virginia Department of Health
Division of Environmental Epidemiology
Under a cooperative agreement with the
Agency for Toxic Substances and Disease Registry

COMMONWEALTH of VIRGINIA

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June 16, 2015

Dawn Fulsher
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1650 Arch Street (3HS12)
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Dear Dawn Fulsher,

Thank you for providing the available data to evaluate the groundwater levels of chromium, copper, and arsenic at New Kent Wood Preservatives located in Providence Forge, VA. In November 2013, you requested that the Virginia Department of Health (VDH) review the U.S. Environmental Protection Agency (EPA) May 2012 final site reassessment report for the New Kent Wood Preservatives site; and determine *if the concentrations of chromium, copper, and arsenic in groundwater at New Kent Wood Preservatives are a public health risk to residents and workers consuming water from private wells in the area*. Through a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), VDH has reviewed the data and concludes that additional exposure data are needed to determine if concentrations of chromium, copper, and arsenic measured in groundwater at New Kent Wood Preservatives in 1986, 1988, and 1996 could have harmed people’s health. Without past or current private well data, we are unable to make a health conclusion for past, current, or future exposures. VDH recommends sampling potable water wells near and on site to determine if current contaminant concentrations pose a risk to residents and workers in the area. To determine current exposure status, VDH will evaluate private well data as they are made available.

Background and Statement of Issue

Site Description and History

The New Kent Wood Preservatives site was founded in 1977 and is located at 4101 S. Mount Castle Road in Providence Forge, Virginia. New Kent Wood Preservatives pressure treated lumber with a pressure/vacuum system that impregnated wood with a chromated copper arsenate (CCA) solution. The excess CCA solution was vacuumed off and the treated wood stored on a drip pad until dry. Any CCA solution that collected on the drip pad was recycled back into the treatment system via a sump pump.

The lumber treatment building was located in the center of the site and the drip pad was located adjacent to the treatment building. A secondary drip pad was located just beyond (further east) the primary drip pad. The facility office was located in the treatment building and two sheds were located north of the treatment area. Drainage from the drip pads appeared to be conveyed off site through two drainage ditches into the wetlands located adjacent to Schiminoe Creek. The property is surrounded by a fence that restricts entry.

Land Use and Demographics

The site is located in a mixture of industrial and undeveloped land (Figure 1). The nearest residential property is located 0.30 mile to the southwest. The nearest surface water is Schiminoe Creek, located 0.14 mile east of the site; Schiminoe Creek flows through wetlands which abuts the eastern boundary of the site. The closest private well is about 0.3 miles southwest of the site and the groundwater flows to the south.

Figure 1. Map of New Kent Wood Preservatives site and surrounding

(*Source:* Bing maps November 2014) = New Kent Wood Preservatives site. See Attachment for additional figures.

According to the 2010 US Census, there are 2006 households in Providence Forge and the median household income is $55,447.[1] Approximately 1,880 people live within a 4-mile radius of the site and about 450 and 1,430 residents depend on domestic wells and public water supply for drinking water, respectively (Table 1).[2] In addition, according to EPA, there are at least two commercial properties adjacent to the site that use private water wells for drinking water purposes at these businesses.[3]

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[1] Zip data maps. Available from: http://www.zipdatamaps.com/23140.
[2] Final reassessment report for the New Kent Wood Preservatives site. Providence Forge, VA. prepared for the Virginia Environmental Quality by Blueskies environmental associates, inc. May 2012
[3] Verbal communication, D. Fulsher, EPA Region 3 to L. Werner, ATSDR Region 3, September 26, 2014.

Table 1. Total population served by groundwater within a 4-mile radius

Radius (miles from center of site)	Domestic Wells in New Kent County	Domestic Wells in Charles City County	Population Domestic Wells	Community Wells	Community Wells Population Served	Total Population
0-0.25	0	0	0	0	0	0
0.25-0.50	12	0	32	0	0	32
0.50-1.0	41	0	111	1	48	159
1.0-2.0	125	24	346	0	0	397
2.0-3.0	123	103	585	1	165	750
3.0-4.0	65	112	451	2	1,428	1,880

(*Source:* DEQ)

Groundwater Sampling

In 1986, Emergency Special Services installed multiple monitoring wells onsite. Wells were installed at each corner of the property to determine the groundwater gradient (P1-P4); three (M1-M3) were installed downgradient of the drip pad, and one (M4) was installed upgradient of the drip pad which served as a background well. The wells were constructed 15-18 feet deep. See Figure 2 in the attachment for a map indicating approximate location of the wells.

In 1988, the Virginia Department of Waste Management performed a CERCLA site inspection and collected various environmental samples including groundwater samples from three of the four on-site monitoring wells; one of the downgradient wells was dry and appeared to have collapsed and therefore could not be sampled. Groundwater samples were also collected from the on-site water supply well (S6) and the well (P3) located in the northeast portion of the site. See attachment for map with approximate location of the wells.

In April 1996, EPA collected groundwater samples from six wells (NK-P1- NK-P6) that were 13 to 18 feet deep. One well was located at each corner of the site property boundary, one located adjacent to the drip pad (downgradient) and one located adjacent to the treatment plant (upgradient of the drip pad). Groundwater from the wells was analyzed for arsenic, total chromium, chromium (VI), and copper. See Figure 3 in the attachment for a map showing approximate location of the wells.

DISCUSSION

Groundwater Monitoring Well Sampling Results

The 1986 groundwater results (Table 2) show that arsenic, chromium, and copper were present in the groundwater. The highest concentration of chromium (20,000 μg/L) was detected in monitoring well M1, and the highest concentrations of arsenic (800 μg/L) and copper (240 μg/L) were detected in monitoring wells M2 and M3, respectively. These three results are from the wells adjacent to the drip pad.

The 1988 groundwater results (Table 2) show that arsenic, chromium, and copper were present in the groundwater. In 1988, arsenic was not detected in the upgradient well (M4). The highest concentrations of chromium (37,800 µg/L), and arsenic (62 µg/L) were detected in monitoring wells M2, and M3 respectively. Both of these results are from wells adjacent to the drip pad. The highest concentration of copper (406 µg/L) reported was from well P3 which is located at the northeast boundary of the site away from the drip pad. See Figure 2 in attachment for location of the 1986 and 1988 wells.

Table 2. 1986 and 1988 monitoring well groundwater results and comparison values

<table>
<tr><th rowspan="3">Contaminant
(Comparison value)[3]</th><th colspan="10">Well Sample ID (relative location to drip pad)
All units µg/L</th></tr>
<tr><th colspan="2">M1
(Downgradient)</th><th colspan="2">M2
(Downgradient)</th><th colspan="2">M3
(Downgradient)</th><th colspan="2">M4
(Upgradient)</th><th>S6[1]</th><th>P3[2]</th></tr>
<tr><th>1986</th><th>1988</th><th>1986</th><th>1988</th><th>1986</th><th>1988</th><th>1986</th><th>1988</th><th>1988</th><th>1988</th></tr>
<tr><td>Arsenic
(3)</td><td>370</td><td rowspan="3">Dry/Collapsed</td><td>800</td><td>ND</td><td>510</td><td>62</td><td>400</td><td>ND</td><td>ND</td><td>ND</td></tr>
<tr><td>Total Chromium
(100)</td><td>20,000</td><td>460</td><td>37,800</td><td>4,700</td><td>1,500</td><td>80</td><td>275</td><td>8</td><td>1,200</td></tr>
<tr><td>Copper
(100)</td><td>100</td><td>180</td><td>167</td><td>240</td><td>167</td><td>90</td><td>112</td><td>NR</td><td>406</td></tr>
</table>

(*Source*: DEQ) **ND**=not detected. **NR**=not reportable. **µg/L**=micrograms/liter. [1]**S**=on-site supply well. [2]**P**=property boundary well on northeastern boundary of site. [3]Comparison Values: **Arsenic**-child chronic environmental media evaluation guide; **Chromium**- maximum contaminant level; **Copper**-child intermediate environmental media evaluation guide.

The 1996 groundwater results (Table 3) show that arsenic, total chromium, chromium (VI), and copper were present in the groundwater. The highest concentration of arsenic (767 µg/L) and copper (892 µg/L) were in well NK-P3. The highest concentration of total chromium (6,840 µg/L) and chromium (VI) (1,310 µg/L) were detected in wells NK-P2 and NK-P6, respectively. Well NK-P6 is adjacent to the drip pad. Wells NK-P2 and NK-P3 are at the extreme southeast and northeast corner of the property, respectively (see Figure 3 in attachment).

Table 3. 1996 monitoring well groundwater results and comparison values

Contaminant (Comparison value)†	Monitoring Well Sample ID All units µg/L					
	NK-P1	NK-P2	NK-P3	NK-P4 (background)	NK-P5	NK-P6
Arsenic (3)	35	47	767	71	107	41
Total Chromium (100)	130	6,840	947	531	422	1,880
Chromium VI (100)	ND	760	ND	ND	ND	1,310
Copper (100)	39	36	892	172	70	24

(*Source*: DEQ) **ND**=not detected. **µg/L**=micrograms/liter. †Comparison Values: **Arsenic**-child chronic environmental media evaluation guide; **Chromium**- maximum contaminant level; **Copper**- child intermediate environmental media evaluation guide.

Public Health Implications

To determine if a site poses a health risk VDH evaluates exposure pathways (how people come into contact with contaminants), and the concentration of contaminants that people may be exposed to in the environment. Table 4 summarizes the groundwater exposure pathway.

Table 4. Groundwater exposure pathway summary

Source	Media	Exposure Point	Exposure Route	Receptor Population	Time Frame	Exposure Status
New Kent Wood Preservatives site	Groundwater	Potable wells	Dermal Contact & Ingestion	Neighboring residents and workers	Past Present Future	Potential Potential Potential

VDH considers the groundwater pathway at New Kent Wood Preservatives site to be a past, present, and future *potential* exposure pathway, because there are potable wells in the area including one that is less than a mile downgradient (south) of the site. Private well sampling data in the vicinity of the site could be used to determine if the groundwater pathway for human exposure is *completed* or *eliminated*.

Results from the 1986, 1988 and 1996 sampling events indicated that the groundwater concentration of arsenic, chromium, and copper exceeded their respective drinking water health based comparison values (CVs). In 1986, arsenic was detected well above its CV in all the monitoring wells, while copper and chromium were detected above their CVs in two and three monitoring wells, respectively. In 1988, arsenic was detected above its CV in only one of the six monitoring wells. Concentrations of chromium were above its CV in four monitoring wells, while copper was above its CV in four wells. The results from 1996 (which are the most recent sampling from the site provided to VDH for review) indicate that arsenic and total chromium concentrations were elevated in all monitoring wells. Chromium (VI) exceeded its CV in two wells while copper exceeded its CV in two monitoring wells. Please see attachment for the toxicological summary of each contaminant.

Without knowing the extent of the groundwater contaminant plume off of the site boundary, if nearby private wells draw from the same aquifer, or are contaminated, it is not possible to estimate and evaluate residential exposures to contaminants. Contamination may or may not have affected groundwater in areas where private wells are in use.

CONCLUSION

VDH concludes that additional exposure data would be needed to determine if concentrations of chromium, copper, and arsenic measured in groundwater at New Kent Wood Preservatives in 1986, 1988, and 1996 could have harmed or may currently harm people's health. The reason for this is that no private well water monitoring data has been collected to determine the levels of chemicals people may have ingested in the past or may be ingesting now.

RECOMMENDATION

VDH recommends sampling potable water wells near and on site to determine if current contaminant concentrations pose a risk to residents and workers in the area.

I trust that the above information will be of help to you. Should you have any additional questions please contact Dwight Flammia by phone at (804)-864-8187 or by email: dwight.flammia@vdh.virginia.gov.

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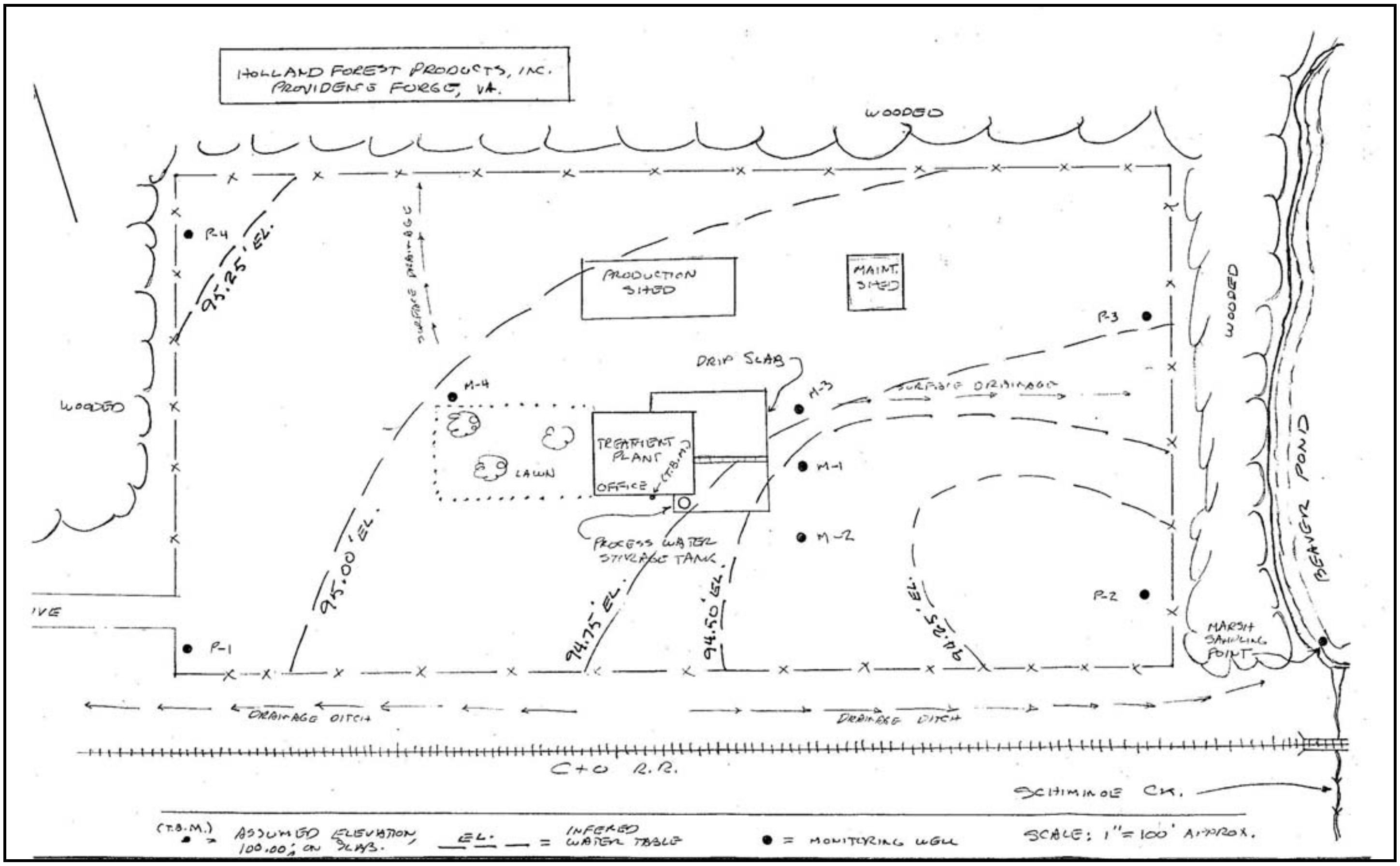
ATTACHMENT

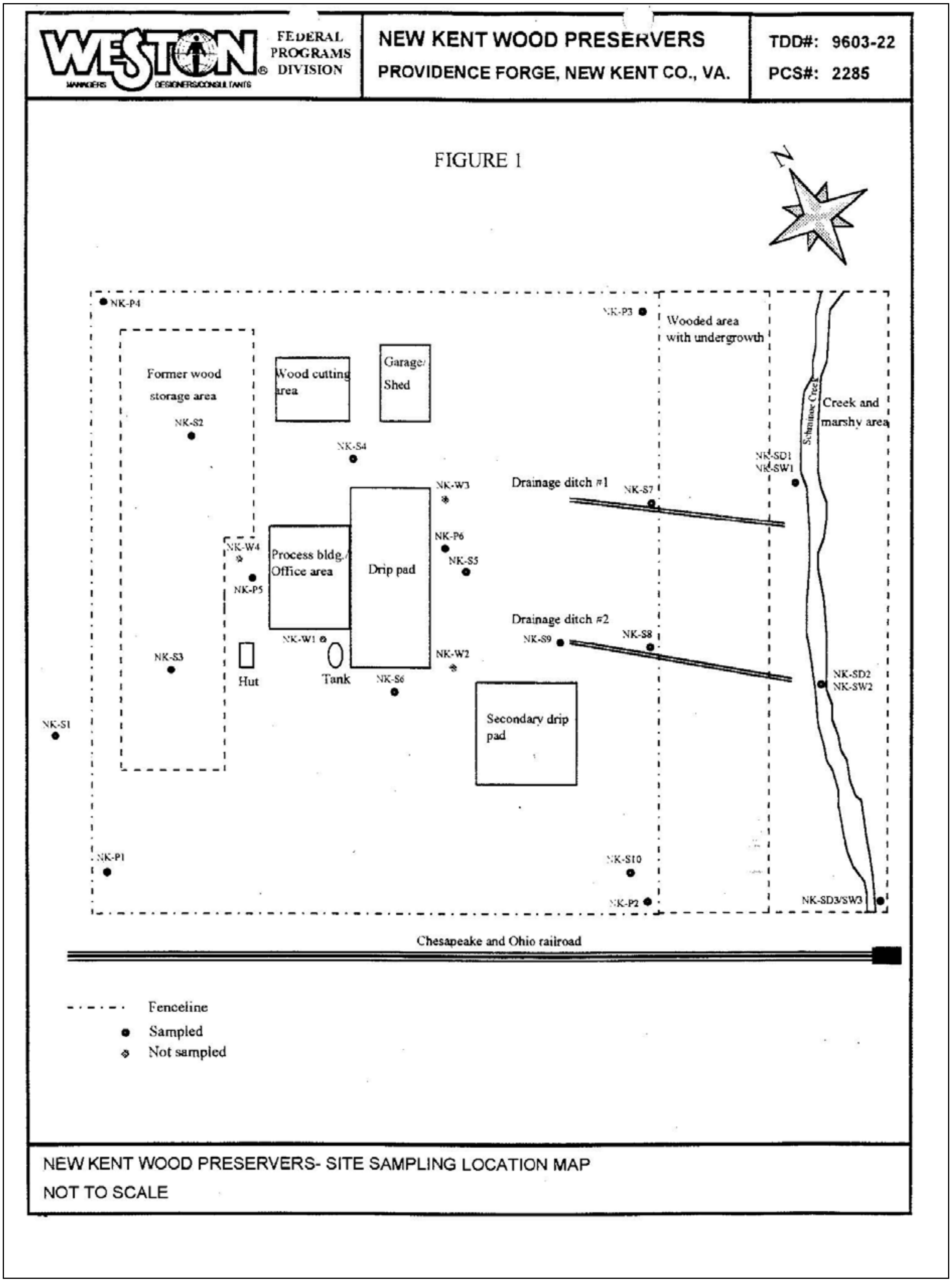
Figures

Figure 2. Approximate 1986 and 1988 groundwater sampling locations



Note: Approximate location of S6 is between M1 and M3.

Figure 3. Approximate 1996 groundwater sampling locations



Chemical Specific Toxicity Information

Chemical specific information on use, health effects, and human exposure for arsenic, chromium, and copper are below. The toxicity of each contaminant exceeding a CV is summarized below. However, it is important to note that this is a summary of general toxicology information and VDH does not know if any of these effects may have or will occur as we presently do not have any exposure point data to evaluate.

Arsenic

Arsenic is a toxic naturally occurring metalloid that is found extensively distributed in the Earth's crust. Inorganic arsenic in the environment is commonly found in combination with other elements such as oxygen, chlorine, and sulfur, while arsenic bound to carbon and hydrogen is organic. About 90% of all arsenic produced is used as a preservative for wood to make it resistant to rotting and decay. Exposure to inorganic arsenic has a wide range of health effects including: skin lesions, stillbirth, spontaneous abortion, cardiovascular diseases, diabetes, and different types of cancers.[4] Ingestion of arsenic may directly affect the atherogenic process involving vascular endothelium, smooth muscle cells, platelets and macrophages; arsenic may exacerbate many risk factors for cardiovascular diseases.[5] Acute oral exposures can cause nausea and vomiting, decreased production of red and white blood cells, abnormal heart rhythm, lung irritation and damage to blood vessels.[6] Chronic oral exposure to inorganic arsenic can lead to physical skin changes (including darkened skin and the appearance of small corns or warts on the palms, soles, and torso), as well as the development of skin cancers.[7] Arsenic is thought to be strongly genotoxic; research has shown that arsenic is able to cause DNA damage such as aneuploidy, micronuclei formation, chromosomal aberrations, deletion mutations, sister chromatid exchange and DNA-protein cross-linking.[8] The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the EPA have all classified inorganic arsenic as a known human carcinogen.[7]

Chromium

Chromium is a naturally occurring element found in rocks, animals, plants and soil. Chromium occurs in combination of other elements to form various compounds; however the most common chromium compounds are chromium (0), chromium (III), and chromium (VI). Chromium is used to harden steel. It is a component of stainless steel and many other alloys. It is also commonly used for plating to produce a shiny, hard surface that is resistant to corrosion. Much of the chromium (VI) in the environment is attributed to anthropogenic sources such as applications in wood preservatives, anticorrosive primers, metal plating, leather tanned with chromic sulfate,

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[4] Smith AH, Steinmaus CM. 2009. Health effects of arsenic and chromium in drinking water: Recent human findings. Annu. Rev. Public Health. 2009;30:107–122.
[5] Chen CJ, Hsueh YM, Lai MS, Shyu MP, Chen SY, Wu MM, Kuo TL, Tai TY. 1995. Increased prevalence of hypertension and long-term arsenic exposure. Hypertension. 25:53–60.
[6] Agency for Toxic Substances and Disease Registry (ATSDR) 2007a. Toxicological Profile for Arsenic (Update). U.S. Department of Health & Human Services.
[7] Agency for Toxic Substances and Disease Registry (ATSDR) 2007b. Public Health Statement for arsenic. [Last updated 2007 August, Accessed 2014 September 9]. Available from: http://www.atsdr.cdc.gov/phs/phs.asp?id=18&tid=3.
[8] Faita F, Cori L, Bianchi F, Andreassi MG. 2013. Arsenic-Induced Genotoxicity and Genetic Susceptibility to Arsenic-Related Pathologies**.** Int J Environ Res Public Health. 10(4): 1527–1546

stainless steel cookware as well as releases as a result of some ferrometal and stainless steel operations, and the combustion of fossil fuel.[9]

Chromium is known to cause respiratory problems in occupationally exposed workers. Respiratory symptoms include irritation of the lining of the nose, runny nose, and breathing problems (asthma, cough, shortness of breath, wheezing). Research in animals has indicated that chromium (VI) can damage sperm and the male reproductive system. Only chromium (VI), but not chromium (0) or chromium (III), has been shown to be carcinogenic in laboratory animals and occupationally exposed workers[9,10]; it has been shown to cause tumors to the stomach, intestinal tract, and lung. Studies by Zhang and Li reported increased mortality from stomach cancers among rural residents in the Liaoning Province of China where drinking water was heavily contaminated with chromium (VI) released by an ore smelting facility.[11] The DHHS, EPA, and IARC all classify chromium (VI) compounds as a known human carcinogen.

Copper

Copper occurs naturally in the environment in plants animals and rocks. Copper is extensively mined and processed in the United States and is primarily used as the metal or alloy in the manufacture of wire, sheet metal, pipe, and other metal products. Copper compounds are also used in agriculture to treat plant diseases, like mildew. Copper can also be used for water treatment and as preservatives for wood, leather, and fabrics. Exposure to copper occurs mostly from food and water intake; although, exposure to small amount of copper can occur through inhalation and dermal contact. Although copper is an essential element that is necessary for the cellular activities in most organisms, it can be toxic at high enough concentrations. Acute copper toxicity is rare but it can occur through ingestion of contaminated food and deliberate or accidental ingestion of high amounts of copper salts. Acute symptoms include gastric pain, excessive salivation, nausea and diarrhea.[12] Intravascular hemolytic anemia, acute hepatic failure, acute tubular renal failure, shock coma and death have been linked with copper poisoning.[13] It is not known if copper is carcinogenic. When EPA assessed the toxicity of copper in 1988, there were inadequate data to determine whether or not copper causes cancer.

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[9] IARC (International Agency for Research on Cancer). 1990. Chromium, Nickel and Welding, IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Vol. 49, pp 49–256, World Health Organization, Lyon, France.
[10] OSHA (Occupational Safety and Health Administration), Department of Labor. 2006. Occupational exposure to hexavalent chromium. Final rule. Fed. Regist. 71, 10099–10385.
[11] Zhang JD, Li XL. 1987. Chromium pollution of soil and water in Jinzhou. Zhonghua Yu Fang Yi Xue Za Zhi 21, 262–264.
[12] Spitalny KC, Brondum J, Vogt RL, Sargent HE, Kappel S. 1984. Drinking-water-induced copper intoxication in a Vermont family. Pediatrics. 74(6):1103–1106
[13] EPA (US Environmental Protection Agency) 1987. IRIS Summary for copper. [Last updated 1988 September 7, Accessed 2014 September 9]. Available from: http://www.epa.gov/iris/subst/0368.htm