

December 18, 2009

MEMORANDUM TO: Andrew Persinko, Branch Chief
Reactor Decommissioning Branch
Decommissioning and Uranium Recovery
Licensing Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

FROM: Christopher McKenney, Branch Chief **/RA/**
Performance Assessment Branch
Environmental Protection and Performance
Assessment Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

SUBJECT: ELIMINATION OF DRINKING WATER PATHWAY FOR AAR SITE IN
LIVONIA, MICHIGAN

Background:

AAR is located in Livonia, Michigan approximately 20 miles northwest of downtown Detroit, MI, in Wayne County. The former owners, Brooks and Perkins, manufactured products using NRC licensed material (thorium as contained in thorium master and magnesium alloys) from 1957 to 1971. As a result of manufacturing processes and practices, site soils became contaminated with thorium contaminated slag from the surface down to a depth of two meters in some locations with contamination concentrated in the western portion of the site (and discrete locations on the south boundary to the east) of the approximately 45,000 m² site. AAR purchased the Brooks and Perkins site in 1981 and has attempted to remediate contaminated soils, establishing clean-up levels and performing soil removal activities. Over the years, AAR has submitted several dose assessments for NRC review. These dose assessments form the basis of clean-up levels for the site.

In a November 2002 dose assessment submitted by Partners Environmental on behalf of AAR Corporation (Partners, 2002), an argument was presented for elimination of the drinking water pathway. AAR contended that the drinking water pathway could be excluded because it is not considered plausible that near-surface wells (i.e., those which could be affected by the thorium contamination) would serve as sources of drinking water in the future. AAR argued that in the

CONTACT: Cynthia Barr, FSME/DWMEP
(301) 415-4015

past, shallow wells have not provided a reliable source of drinking water in this region. The site and surrounding area are zoned for industrial use and currently, drinking water is provided by local municipalities. The water level in the upper sand aquifer fluctuates with the seasons and after prolonged drought may essentially evaporate. AAR also argued that the unconfined groundwater is also susceptible to contamination from surface pollutants such as pesticides, fertilizers, and animal waste. Historically, shallow wells in this region were not sufficient to support a reliable or potable water supply (Partners, 2002).

Previously, NRC staff reviewed information submitted by AAR and concluded that due to the low risk significance of the groundwater pathway, no additional justification for elimination of the groundwater pathway was needed. However, the basis for this assumption was never formally documented in a Technical Evaluation Report. Therefore, the purpose of this memorandum is to more formally document the basis for elimination of the drinking water pathway consistent with assumptions made in recent dose assessments performed by AAR and NRC staff.

Regional Geology:

The regional geology near the AAR site is well studied. The hydrogeology of the surrounding region is summarized nicely in a permit application for an underground injection control well proposed for location in the Romulus township (two townships¹ south of AAR). The Environmental Geo-Technologies, LLC, application (2007) references three relevant studies.

- Mazola, 1969, "Geology for Land Ground-Water Development in Wayne County."
- Southeast Michigan Council of Governments, 1978, "Groundwater Quality in Southeast Michigan."
- Western Michigan University, Department of Geology, 1981, "Hydrogeologic Atlas of Michigan."

The glacial deposits in the area are mapped by Mozola (1969) as lacustrine and deltaic sands or lake bed clays deposited during the Wisconsin stage of glaciation. In the study area there appears to be non-continuous, relatively thin veneers of lacustrine sand at the surface underlain by a thick deposit of glacial till. The till is composed of silty to sandy clay with occasional lenses of granular soils within the clay matrix. The glacial deposits are approximately 100 feet in thickness. Mozola (1969) indicates that groundwater in the sedimentary rock formations in Wayne County occurs under artesian (confined) conditions, and groundwater in the glacial deposits occurs under confined and unconfined conditions. Although the primary groundwater source in the region, when available, is the glacial drift, the quantity and quality of the water available in the drift is locally variable. While Mozola (1969) reported that small domestic groundwater supplies could be developed in the glacial drift, storage capacity of the surficial sand is considered limited and well failures would be expected during prolonged droughts. A more recent report published by Southeast Michigan Council of Governments (1978) indicates that the water-bearing glacial deposits in the area of AAR are not extensive enough to supply

¹ Michigan is divided into townships that are six miles wide by six miles long.

usable quantities of water. Additionally, groundwater in the limestone formation is reported to be highly mineralized and may be unsuitable for use as a water supply (Hydrogeologic Atlas of Michigan, 1981). Wayne County, where AAR is located, was reported as having the lowest water well density of any county in southeastern Michigan with less than eight wells per township (Environmental Geo-Technologies, 2007).

Water Supply:

Forty-two municipal water systems are located in Wayne County and all use surface water obtained from Lake Huron and the Detroit River (Environmental Geo-Technologies, 2007). Detroit Water and Sewerage Department (DWSD) provides water service to one million people in Detroit and three million people in the neighboring southeastern Michigan communities, including Wayne County and the township of Livonia. The water system draws fresh water from the Great Lakes System with Lake Huron to the north and the Detroit River to the south (see www.dwsd.org (i) About DWSD Fact Sheet and (ii) Comprehensive Water Master Plan Summary Report).

Although DWSD supplies water to the community of Livonia, it is possible that private residents or businesses may install water wells for their own drinking water purposes. However, Michigan State code restricts the use of potentially contaminated groundwater in unconfined, unconsolidated sediments located less than 25 feet from the ground surface for drinking water or to supply water to habitable structures (see www.michigan.gov/deq, Michigan Safe Drinking Water Act 1976 PA 399, as Amended, and the Administrative Rules; and Well Construction Code and Administrative Rules).

Local Geology and Well Use:

Based on limited characterization, the subsurface at AAR includes a thin (approximately one-half to one foot thick) fill and approximately three to four foot thick sand unit underneath the site with at least three foot of clay underlying the sand unit (B. Koh & Associates, 1998). The shallow, sand unit above the clay is less than 25 foot below grade and would not be expected to be used for drinking water. NRC staff contacted the Michigan Department of Environmental Quality (MI DEQ) to obtain additional information regarding the hydrogeology near the site. A staff person from MI DEQ familiar with the geology in the Livonia, Michigan area, confirmed the presence of a thick regional clay (about 100 feet thick) and underlying bedrock in the area of the AAR site (ML093490722). To locally confirm the presence of the clay unit, MI DEQ data were accessed through an online resource--<http://www.deq.state.mi.us/well-logs/>. Google Earth was used to map the area surrounding the AAR site located at 12633 Inkster Road, Livonia, MI at 42 22 39 N, 83 18 55 W latitude and longitude, respectively (see Figures 1 and 2). A Google Earth tool was used to provide layer data indicating town, range, and sections near the AAR site <http://www.earthpoint.us/townships.aspx>. AAR is located in the Township of Livonia, town 1S and range 9E, section 25.² The MI DEQ database of well logs was searched by town and range with sections within two grids (or two miles) from the section that AAR is located evaluated in greater detail (see Appendix A). The evaluated sections are delineated in red outline on Figure 1. The well logs for this area close to the AAR site, confirm the existence of clay at least a few tens of feet in thickness (see Appendix A). None of the well logs specifically

² Townships are comprised of sections. A section is 1 mile by 1 mile in area and thirty-six sections make up a township.

indicated use of the well for drinking water purposes, although one well log completed by “Liv. Cut Stone” in an industrial area within two sections of the AAR site was said to be used for “domestic” purposes (well screened in a gray sand approximately 60 feet below land surface) and another well owned by “Mrs. Kitchen” located a few miles to the southwest of AAR screened at a depth of 132 feet which was also said to be used for “domestic” purposes. Essentially all of the logs in the four closest townships indicated wells were screened at depths greater than 50 feet.

A simple calculation reveals that the travel time through a thick (50 foot) clay assuming an infiltration rate of 0.34 m/yr³ and a conservative assumption regarding the sorptive capacity of the clay (that it is similar to sand) is over 200,000 years for thorium and over 30,000 years for more mobile radium assuming a moisture content of 0.16⁴ and bulk soil density of 1.5 g/cm³. Thus, it is unlikely that thorium and its progeny will travel significant depths to a deeper aquifer within the 1000 year compliance period.

Conclusion:

Because (i) DWSD supplies drinking water to the township of Livonia sourced by surface water from the Great Lakes and Detroit River, (ii) State code restricts the use of unconfined shallow groundwater in unconsolidated sediments located less than 25 feet from the ground surface for drinking water (see www.michigan.gov/deg, Michigan Safe Drinking Water Act 1976 PA 399, as Amended, and the Administrative Rules; and Well Construction Code and Administrative Rules), and (iii) shallow groundwater located underneath the site is not expected to be potable or of reliable yield, potentially contaminated, shallow groundwater underneath the AAR site is not expected to be used as a source of drinking water for potential receptors in the foreseeable future. Inspection of well log data in the vicinity of AAR supports the presence of a thick (tens of feet) clay directly underneath the surficial sand. The regional clay is expected to represent a competent confining unit that will significantly retard the transport of constituents such as thorium and its decay products to more permeable zones within the glacial deposits or underlying bedrock. Therefore, NRC staff continues to support elimination of the drinking water pathway for the AAR site.

Enclosures:

1. Figures 1 & 2: Numbers for Sections Located in Townships Near AAR
2. Appendix A/References

³ The infiltration rate is calculated assuming an irrigation rate of 0.2 m/yr representative of humid areas, a runoff coefficient of 0.4 representative of flat residential areas, and an evapotranspiration coefficient of 0.5.

⁴ The moisture content was calculated using the approach outlined in the RESRAD User’s Manual (Yu et. al., 2001) assuming hydraulic properties (i.e., porosity, hydraulic conductivity) similar to sand.

indicated use of the well for drinking water purposes, although one well log completed by “Liv. Cut Stone” in an industrial area within two sections of the AAR site was said to be used for “domestic” purposes (well screened in a gray sand approximately 60 feet below land surface) and another well owned by “Mrs. Kitchen” located a few miles to the southwest of AAR screened at a depth of 132 feet which was also said to be used for “domestic” purposes. Essentially all of the logs in the four closest townships indicated wells were screened at depths greater than 50 feet.

A simple calculation reveals that the travel time through a thick (50 foot) clay assuming an infiltration rate of 0.34 m/yr⁵ and a conservative assumption regarding the sorptive capacity of the clay (that it is similar to sand) is over 200,000 years for thorium and over 30,000 years for more mobile radium assuming a moisture content of 0.16⁶ and bulk soil density of 1.5 g/cm³. Thus, it is unlikely that thorium and its progeny will travel significant depths to a deeper aquifer within the 1000 year compliance period.

Conclusion:

Because (i) DWSD supplies drinking water to the township of Livonia sourced by surface water from the Great Lakes and Detroit River, (ii) State code restricts the use of unconfined shallow groundwater in unconsolidated sediments located less than 25 feet from the ground surface for drinking water (see www.michigan.gov/deg, Michigan Safe Drinking Water Act 1976 PA 399, as Amended, and the Administrative Rules; and Well Construction Code and Administrative Rules), and (iii) shallow groundwater located underneath the site is not expected to be potable or of reliable yield, potentially contaminated, shallow groundwater underneath the AAR site is not expected to be used as a source of drinking water for potential receptors in the foreseeable future. Inspection of well log data in the vicinity of AAR supports the presence of a thick (tens of feet) clay directly underneath the surficial sand. The regional clay is expected to represent a competent confining unit that will significantly retard the transport of constituents such as thorium and its decay products to more permeable zones within the glacial deposits or underlying bedrock. Therefore, NRC staff continues to support elimination of the drinking water pathway for the AAR site.

Enclosures:

1. Figures 1 & 2: Numbers for Sections Located in Townships Near AAR
2. Appendix A/References

ML093480483

| | | | |
|-------------|----------|---------------|-----------|
| OFC | EPPAD | EPPAD | EPPAD |
| NAME | CBarr | AWalker-Smith | CMcKenney |
| DATE | 12/15/09 | 12/ 15 /09 | 12/18/09 |

OFFICIAL RECORD COPY

⁵ The infiltration rate is calculated assuming an irrigation rate of 0.2 m/yr representative of humid areas, a runoff coefficient of 0.4 representative of flat residential areas, and an evapotranspiration coefficient of 0.5.

⁶ The moisture content was calculated using the approach outlined in the RESRAD User’s Manual (Yu et. al., 2001) assuming hydraulic properties (i.e., porosity, hydraulic conductivity) similar to sand.

| | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|----|
| 6 | 5 | 4 | 3 | 2 | 1 | 6 | 5 | 4 | 3 | 2 | 1 |
| 7 | 8 | 9 | 10 | 11 | 12 | 7 | 8 | 9 | 10 | 11 | 12 |
| 18 | 17 | 16 | 15 | 14 | 13 | 18 | 17 | 16 | 15 | 14 | 13 |
| 19 | 20 | 21 | 22 | 23 | 24 | 19 | 20 | 21 | 22 | 23 | 24 |
| 30 | 29 | 28 | 27 | 26 | 25 | 30 | 29 | 28 | 27 | 26 | 25 |
| 31 | 32 | 33 | 34 | 35 | 36 | 31 | 32 | 33 | 34 | 35 | 36 |
| 6 | 5 | 4 | 3 | 2 | 1 | 6 | 5 | 4 | 3 | 2 | 1 |
| 7 | 8 | 9 | 10 | 11 | 12 | 7 | 8 | 9 | 10 | 11 | 12 |
| 18 | 17 | 16 | 15 | 14 | 13 | 18 | 17 | 16 | 15 | 14 | 13 |
| 19 | 20 | 21 | 22 | 23 | 24 | 19 | 20 | 21 | 22 | 23 | 24 |
| 30 | 29 | 28 | 27 | 26 | 25 | 30 | 29 | 28 | 27 | 26 | 25 |
| 31 | 32 | 33 | 34 | 35 | 36 | 31 | 32 | 33 | 34 | 35 | 36 |



Location of AAR--Section 25, Town/Range 1S/9E



Well Data Available



Outline of Townships Near AAR (Livonia [1S9E, upper left], Redford [1S10E, upper right], Westland [2S9E, lower left], Dearborn Heights [2S10E, lower right])



Outline of Sections Within Two Grids of AAR (Well Logs Found in Appendix A)

Note: Sections Are 1 mi²; Townships are 36 mi²

Figure 1 Numbers for Sections Located in Townships Near AAR

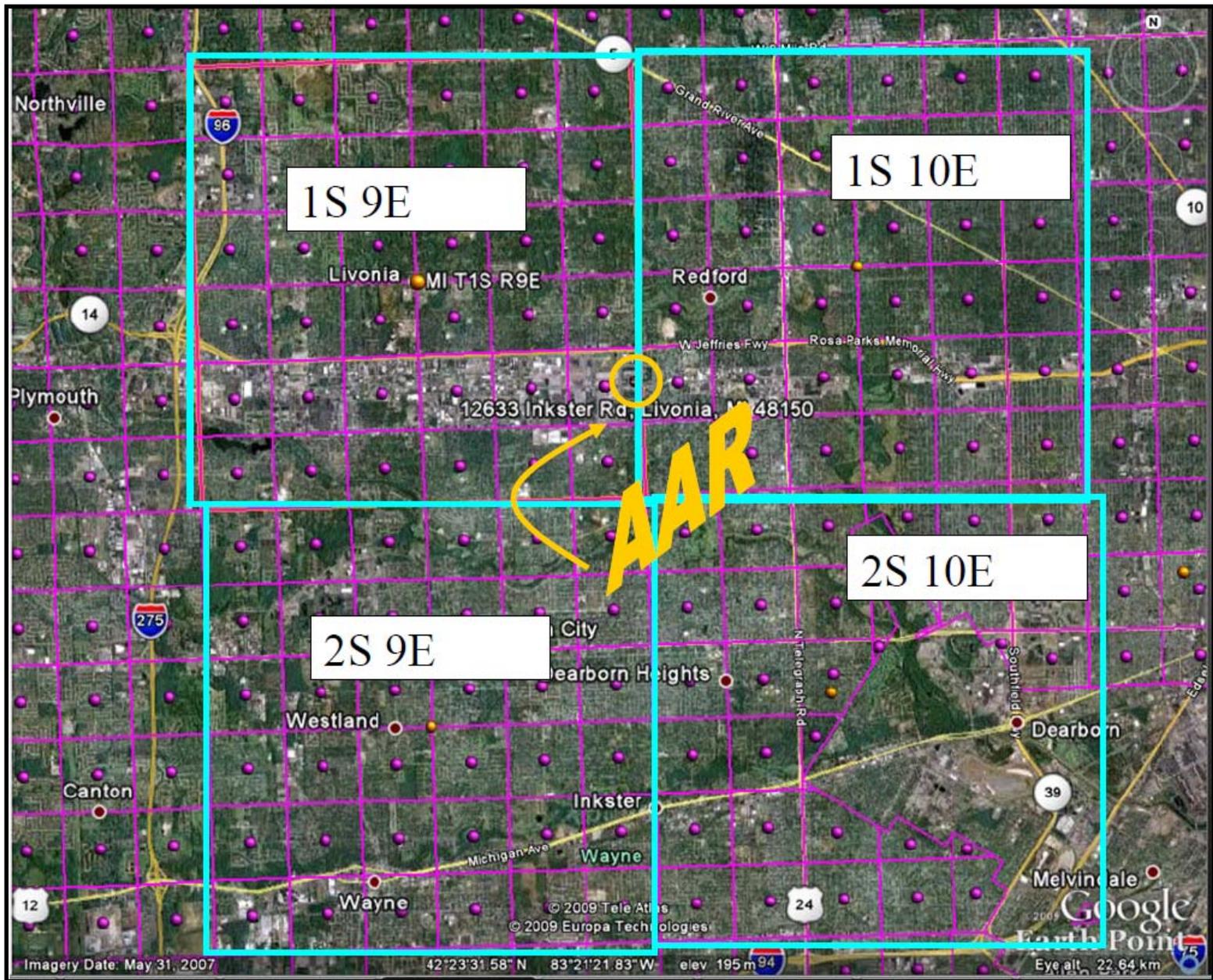


Figure 2 Aerial Map Showing Location of AAR Site in the Township of Livonia and Surrounding Townships

Appendix A

Well Logs for Sections Near AAR Site (See Figure 1)

References

B. Koh & Associates, Inc., "Site Remediation Plan for the Former Brooks and Perkins, Inc., Site, AAR Manufacturing, Inc., Livonia, MI," Revision 2, October, 1998.

Detroit Water and Sewerage Department, www.dwsd.org, Fact Sheet and "Comprehensive Water Master Plan Summary Report," June 2004.

Environmental Geo-Technologies, LLC, "Permit Application for Class I Hazardous #1-12 and #2-12," December, 2007.

Michigan Department of Environmental Quality, www.michigan.gov/deq, "Michigan Safe Drinking Water Act 1976 PA 299, as Amended, and the Administrative Rules" Revision July 9, 2008, and "Well Construction Code Administrative Rules," January 22, 2002.

Partners Environmental, "Probabilistic Dose Assessment Former Brooks and Perkins Site, Livonia, MI," November, 13, 2002.

Yu et. al., "User's Manual for RESRAD Version 6," Environmental Assessment Division, Argonne National Laboratory, for US Department of Energy, July, 2001.