LACROSSE*SOLUTIONS*

May 24, 2018 LC-2018-0039

Mr. Tim Zeichert
Hydrogeologist, Remediation & Redevelopment Program
Wisconsin Department of Natural Resources
P.O. Box 7921
Madison, WI 53707-7921

Subject: Site Investigation Work Plan
LaCrosse Boiling Water Reactor
4601 State Highway 35, Genoa WI
DNR BRRTS Activity #02-62-58112
DNR FID #663020930

Dear Mr. Zeichert:

In accordance with your letter dated March 30, 2018, enclosed please find the Site Investigation Work Plan that has been developed to address the tritium detected in site groundwater. We have also enclosed payment as proscribed in NR 749 Wisconsin Administrative Code so that we may receive your written comments on our proposed scope of work.

The Site Investigation Work Plan builds on the previous characterization efforts that have been completed in support of the ongoing site decommissioning process. It also includes the Dye Tracer Study scope, submitted for your approval on March 15, 2018. We are prepared to introduce the dyes, as soon as approval is granted, and we will to continue monitor groundwater quality while awaiting DNR approval.

We look forward to your continued support, and as always, if you have any questions or wish to discuss our proposed approach, do not hesitate to call me at (860) 462-9707 or our consultant, Nadia Glucksberg at (207) 482-4623.

Sincerely yours,
LaCrosse*Solutions*, LLC

Gerard van Noordennen

Gerard van Noordennen
Vice President Regulatory Affairs

cc: Joseph Nowak, EnergySolutions
Bob Busch, Wisconsin Department of Public Health (electronic copy)
Rhex Edwards, Nuclear Regulatory Commission, Region III (electronic copy)
Marlayna Vaaler, Nuclear Regulatory Commission, Headquarters (electronic copy)
Nadia Glucksberg, PG, Haley & Aldrich, Inc. (electronic copy)

www.haleyaldrich.com

SITE INVESTIGATION WORK PLAN

LA CROSSE BOILING WATER REACTOR
GENOA, WISCONSIN

DNR BRRTS ACTIVITY #02 – 63-581112
DNR FID #663020930

by Haley & Aldrich, Inc.
Portland, Maine

for
LaCrosse*Solutions*
Genoa, Wisconsin

File No. 128924-004
May 2018

List of Tables iii
List of Figures iii
List of Acronyms iv

1. Introduction 1

1.1 SITE LOCATION AND DESCRIPTION 1
1.2 PURPOSE 1
1.3 APPLICABLE CODES, STANDARDS AND GUIDELINES 1
1.4 WORK PLAN ORGANIZATION 2

2. Site Background 2

2.1 SITE HISTORY 2
2.2 PHYSICAL SETTING 2
2.2.1 Topography 3
2.2.2 Geology 3
2.2.3 Hydrology 4
2.2.4 Surface Water 5
2.3 SUMMARY OF PREVIOUS INVESTIGATIONS 5
2.3.1 Preliminary Conceptual Site Model and Hydrogeologic Investigation 5
2.3.2 Groundwater Monitoring 6

3. Conceptual Site Model 9

4. Investigation Work Scope 10

4.1 ADDITIONAL GROUNDWATER QUALITY MONITORING 10
4.2 GROUNDWATER MODELING 10
4.3 DYE TRACER STUDY 11
4.4 VAPOR INTRUSION EVALUATION 11
4.5 RECEPTOR SURVEY 11

5. Sample Collection 12

5.1 SAMPLING METHOD 12
5.2 SAMPLE CUSTODY AND MANAGEMENT 12
5.3 LABORATORY ANALYTICAL METHODS AND DETECTION LIMITS 12
5.4 EQUIPMENT CALIBRATION AND DECONTAMINATION 13

6. Quality Control and Data Validation 13

7. Schedule and Sequence 14

8. Report 14

References **15**

Tables
Figures
Appendix A - LC-RP-PR-057 Revision No. 2

List of Tables

Table No.	Title
1	Summary of Radiological Analytical Results for Groundwater
2	Analytical Methods and Detection Limits

List of Figures

Figure No.	Title
1	Site Locus
2	Site Plan
3	Groundwater Contours Shallow Aquifer
4	Groundwater Contours Deep Aquifer
5	Estimated Extents of Tritium Impacted Groundwater

List of Acronyms

AEC	Atomic Energy Commission
ALARA	As Low As Reasonably Achievable
AOI	Area of Interest
Bgs	Below ground surface
Cm/sec	Centimeters per second
Cs-137	Cesium-137
Co-60	Cobalt-60
COC	Contaminant of Concern
CSM	Conceptual Site Model
D&D	Decontamination and Decommissioning
ft	feet or foot
ft/ft	feet per foot
Haley & Aldrich	Haley & Aldrich, Inc.
H-3	Tritium
ISFSI	Independent Spent Fuel Storage Installation
LACBWR	La Crosse Boiling Water Reactor
LTP	License Termination Plan
MCLs	Maximum Contaminant Levels
MSL	Mean Sea Level
MWe	Megawatt Electrical
PCBs	Polychlorinated Biphenyls
Ni-63	Nickel-63
NRC	Nuclear Regulatory Commission
SAFSTOR	SAFe STORage
SIR	Site Investigation Report
Sr-90	Strontium-90
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
DNR	Wisconsin Department of Natural Resources

1. Introduction

Haley & Aldrich, Inc. (Haley & Aldrich) has prepared this Site Investigation Work Plan (Work Plan) on behalf of LaCrosse*Solutions* to assess tritium concentrations detected in groundwater at the La Crosse Boiling Water Reactor (LACBWR). This Work Plan has been developed in response to the letter received from the Wisconsin Department of Natural Resources (DNR) dated March 30, 2018 which entered the reported contamination into the Bureau for Remediation and Redevelopment Tracking System (BRRTS) as Activity # 02-63-581112.

1.1 SITE LOCATION AND DESCRIPTION

The site is located at 4601 State Highway 35, Genoa, in Vernon County, Wisconsin (43° 13' 35" north and 91° 13' 53" west) as shown on Figure 1. Surrounding lands are predominantly used for agriculture (dairy) and forestry (DPC, 1972). LACBWR is bordered to the west by the Mississippi River, to the north by the former Genoa-1 coal-fired plant (currently a vacant lot), to the east by State Highway 35 and to the south by the Genoa-3 coal-fired plant. The railroad also crosses through the eastern portion of the parcel, east of the plant structures.

LACBWR was built in 1967 as part of a federal project to demonstrate the viability of nuclear power. It contained a small 50 megawatt (MWe) electrical nuclear generating plant that utilized a 165 MWe boiling water reactor that was owned and operated by the Dairyland Power Cooperative (DPC). In 1987, after 19 years of operation, the plant was shut down and was placed in SAFSTOR (1991). In 2007, the reactor pressure vessel was removed and shipped to the Barnwell Waste Management Facility in South Carolina. The site is currently undergoing final decontamination and decommissioning (D&D) with the goal of license termination. Site features and boundaries are shown on Figure 2.

1.2 PURPOSE

In accordance with Section 292.11 of the Wisconsin Statues and Chapter NR 716 of the Wisconsin Administrative Code, this Work Plan has been developed to investigate the potential source of the tritium contamination found in the groundwater, to further characterize the current concentrations seen in groundwater onsite, and to verify that these conditions do not pose a threat to the drinking water wells located onsite or to the Mississippi River. Prior to the release reported on 14 March 2018, no impacts to site groundwater quality were observed in the monitoring well network which was established and monitored during D&D activities starting in 2013 as discussed in Section 2.3.2.

1.3 APPLICABLE CODES, STANDARDS AND GUIDELINES

The Nuclear Regulatory Commission (NRC) is the primary stakeholder for license termination however; the DNR and United States Environmental Protection Agency (USEPA) regulations apply to site groundwater, soil, and surface waters. All site investigation activities will be conducted in accordance with all local, state and federal rules, laws and regulations, including but not limited to:

- Section 292.11 Wisconsin Statutes;
- Wisconsin Administrative Code chapters NR 700 through NR 754;
- Wisconsin Administrative Code chapter NR 140;

- Nuclear Regulatory Commission; and
- US USEPA 40 CFR 761.61 for Polychlorinated Biphenyls (PCBs).

1.4 WORK PLAN ORGANIZATION

The remainder of this Work Plan presents the following:

Section 2 – Site Background
Section 3 – Conceptual Site Model
Section 4 – Investigation Work Scope
Section 5 – Sample Collection
Section 6 – Quality Control and Data Validation
Section 7 – Schedule and Sequence
Section 8 – Report

2. Site Background

2.1 SITE HISTORY

LACBWR is a 50 MWe nuclear power plant that is owned and was operated by DPC of La Crosse, Wisconsin. The plant is located on the east bank of the Mississippi River in Vernon County, Wisconsin, approximately one mile south of the village of Genoa, Wisconsin and approximately 19 miles south of the city of La Crosse, Wisconsin. The plant was one of a series of demonstration plants funded in part by the United States Atomic Energy Commission (AEC). The Allis-Chalmers Company was the original licensee. The AEC later sold the plant to DPC and provided DPC with a provisional operating license. LACBWR achieved initial criticality on 11 July 1967 and began commercial power generation on 1 November 1969. The plant operated for 19 years until it was shut down permanently on 30 April 1987.

The NRC approved the Decommissioning Plan on 7 August 1991. DPC conducted decontamination and decommissioning (D&D) activities until the middle of 2014, when it was decided to return the facility to SAFSTOR until additional resources could be obtained to complete the decommissioning effort. In June 2016, DCP transferred the storage and decommissioning license to LaCrosse*Solutions* for the purpose of completing the decommissioning effort.

Several structures, including the reactor core, have been removed from site. The spent fuel is all stored on the ISFSI storage pad.

2.2 PHYSICAL SETTING

The LACBWR site location was first developed by hydraulic dredging and relocating sands from the adjacent river to fill in the low-lying areas to extend the shoreline such that the reactor and supporting structures could be constructed. This section provides an overview of the physical setting of the area, with a focus on the plant itself and specifically how the physical setting impacts groundwater flow directions and hydrogeological properties.

2.2.1 Topography

The site is located within the Mississippi River Valley, where the valley is cut into highly dissected uplands. From La Crosse to Prairie du Chien, Wisconsin, the valley width varies between 2.5 to 4.5 miles and the valley walls rise sharply to heights of 500 to 600 feet above the river level.

Initially, the site consisted of marshes and low-lying wetlands. The current property was then built up through the deposition of hydraulically dredged sands from the river. During the sand placement and site preparation (prior to construction), the area was graded to a relatively flat ground surface. The resulting grade for the LACBWR site is generally flat with grade level at approximately 639 feet above Mean Sea Level (MSL) from the access road along the eastern boundary of the site to the riprap along the river shore (Figure 2).

The site is situated between two valleys that cut in to the bluffs located east of Highway 35 (Figure 1). The first valley drains to an area north of the site, toward Genoa, and the second valley drains to an area south of the site. These two valleys limit the drainage area that may contribute stormwater runoff from upgradient sources. Furthermore, drainage upgradient of the site is channeled along the highway and railroad into a recharge swale. A small amount of other drainage from the railroad right-of-way and nearby hills is channeled to the river via three underground culverts. These culverts cross the property discharging to the Mississippi River (DPC, 1972).

2.2.2 Geology

LACBWR is located on the east bank of the Mississippi River in the Wisconsin Driftless section of the Central Lowland Physiographic Province. It sits on the southwest flank of the Wisconsin Dome and the western flank of the Wisconsin Arch. The sedimentary strata or bedrock in this region dips less than 20 feet per mile to the southwest (Dames & Moore, 1973).

Much of the regional and site geology has been studied and is well documented. During construction and then during support of seismic studies, soil borings were completed within the LACBWR footprint and the shallow geology is very well understood.

Generally, the local geology is described as approximately 15 feet of hydraulic fill overlying 100 to 130 feet of glacial outwash and fluvial deposits on the east flood plain of the Mississippi River Valley. These unconsolidated deposits are underlain by flat lying sandstone and shales of the Dreshbach Group (Upper Cambrian). The Dreshbach Group is then underlain by dense Precambrian crystalline rocks encountered at approximately 650 feet bgs (Dames & Moore, 1973). At the subject site, the bedrock surface is encountered at an elevation of approximately 509 feet above MSL near the Reactor Building and slopes to approximately 501 feet above MSL near the river shoreline.

Numerous geotechnical subsurface explorations have been conducted on site. Below is a summary of site-specific soil conditions encountered.

- 0 to 20 feet bgs. Hydraulic Fill – Fill sands are encountered from approximately 0 to 20 feet bgs and described as light brown to brown, fine to medium sands with occasional fine gravel.

- 20 to 30 feet bgs. Brown to grey, fine to medium sands underlie the fill, with an average thickness of 7 to 28 feet.

- 30 to 100 feet bgs. Brown, fine to medium sands that also have zones of coarse sand and fine gravel below the finer sands.

- 100 to 115 feet bgs. Brown fine to medium sand and fine to medium gravels.

- 115 to 135 feet bgs. Brown fine to medium sand with trace silt, occasional zones of gravel.

These data were used to better understand site hydrogeology, specifically how the shallow unconsolidated deposits that underlie LACBWR govern groundwater flow, as well as, the fate and transport of potential radionuclides in both the vadose zone and in the aquifers below.

2.2.3 Hydrology

Regionally, groundwater flows from the bluff towards the Mississippi River. Closer to the river, it is likely that the groundwater flow direction turns 'downstream' as groundwater discharges to the surface water. Groundwater elevation data from site monitoring wells agree with the regional groundwater flow, and show seasonal variation on upward and downward gradients, that are influenced by the river stage.

Groundwater beneath the site is first encountered at depths ranging from approximately 15 to 25 feet bgs and the water table aquifer is in strong hydraulic communication with the adjacent Mississippi River. Groundwater in the shallow deposits and fill material flows towards the west and discharges into the Mississippi River. The deeper groundwater flows west but may be influenced by the river and may turn and flow parallel to the river. Site monitoring well locations and groundwater elevation contours are shown on Figures 3 and 4.

Groundwater flow through the site is generally towards the river but impacted locally by the deeper structures (i.e., the containment structure shell) as well as the deep pilings that support the structures. During plant construction, and more specifically the installation of the support pilings, the soil was compacted, reducing the effective porosity and permeability of the soils. This reduction in permeability likely decreased the hydraulic conductivity of the aquifer within the footprint of the buildings. The resulting impact to groundwater flow is that groundwater within the compacted soils will flow at a slower velocity.

Based on the soil classification of fine to medium sands (SM and SP) and silts (ML) for the shallow soils, expected hydraulic conductivities for the shallow aquifer range from 10-5 centimeters per second (cm/sec) (or 10-1 feet per day [ft/day]) to 10-1 cm/sec (or 100 ft/day). The average shallow aquifer hydraulic conductivity is approximately 313 feet per day and the average deep aquifer hydraulic conductivity is approximately 429 feet per day.

The horizontal gradient of the water table ranges from 0.004 to 0.005 feet per foot (ft/ft) in the shallow aquifer and 0.001 to 0.002 ft/ft in the deeper aquifer. Vertical groundwater gradients also vary and are impacted by the river stage. Generally, there is an upward gradient, as expected, during the low river stages with a downward gradient during times of extremely high water. Vertical gradients are small and range from 0.015 ft/ft in the downward direction to 0.028 ft/ft in the upward direction.

Groundwater velocity is directly related to the gradients or difference in hydraulic head across the site. Groundwater velocity in the shallow water bearing zone ranges from 0.13 to 1.67 ft/day and 0.25 to 0.69 ft/day in the deep zone (Haley & Aldrich, 2016).

2.2.4 Surface Water

LACBWR is located along the Mississippi River with the discharge located at the head of Thief Slough, a side channel of the Mississippi River that is separated from the main channel by Island 126. The Mississippi River Valley floor is primarily comprised of marsh lands, with islands between river channels and extensions of low lying flood plain cut by ponds, sloughs and meandering stream channels. The main channel of the river varies greatly in width both above and below the site. A series of dams are operated by the United States Army Corps of Engineers for navigational purposes. Above Dam No. 8 (about ¾ mile north of the site) the river is nearly 4 miles wide. Below the dam and closer to the site, the river is 1,500 to 2,000 feet wide (DPC, 1972). The published flood stages for the Mississippi River at the site are:

- 50-year flood state is at 635'2" above MSL
- 100-year flood stage is 637'2" above MSL
- 500-year flood stage is at 640' above MSL

Therefore, the 100-year flood is within two feet of the plant grade (639 feet above MSL).

2.3 SUMMARY OF PREVIOUS INVESTIGATIONS

Several phases of environmental assessments and investigations have been conducted on-site since 2012. This section provides a brief summary of the work performed and significant findings.

2.3.1 Preliminary Conceptual Site Model and Hydrogeologic Investigation

In August 2012, Haley & Aldrich developed a preliminary Hydrogeologic CSM for the Site by reviewing available relevant documents regarding the plant construction, physical setting (e.g. geology, hydrogeology, etc.), and historic operations.

In September 2012, based on the preliminary CSM and data gaps identified, Haley & Aldrich developed a Hydrogeologic Investigation Work Plan (Work Plan) to evaluate the AOIs and obtain data to characterize the site's hydrogeology and support the D&D efforts. The Work Plan was paired with a Quality Assurance Project Plan (QAPP) to ensure the that appropriate and defensible data are collected and that all regulatory requirements are met.

The scope of the investigation included:

- Drilling of five deep borings for observation and collection of soil samples;
- Installation of five paired monitoring wells;
- Collection of soil samples for geotechnical analyses;
- Hydraulic conductivity testing of all newly installed wells;
- Collection of groundwater level measurements; and
- Collection of groundwater samples for on-site tritium analysis and off-site radiochemical analyses.

Results of the Hydrogeological Investigation are included in our "Hydrogeologic Investigation Report" dated 15 January 2015, revised 14 February 2016. Pertinent findings and conclusions are summarized below:

- Geology is well understood and consists of fill sands overlying fine to medium sands with increasingly coarse sands and gravel with depth. Bedrock is encountered at approximately 130 feet bgs. In general, the monitoring well network installed within the LACBWR area is screened in medium or medium-fine sand.

- Groundwater flows towards the Mississippi River and is hydraulically connected to the river. River stage affects local groundwater fluctuations and may slightly alter groundwater flow direction to parallel river flow. Typically, groundwater is encountered at approximately 20 feet bgs.

- The average shallow aquifer hydraulic conductivity is approximately 313 ft/day and the average deep aquifer hydraulic conductivity is approximately 429 ft/day.

- The horizontal gradient of the water table ranges from 0.004 to 0.005 ft/ft in the shallow aquifer and 0.001 to 0.002 ft/ft in the deeper aquifer.

- Vertical groundwater gradients are impacted by the river stage. Generally, there is an upward gradient, as expected, during the low river stages with a downward gradient during times of extremely high water. Vertical gradients are small and range from 0.015 ft/ft in the downward direction to 0.028 ft/ft in the upward direction.

- Groundwater velocity in the shallow water bearing zone ranges from 0.13 to 1.67 ft/day and 0.25 to 0.69 ft/day in the deep zone.

- The data indicate that the shallow aquifer has slower velocities and groundwater movement below the Turbine Building and faster groundwater movement outside and around the Turbine Building, suggesting some interference of the subsurface pilings associated with the building. Groundwater velocity data for the deep aquifer indicate less variability and lack the influence of subsurface disturbances.

- The most likely AOIs where radionuclides could have been released to soils and groundwater include the Turbine Building waste collection system and the Underground Gas Storage Tank Vault and Piping. No radionuclides were detected above background from the groundwater monitoring wells suggesting that these AOIs did not impact downgradient conditions.

- Groundwater analytical results did not report radionuclides at activities above background in any of the samples; historic site operations did not significantly impact groundwater quality downgradient of the potential AOIs.

2.3.2 Groundwater Monitoring

Several rounds of groundwater samples have been collected from site monitoring wells. This includes two rounds of groundwater samples collected in 2014; and quarterly samples collected in 2015.

Samples were collected from monitoring wells MW-201A/B, MW-202A/B, MW-203A/B, MW-204A/B, MWB11R, and MWB11AR (Figure 2).

Groundwater samples were collected using USEPA's Low Stress/Low Flow Sampling Methods (USEPA 2010) with field parameter measurements for the following:

- pH;
- oxidation reduction potential (ORP);
- Temperature;
- Conductivity; and
- Turbidity.

As part of this collection method, groundwater is purged as a rate not to depress the water table. Samples are then collected for laboratory analysis once the field parameters have stabilized to within 10%.

Groundwater samples were submitted to Eberline Analytical Services (Oak Ridge, Tennessee), Chemical Services Laboratory (La Crosse, Wisconsin), and Northern Lake Service (Crandon, Wisconsin) for one or more of the following analyses:

- Radionuclides by alpha and gamma spectroscopy;
- Volatile organic compounds (VOCs) by USEPA method 8260C;
- Inorganic constituents, or metals by USEPA Methods 9056, 6010B, 7010B, and/or SW-846; and
- Polychlorinated biphenyls (PCBs) by USEPA Method 8082.

Samples were also collected in domestic wells number 3, 4, and 7 (in June 2014, radionuclides only) and domestic well number 5 (in June and September 2014 and quarterly in 2015, full suite analyzed). Domestic well locations are shown on Figure 2.

In December 2016, May 2017 and December 2017 additional groundwater samples were collected from monitoring wells MW-200A/B, MW-201A/B, MW-202A/B, MW-203A/B, MW-204A/B, MWB11R, MWB11AR, and domestic Well Number 5. (Note: MW-201B was destroyed during demolition of the Turbine Building and was not sampled in December 2017). An additional limited round of groundwater samples was collected from MW-201A, MW-202A and MW-203A in February and analyzed for tritium only.

Groundwater samples were submitted to General Engineering Laboratories (Charleston, South Carolina) for the following analyses:

- Radionuclides Co-60 and Cs-137 by gamma spectroscopy;
- Radionuclides Nickel-63 (Ni-63) and tritium (H-3) by liquid scintillation; and
- Radionuclide Sr-90 by gas flow proportional counting.

A summary of radiological groundwater analytical results is provided on Table 1.

2.3.2.1 Radionuclide Analytical Results

Samples collected from monitoring and domestic wells between 2014 and May 2017 showed low levels of radionuclides that are consistent with expected background values. Reported values were well below the USEPA MCLs for groundwater and do not suggest site-related impacts.

During the December 2017 sampling event, tritium was detected at MW-203A at a concentration of 13,000 picocuries per liter (pCi/L). Tritium had not been detected at this location the previous two sampling rounds and was last detected at a concentration of 104 pCi/L in November 2015. While this reported value is below the USEPA maximum contaminant level (MCL) of 20,000 pCi/L, additional investigation was warranted to verify the decreasing trend and document potential seasonal impacts.

In February 2018, additional samples were collected from MW-201A, MW-202A and MW-203A to further evaluate results from the December 2017 event. Tritium was detected below detection in MW-201A, below the MCL in MW-202A (13,200 pCi/L), however; it exceeded the MCL in MW-203A at 24,200 pCi/L.

Concentrations observed in all other groundwater samples collected during this event showed low levels of radionuclides that are consistent with background values. Reported values were well below the USEPA MCLs for groundwater and do not suggest site-related impacts or increasing trends.

2.3.2.2 Chemical Constituent Analytical Results

All VOC and PCB chemical constituents were reported at concentrations below the USEPA and the DNR drinking water criteria. The regulatory standards used for comparison include USEPA MCLs for drinking water and DNR's Public Health Groundwater Quality Standards and Public Welfare Groundwater Quality Standards. Each of the DNR Groundwater Quality Standards (Public Health and Public Welfare) has an Enforcement Standard and a Preventative Action Limit. The preventative action limits are 10 to 25% lower than enforcement standards for Public Health Standards and 50% lower Public Welfare Standards. Note that the Public Health Groundwater Quality Standards are substances of public concern that cause or contribute to an increase in mortality, illness, incapacity, adverse human health effect, or pose a substantial present or potential hazard to human health. The Public Welfare Groundwater Quality Standards are also a substance of public concern but are related to the influence of the substance on aesthetics, suitability of water for other uses, and adverse effect on plant life or animal life.

VOCs. VOCs were not detected at the site, with the exception of acetone, chloromethane, tetrachloroethene (PCE), and toluene, which were "J" flagged indicating that the result was an estimated value which was less than the laboratory reporting limit. PCE was detected in March and September 2015 in MW-201A groundwater but was not detected in either June or November 2015 groundwater samples collected from this well. Chloromethane and toluene were only detected in one round of sampling (31 August and 1 September 2015) and may be a laboratory error or environmental contaminant from the sampling procedures. These constituents were not detected in subsequent sampling rounds and are not interpreted to be site-related. Acetone was detected (J-flagged) in MW-200A only on 24 March 2015 and was not detected in subsequent sampling rounds.

PCBs. PCBs were not detected in the groundwater samples.

Inorganics. No inorganic constituents exceeded the USEPA MCLs; however, manganese and iron exceeded both the DNR's Enforcement Standard as well as the more conservative Preventive Action Standard. It should also be noted that elevated manganese and iron concentrations was also detected consistently in well B11R, confirming that it is likely either naturally occurring or not site-related.

Arsenic and cobalt also exceeded the DNR's Preventative Action Limits for at least one well in the groundwater monitoring network. Both of these constituents were also detected in Well B11R with arsenic at an elevated concentration.

In addition to the Public Health Groundwater Quality Standards, several compounds (iron, chloride and nitrite/nitrate as Nitrogen) also exceeded the Public Welfare Groundwater Quality Standards. These are criteria that may not be required to be protective of human health but are more protective of the water quality aesthetics (color, iron chlorides, sulfates and also manganese). Note that in some instances a compound may be included on both the Public Health and Public Welfare Groundwater Quality Standards.

Per the DNR regulation, (§140.14 (1)(1)), state notification is required if groundwater results exceed either criteria. It should also be noted that for several constituents, the laboratory's detection and reporting limits exceed the DNR Preventive Action Standard however; these constituents are naturally occurring inorganics and do not suggest influences by historic site practices. Additionally, there is no exposure pathway for shallow groundwater and therefore, potential impacts to human health.

No inorganic compounds were detected above the MCLs or DNR criteria from samples collected from the domestic, i.e. drinking water wells.

3. Conceptual Site Model

The CSM was updated following the Hydrogeological Investigation. It noted that historic operations may have released COCs to the environment however, no impacts were observed in the groundwater collected from downgradient wells. Generally, most of the potential releases were associated with the waste collection system in the Turbine Building. For this building, radioactive liquid waste was collected by floor drains, pumped into waste water tanks and then batch released into the circulating water line. In the late 1970s, voids were characterized below the building (mostly in the northeast below the laundry area). When the voids were grouted, grout then entered the floor drains, plugging them. These data raise questions on the integrity of the Turbine Building subsurface floor drains.

There were likely localized impacts on groundwater flow from deeper plant structure and the areas were pilings were used to support structures. The implications of these localized flow regimes on contaminant fate and transport are that potential releases that occurred within the footprint of the buildings via floor drains could take longer to migrate both in the vadose zone as well as the underlying aquifer. This is further compounded as the overlying structures isolate the shallow soils from precipitation, creating an area that will likely retain any potentially released contamination. Therefore, although no site related radionuclides were detected above background levels, it was still possible to have impacted media below the Turbine Building.

4. Investigation Work Scope

On 14 March 2018, LaCrosse*Solutions* reported a tritium release to DNR. This was based on recent site data that showed increasing tritium levels in down gradient groundwater samples collected from MW-202A and 203A. To verify the source of contamination; groundwater migration pathways; and evaluate if there is a potential for tritium to reach sensitive receptors, the following work will be completed in accordance with the requirements in NR 716 of the Wisconsin Administrative Code:

- Additional Groundwater Quality Monitoring;
- Groundwater Modeling;
- Dye Tracer Study;
- Evaluation of Potential Receptors; and
- Assessment of Potential Vapor Intrusion Pathways.

4.1 ADDITIONAL GROUNDWATER QUALITY MONITORING

Additional groundwater samples will be collected from monitoring wells MW-202AR (installed in March 2018 following destruction of MW-202A and subsequent abandonment due to construction activities), MW-202B, MW-203A and MW-203B, MW-201A and MW-201B,and from the water supply wells on-site, to continue to evaluate concentrations and migration. Purge water from wells that are documented to be below the MCLs (20,000 pCi/L) will be returned to the ground in the area of the well. If there is a potential for increased tritium in groundwater, the purge water will be containerized and disposed of in accordance with the site's health physic program.

4.2 GROUNDWATER MODELING

Haley & Aldrich will use the existing CSM data along with regional geological data to generate a groundwater flow and transport model. This modeling effort will use MODFLOW and simplified box model for particle tracking to assess groundwater flow paths and possible capture zones in three dimensions. Additional analytical models or combination of models may be employed, if warranted, and may be used along with MODFLOW. Once a groundwater flow model is developed, it may also be used to estimate capture zones for pumping wells, or guide other remedy options, should hydraulic controls or dewatering activities be needed. The model may also be used to demonstrate that the existing groundwater monitoring network is appropriate to monitor the plume migration, with wells located down gradient of the potential sources (as evidenced by the presence of tritium in MW-202A and MW-203A) and that the duration of the dye tracer test is appropriate. Preliminary test results have indicated no migration of tritium to the drinking water wells or up-gradient toward residential wells along the other side of the highways as shown on Figure 5.

Data from these wells and the estimated concentration in groundwater will also be used to evaluate the potential for tritium to migrate via vapor intrusion to site buildings (if they remain) or for future site uses.

4.3 DYE TRACER STUDY

The purpose of this study is to confirm if the Reactor Plant, Generator Plant Access (RPGPA) sump is the source for tritium detected in monitoring wells MW-202A and MW-203A. These data will also be used to calibrate the groundwater model with respect to the groundwater velocity as well as the potential flux of tritium towards the Mississippi River.

A non-toxic fluorescent dye will be introduced to the sump to identify if it represents the source of tritium to groundwater. Dye testing will be completed via the following steps:

- Work Plan: A brief workplan was provided to WI DNR in March 2018, with the necessary information to approve the dye introduction.

- Background Evaluation: To first establish that there are no background dyes present, carbon packets were placed in three of the wells onsite on 8 March 2018. The carbon packets contain granular activated carbon placed in a cloth bag. The carbon packets were removed after being submerged for a minimum of seven days, dried to remove residual tritium, and submitted to the laboratory to evaluate background conditions and support dye selection.

- Dye Introduction: With WI DNR approval, approximately one pound of fluorescent dye will be introduced to the sump. If the sump is dry, the dyes will then be flushed with up to 200 gallons of non-chlorinated water. If the sump has water, no additional water may be needed.

- Sampling: Charcoal packets shall be placed in up to 6 wells. These samples will be replaced weekly for up to four weeks to identify the leading edge of the plume and verify whether or not the sump is the source. Upon removal, the packets will be dried and submitted to Ozarks Underground Laboratory for analysis. Once data are sufficient to confirm/deny that the sump is the source, sampling may be terminated. A copy of the application and dye study work plan is provided in Attachment A.

The results of the dye tracer study will confirm the presumed source of the release and be used to calibrate the groundwater model, to be able to estimate flux and groundwater velocity.

4.4 VAPOR INTRUSION EVALUATION

In accordance with Chapter NR 716 of the W.A.C, Haley & Aldrich will also evaluate the groundwater data with respect to potential vapor intrusion pathways for existing and potential future structures.

4.5 RECEPTOR SURVEY

Haley & Aldrich will also perform an evaluation of the potential receptors in the Mississippi River and on site. We will use this data to perform a limited screening level ecological risk assessment to identify any potential risks of tritium on the benthic and aquatic receptors.

5. Sample Collection

Groundwater samples will be collected in accordance with the "LACBWR Site Restoration Project Work Control Procedure, Groundwater Sampling, Procedure No. LC-RP-PR-057, Revision 2." (LC-RP-PR-057) This document includes procedures for sampling, equipment requirements, sample collection and preservation, decontamination, quality control and sample documentation. A copy is provided in Appendix A.

5.1 SAMPLING METHOD

Groundwater samples will be collected using the USEPA's Low Stress/Low Flow Sampling Methods (USEPA 2010) with field parameter measurements for the following:

- pH;
- ORP;
- Temperature;
- Conductivity;
- Dissolved oxygen (DO); and
- Turbidity.

As part of this collection method, groundwater is purged at a rate not to depress the water table. Samples are collected once the field parameters have stabilized to within applicable criteria.

5.2 SAMPLE CUSTODY AND MANAGEMENT

Each sample will be given a unique identification using the following nomenclature:

AA-BBB- CCCCCC where:

- AA represents the sample type (i.e. MW for monitoring well)
- BBB represents the well location (i.e. 201A)
- CCCC represents the date of collection

For example, sample MW-201A-120617 is a sample collected from MW-201A on December 6, 2017.

If a duplicate sample is collected for quality assurance/quality control (QA/QC) requirements, a "D" will be inserted between the well location and the sample collection date (i.e. MW-201A-D-120617).

Samples will be maintained under chain of custody, as required by the site sampling procedure (LC-RP-PR-057). All samples will be screened on site by the Radiation Protection department before being shipped to the analytical laboratory for radiological analysis.

5.3 LABORATORY ANALYTICAL METHODS AND DETECTION LIMITS

Samples will be collected into laboratory provided glassware and submitted to GEL Laboratories, LLC (GEL) for analysis. Analytical methods and laboratory method detection limits (MDLs) are provided in Table 2.

Table 2: Summary of Analytical Methods and Detection Limits

Compound	EPA Method	Units	MDL
Cesium-137	901.1 (Rad Gamma Spec)	pCi/L	10
Cobalt-60	901.1 (Rad Gamma Spec)	pCi/L	10
Nickel-63	DOE RESL Ni-1, Modified	pCi/L	50
Strontium-90	905.0 Modified/DOE RP501 Rev. 1 Modified	pCi/L	2
Tritium (H-3)	906.0 Modified	pCi/L	700

Note: MDLs are based on standard operating procedures provided by GEL.

5.4 EQUIPMENT CALIBRATION AND DECONTAMINATION

A calibration verification of field instruments will be performed daily, prior to initial use in the field. Additional calibration may be required if signs of instrument malfunction or questionable readings are observed. Calibration procedures are included in Attachment 3 of the LC-RP-PR-057 (Appendix A).

Dedicated and/or disposable equipment will be used when possible to prevent cross-contamination. Equipment such as water level indicators that will be used to collect data from multiple wells, will be decontaminated between each use. Decontamination will be performed in accordance with Attachment 6 of the LC-RP-PR-057.

6. Quality Control and Data Validation

The commercial laboratory supplying radiological analytical services shall have current National Environmental Laboratory Accreditation Program (NELAP) and Wisconsin required certifications. The commercial laboratory's QA program will include provisions for replicate, method blank, matrix spike, tracer yield, internal standards, and surrogate measurements.

Laboratory analytical reports will be reviewed to determine data usability in accordance with guidance provided by the US USEPA. The following QA/QC criteria from the analysis of the project samples will be evaluated as applicable:

- Sample Preservation and Holding Time Compliance
- Method Sample Analysis
- Blank Sample Analysis
- Laboratory Control Samples
- Field and Laboratory Duplicates
- Target Analyte Identification
- Use of Laboratory Data Qualifiers

Analytical precision and accuracy will be evaluated based on laboratory duplicate analyses performed concurrently with the project samples. Field precision will be evaluated based on field duplicates.

Sample data shall be qualified by the laboratory in accordance with laboratory standard operating procedures (SOPs). Data qualifiers assigned to project sample results by the laboratory will be applied to

the reported results. Data will be evaluated to determine compliance with the data quality objectives (DQOs) and usability for the project. All exceptions will be noted in data validation reports.

7. Schedule and Sequence

LaCrosse*Solutions* began investigation activities in advance of the 31 March 2018 DNR letter. As a result of on-going groundwater monitoring conducted as part of the D&D effort, the tritium release to groundwater was identified and reported. Work has begun on a calibrated groundwater model to evaluate if there was any potential for tritium to migrate to the drinking water supply or off site. This effort was coupled with the design of a dye tracer study to confirm the source and to calibrate the model. Preliminary results indicate there has been no migration to of H-3 to the site drinking water wells or upgradient to the residential wells on the other side of the highway.

LaCrosse*Solutions* has increased the sampling frequency of monitoring wells MW-202AR/B, MW-203A/B, MW-201A/B and with approval of this Work Plan they will continue bi-monthly monitoring, with the remaining site wells to be sampled semiannually.

LaCrosse*Solutions* will meet the following schedule for remaining tasks as required by the DNR in their 30 March 2018 letter:

- Site investigation will be initiated within 90 days of submitting this Site Investigation Work Plan. The field investigation will begin within 60 days for receiving DNR approval.
- A Site Investigation Report (SIR) will be submitted to the DNR within 60 days of field investigation completion and receipt of laboratory analytical data.
- A Remedial Actions Options Report will be submitted within 60 days after submittal of the SIR, if remediation is warranted.

8. Report

Upon receipt of laboratory data, Haley & Aldrich will complete a SIR. The report will include descriptions of the field programs, field logs, analytical results, and an updated CSM. This will include evaluation of groundwater flow directions and velocities, and an assessment of the tritium plume at the LACBWR site. The report will also include recommendations for additional investigations, if warranted.

The report will discuss the potential impacts of the tritium release on the environment and potential impacts to both human heath receptors via vapor intrusion as well as the aquatic and benthic receptors in the adjacent Mississippi River.

References

Dames & Moore, 1973. Geotechnical Investigation of Geology, Seismology, and Liquefaction Potential, La Crosse Boiling Water Reactor (LACBWR) near Genoa, Vernon County, Wisconsin for Gulf United Nuclear Fuels Corporation, October 1973.

DPC, 1972. Environmental Report, La Crosse Boiling Water Reactor, Full Term Operating License Stage, Dairyland Power Cooperative, La Crosse, WI, September 1972.

Haley & Aldrich, Inc. (Haley & Aldrich), 2016a. Groundwater Monitoring Report, 2014-2015; La Crosse Boiling Water Reactor. April 2016.

Haley & Aldrich, 2016b. Hydrogeological Investigation Report, La Crosse Boiling Water Reactor, Dairyland Power Cooperative. Revised 24 February 2016.

Haley & Aldrich. 2017. Groundwater Monitoring Report, December 2016; La Crosse Boiling Water Reactor. January 2017.

LaCrosse*Solutions*. 2017. Radiation Protection, Instruction No. LC-RP-PR-057, Revision 2, Groundwater Sampling, LaCrosse*Solutions* Site Restoration Project. 2 April 2018.

U.S. Environmental Protection Agency. 2010. Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells. USEPA – Region 1.

Wisconsin Department of Natural Resources, NR 140. Published under s. 35.93, stats. Register July 2015, No 715.

Wisconsin Department of Natural Resources, March 2018. Reported Contamination at La Crosse Boiling Water Reactor Facility. 30 March 2018.

TABLES

TABLE 1
SUMMARY OF RADIOLOGICAL ANALYTICAL RESULTS FOR GROUNDWATER (2014-2017)
LA CROSSE BOILING WATER REACTOR (LACBWR)
GENOA, WISCONSIN

Location	3	4	5	5	5	5	5
Sample ID	MW-DW3-06182014	MW-DW4-06182014	MW-DW5-06182014	MW-DW5-09242014	DW-5-03252015	DW-5-11122015	Well 5-120716
Sample Date	06/18/2014	06/18/2014	06/18/2014	09/24/2014	03/25/2015	11/12/2015	12/07/2016
Radiological (pCi/L)							
Americium-241	0.0538 ± 0.0898	0.0341 ± 0.09	0.00464 ± 0.0846	0.128 ± 0.156	-	-	-
Carbon-14	2.79 ± 8.74	0 ± 8.89	-3.97 ± 8.76	-0.944 ± 7.34	-	-	-
Cesium-137	-0.597 ± 2.03	-0.346 ± 1.49	-0.745 ± 2.06	3.96 ± 2.45	2.17 ± 2.8	-0.568 ± 3.01	0.249 U ± 2.32
Cobalt-60	1.02 ± 1.98	0.394 ± 2.17	2.49 ± 2.11	2.17 ± 3.17	2.37 ± 3.52	0.377 ± 2.15	0.0409 U ± 1.50
Europium-152	9.48 ± 12.9	2.34 ± 7.76	-7.42 ± 11.2	2.48 ± 20.5	4.59 ± 12.6	1.51 ± 17.9	-
Europium-154	-5.23 ± 4.13	3.15 ± 5.06	1.34 ± 6.02	-3.3 ± 7.97	-3.36 ± 10.1	-0.26 ± 7.18	-
Europium-155	-2.67 ± 4.38	1.46 ± 4.67	-0.154 ± 4.42	2.68 ± 4.49	0.902 ± 7.84	0.438 ± 6.76	-
Gross Alpha Analytes	0.126 ± 1.01	-0.132 ± 0.862	4.43 ± 1.71	0.847 ± 0.725	-1.06 ± 1.15	0.947 ± 1.82	-
Gross Beta Analytes	1.48 ± 1.57	3.13 ± 1.65	1.92 ± 2.15	2.95 ± 1.74	2.09 ± 1.64	-1.05 ± 2.42	-
Iron-55	-20 ± 70	-31.1 ± 78.2	-26.6 ± 80.2	9.39 ± 77.7	-	-	-
Nickel-59	18.3 ± 62.2	39.6 ± 76.9	-47.4 ± 87.9	3.12 ± 59.9	-	-	-
Nickel-63	-1.77 ± 3.82	-6.13 ± 3.62	-7.4 ± 3.62	2.79 ± 2.89	-	-	16.4 U ± 25.4
Niobium-94	0.44 ± 2.13	0.143 ± 1.98	-1.25 ± 1.68	-0.945 ± 2.04	1.86 ± 2.14	-0.374 ± 2.1	-
Plutonium-238	0.0282 ± 0.279	-0.0476 ± 0.172	-0.0221 ± 0.154	0.0171 ± 0.0713	-	-	-
Plutonium-239/240	-0.096 ± 0.201	0.0336 ± 0.172	0.0313 ± 0.16	0.0928 ± 0.12	-	-	-
Plutonium-241	3.51 ± 17.4	2.7 ± 20.1	-8.39 ± 17.6	3.17 ± 9.31	-	-	-
Strontium-90	0.609 ± 0.686	0.0898 ± 0.658	0.0898 ± 0.595	-0.0174 ± 0.657	-0.0369 ± 0.658	-0.579 ± 0.906	0.870 U ± 0.829
Technetium-99	-8.27 ± 3.48	-7.37 ± 3.52	-8.26 ± 3.48	-1.54 ± 3.14	-	-	-
Tritium	104 ± 137	159 ± 140	194 ± 141	34.2 ± 139	-52.6 ± 143	-104 ± 146	-96.7 U ± 133

Notes:

1	Regulatory criteria from NR 140.10 Subchapter II
2	USEPA MCLS, 40 CFR Part 141
#	Result between Detection & Quantification Limit
-	Not Analyzed
A	Matrix Spike Recovery outside control limits
J	Value is estimated
R	Result is rejected
NA	Not Applicable
pCi/L	picoCuries per liter
U	Not detected above laboratory reporting limit
	Exceeds one or more regulatory criteria
	Exceed DNR Table 2 - Public Welfare Groundwater Quality Standards only.
	Shaded cells indicate duplicate analyses.

TABLE 1
SUMMARY OF RADIOLOGICAL ANALYTICAL RESULTS FOR
LA CROSSE BOILING WATER REACTOR (LACBWR)
GENOA, WISCONSIN

Location	5	5	7	B11AR	B11AR	B11AR
Sample ID	Well-5-052217	Well-5-120717	MW-DW7-06182014	MW-B11AR-06182014	MW-B11AR-09242014	MW-B11AR-03252015
Sample Date	05/22/2017	12/07/2017	06/18/2014	06/18/2014	09/24/2014	03/25/2015
Radiological (pCi/L)						
Americium-241	-	-	-0.0109 ± 0.0766	0.0837 ± 0.107	-0.0168 ± 0.0514	-
Carbon-14	-	-	-5.08 ± 9.8	6.83 ± 9.84	0 ± 7.01	-
Cesium-137	-0.132 U ± 2.08	-1.03 U ± 4.12	-1.83 ± 2.24	1.83 ± 3.8	0.972 ± 2.18	-0.186 ± 2.71
Cobalt-60	-1.12 U ± 2.41	0.457 U ± 4.65	-2.41 ± 3.24	-1.93 ± 3.73	1.22 ± 1.98	2.58 ± 2.21
Europium-152	-	-	-5.5 ± 21.1	1.47 ± 21.7	6.41 ± 13.9	-4.68 ± 15.7
Europium-154	-	-	-4.73 ± 5.45	-2.61 ± 9.62	1.1 ± 5.62	4.5 ± 7.25
Europium-155	-	-	-0.174 ± 4.33	-4.46 ± 5.54	1.69 ± 4.49	-5.89 ± 7.09
Gross Alpha Analytes	-	-	-0.378 ± 0.909	0.733 ± 1.6	0.207 ± 1.86	0.221 ± 1.56
Gross Beta Analytes	-	-	0 ± 1.38	-0.269 ± 2.36	0.303 ± 1.97	-1.43 ± 3.06
Iron-55	-	-	-38.5 ± 82.3	-37.5 ± 74.2	-34.8 ± 77.2	-
Nickel-59	-	-	26 ± 65.9	2.52 ± 54.9	-8.49 ± 60.6	-
Nickel-63	18.6 U ± 19.7	-14.5 U ± 18.1	-4.38 ± 3.83	0 ± 3.62	-0.413 ± 2.92	-
Niobium-94	-	-	0.748 ± 2.35	1.52 ± 3.07	-0.129 ± 1.82	0.985 ± 2.13
Plutonium-238	-	-	0.0822 ± 0.168	0.0409 ± 0.118	-0.0055 ± 0.0643	-
Plutonium-239/240	-	-	0.406 ± 0.331	-0.0339 ± 0.122	-0.0109 ± 0.0652	-
Plutonium-241	-	-	2.62 ± 13	0.837 ± 12.4	-2.29 ± 8.27	-
Strontium-90	0.370 U ± 0.696	-0.25 U ± 0.443	0.0177 ± 0.725	0.611 ± 0.633	1.32 ± 0.735	3.52 ± 0.924
Technetium-99	-	-	-9.35 ± 3.53	-8.46 ± 3.48	-1.56 ± 3.18	-
Tritium	-8.03 U ± 237	-127 U ± 330	123 ± 139	161 ± 142	34.3 ± 139	-69.4 ± 141

Notes:

1	Regulatory criteria from NR 140.10 Subchapter II
2	USEPA MCLS, 40 CFR Part 141
#	Result between Detection & Quantification Limit
-	Not Analyzed
A	Matrix Spike Recovery outside control limits
J	Value is estimated
R	Result is rejected
NA	Not Applicable
pCi/L	picoCuries per liter
U	Not detected above laboratory reporting limit
	Exceeds one or more regulatory criteria
	Exceed DNR Table 2 - Public Welfare Groundwater Quality Standards only.
	Shaded cells indicate duplicate analyses.

TABLE 1
SUMMARY OF RADIOLOGICAL ANALYTICAL RESULTS FOR
LA CROSSE BOILING WATER REACTOR (LACBWR)
GENOA, WISCONSIN

Location	B11AR	B11AR	B11AR	B11AR	B11AR	B11AR	B11R
Sample ID	MW-B11AR-11122015	B11AR-120616	B11AR-052217	B11AR-D-052217	B11AR-120517	B11AR-D-120517	MW-B11R-06182014
Sample Date	11/12/2015	12/06/2016	05/22/2017	05/22/2017	12/05/2017	12/05/2017	06/18/2014
Radiological (pCi/L)							
Americium-241	-	-	-	-	-	-	0.0122 ± 0.0626
Carbon-14	-	-	-	-	-	-	9.06 ± 9.66
Cesium-137	2.38 ± 2.93	-0.727 U ± 1.95	-0.421 U ± 1.98	1.08 U ± 2.19	8 U ± 10.5	-0.274 U ± 4.93	1.24 ± 2.12
Cobalt-60	6.3 ± 3.29	-1.72 U ± 2.18	-0.214 U ± 2.30	0.690 U ± 2.19	-1.94 U ± 6.37	-1 U ± 5.26	0.876 ± 1.87
Europium-152	-29.8 ± 36.3	-	-	-	-	-	-0.993 ± 13.4
Europium-154	-0.762 ± 4.12	-	-	-	-	-	1.63 ± 5.5
Europium-155	1.69 ± 7.93	-	-	-	-	-	1.59 ± 4.53
Gross Alpha Analytes	-0.239 ± 2.61	-	-	-	-	-	0 ± 1.66
Gross Beta Analytes	-0.0949 ± 3.01	-	-	-	-	-	3.59 ± 3.02
Iron-55	-	-	-	-	-	-	-31.8 ± 81.3
Nickel-59	-	-	-	-	-	-	-4.16 ± 55.6
Nickel-63	-	-12.5 U ± 23.2	5.53 U ± 16.6	21.4 U ± 22.1	-6.1 U ± 17.1	-5.69 U ± 17.5	-3.56 ± 4.1
Niobium-94	-1.22 ± 3.25	-	-	-	-	-	-0.699 ± 1.83
Plutonium-238	-	-	-	-	-	-	0 ± 0.12
Plutonium-239/240	-	-	-	-	-	-	-0.0254 ± 0.092
Plutonium-241	-	-	-	-	-	-	-5.72 ± 9.32
Strontium-90	1.4 ± 0.678	0.248 U ± 0.609	1.02 U ± 1.01	1.44 U ± 1.01	-0.784 UJ ± 0.396	0.0335 U ± 0.561	0.733 ± 0.673
Technetium-99	-	-	-	-	-	-	-5.52 ± 3.48
Tritium	-86.3 ± 146	-367 U ± 316	-93.5 U ± 229	-51 U ± 224	-243 U ± 322	-85.9 U ± 337	245 ± 141

Notes:

1	Regulatory criteria from NR 140.10 Subchapter II
2	USEPA MCLS, 40 CFR Part 141
#	Result between Detection & Quantification Limit
-	Not Analyzed
A	Matrix Spike Recovery outside control limits
J	Value is estimated
R	Result is rejected
NA	Not Applicable
pCi/L	picoCuries per liter
U	Not detected above laboratory reporting limit
	Exceeds one or more regulatory criteria
	Exceed DNR Table 2 - Public Welfare Groundwater Quality Standards only.
	Shaded cells indicate duplicate analyses.

TABLE 1
SUMMARY OF RADIOLOGICAL ANALYTICAL RESULTS FOR
LA CROSSE BOILING WATER REACTOR (LACBWR)
GENOA, WISCONSIN

Location	B11R	B11R	B11R	B11R	B11R	B11R	B2
Sample ID	MW-B11R-09242014	MW-B11R-03252015	MW-B11R-11122015	B11R-120616	B11R-052217	B11R-120517	MW-B2-06182014
Sample Date	09/24/2014	03/25/2015	11/12/2015	12/06/2016	05/22/2017	12/05/2017	06/18/2014
Radiological (pCi/L)							
Americium-241	0.0368 ± 0.108	-	-	-	-	-	0.00398 ± 0.0725
Carbon-14	-2.7 ± 6.97	-	-	-	-	-	1.93 ± 10
Cesium-137	-0.724 ± 2.06	-2.2 ± 2.54	-0.562 ± 2.79	R	0.0792 U ± 2.81	1.81 U ± 4.06	1.36 ± 2.02
Cobalt-60	1.32 ± 2.08	1.04 ± 2.7	1.34 ± 2.06	0.436 U ± 2.00	-0.347 U ± 2.05	-2.31 U ± 5.16	-1.38 ± 1.86
Europium-152	3 ± 10.3	10.5 ± 16.9	-6.36 ± 14.7	-	-	-	0.106 ± 12
Europium-154	-3.92 ± 5.31	-0.782 ± 5.42	1.97 ± 6.45	-	-	-	2.35 ± 4.86
Europium-155	1.94 ± 4.61	2.39 ± 6.91	-6.62 ± 7.29	-	-	-	-1.6 ± 4.72
Gross Alpha Analytes	3.08 ± 1.94	-1.11 ± 2.1	-0.267 ± 3.1	-	-	-	-2.12 ± 3.23
Gross Beta Analytes	14.4 ± 4.05	4.68 ± 2.8	2.26 ± 3.61	-	-	-	11.2 ± 4.99
Iron-55	-30.9 ± 71	-	-	-	-	-	-9.2 ± 72.9
Nickel-59	16.3 ± 66.8	-	-	-	-	-	-7.12 ± 57.7
Nickel-63	2.47 ± 2.98	-	-	3.05 U ± 24.3	12.8 U ± 17.4	-4.5 U ± 17.6	-7.94 ± 3.63
Niobium-94	-1.39 ± 1.64	-0.556 ± 2.32	-0.284 ± 2.3	-	-	-	1.76 ± 1.62
Plutonium-238	0.0368 ± 0.102	-	-	-	-	-	0.0539 ± 0.142
Plutonium-239/240	0 ± 0.102	-	-	-	-	-	0.034 ± 0.0985
Plutonium-241	-3.68 ± 8.84	-	-	-	-	-	0 ± 11.8
Strontium-90	1.63 ± 0.642	0.974 ± 0.682	2.46 ± 0.777	-0.702 U ± 0.482	0.993 U ± 0.918	-0.313 U ± 0.572	0.652 ± 0.69
Technetium-99	-0.399 ± 3.27	-	-	-	-	-	-7.41 ± 3.44
Tritium	0 ± 140	-191 ± 139	-105 ± 147	-322 U ± 318	-69.3 U ± 229	-89.2 U ± 331	159 ± 141

Notes:

1	Regulatory criteria from NR 140.10 Subchapter II
2	USEPA MCLS, 40 CFR Part 141
#	Result between Detection & Quantification Limit
-	Not Analyzed
A	Matrix Spike Recovery outside control limits
J	Value is estimated
R	Result is rejected
NA	Not Applicable
pCi/L	picoCuries per liter
U	Not detected above laboratory reporting limit
	Exceeds one or more regulatory criteria
	Exceed DNR Table 2 - Public Welfare Groundwater Quality Standards only.
	Shaded cells indicate duplicate analyses.

TABLE 1
SUMMARY OF RADIOLOGICAL ANALYTICAL RESULTS FOR
LA CROSSE BOILING WATER REACTOR (LACBWR)
GENOA, WISCONSIN

Location	B3	MW-200A	MW-200A	MW-200A	MW-200A	MW-200A
Sample ID	MW-B3-06182014	MW-200A-06172014	MW-200A-09242014	MW-200A-03242015	MW-200A-11112015	MW-200A-120816
Sample Date	06/18/2014	06/17/2014	09/24/2014	03/24/2015	11/11/2015	12/08/2016
Radiological (pCi/L)						
Americium-241	0.0228 ± 0.066	0.172 ± 0.179	0.11 ± 0.133	-	-	-
Carbon-14	-2.04 ± 10.5	9.25 ± 7.33	-0.455 ± 7.09	-	-	-
Cesium-137	2.13 ± 2.22	0.176 ± 2.05	1.71 ± 2.73	1.13 ± 3.08	3.93 ± 4.18	1.29 U ± 1.98
Cobalt-60	-1.13 ± 1.77	1 ± 2.02	3.55 ± 2.86	4.15 ± 3.8	-0.653 ± 4.12	1.11 U ± 1.89
Europium-152	14.2 ± 13.1	9.7 ± 14.8	-2.38 ± 21.9	-3.51 ± 18.4	4.84 ± 28.7	-
Europium-154	1.69 ± 5.46	0.576 ± 5	-0.657 ± 7.96	11 ± 8.14	-0.816 ± 7.7	-
Europium-155	-3.16 ± 4.36	-3.62 ± 4.33	-0.816 ± 3.91	2.13 ± 7.82	-8.19 ± 7.63	-
Gross Alpha Analytes	0.645 ± 1.83	4.04 ± 1.91	0.241 ± 1.7	1.05 ± 1.82	0.322 ± 2.89	-
Gross Beta Analytes	4.14 ± 3.33	8.65 ± 3.88	2.4 ± 3.16	5.27 ± 5.09	0.964 ± 4.44	-
Iron-55	-43.9 ± 85.6	19.3 ± 74.6	-33.4 ± 73.4	-	-	-
Nickel-59	31.4 ± 76.5	-21.8 ± 68	7.84 ± 66.7	-	-	-
Nickel-63	1.49 ± 3.83	-1.97 ± 2.86	3.61 ± 2.93	-	-	0.294 U ± 23.1
Niobium-94	0.664 ± 1.87	1.08 ± 1.75	-1.42 ± 2.63	1.94 ± 3.18	0.59 ± 4.27	-
Plutonium-238	0.0829 ± 0.138	-0.0138 ± 0.0818	0.0264 ± 0.0635	-	-	-
Plutonium-239/240	0.145 ± 0.192	0.0267 ± 0.0819	0.0583 ± 0.0894	-	-	-
Plutonium-241	-0.739 ± 10.9	0 ± 7.96	-2.22 ± 8.04	-	-	-
Strontium-90	0.612 ± 0.671	0.986 ± 0.723	2.17 ± 0.748	0.522 ± 0.644	2.4 ± 0.919	-1.8 U ± 0.916
Technetium-99	-8.09 ± 3.41	3.54 ± 3.15	-1.57 ± 3.2	-	-	-
Tritium	193 ± 140	52.3 ± 140	68.6 ± 140	-155 ± 139	-17.2 ± 147	-469 U ± 326

Notes:

1	Regulatory criteria from NR 140.10 Subchapter II
2	USEPA MCLS, 40 CFR Part 141
#	Result between Detection & Quantification Limit
-	Not Analyzed
A	Matrix Spike Recovery outside control limits
J	Value is estimated
R	Result is rejected
NA	Not Applicable
pCi/L	picoCuries per liter
U	Not detected above laboratory reporting limit
	Exceeds one or more regulatory criteria
	Exceed DNR Table 2 - Public Welfare Groundwater Quality Standards only.
	Shaded cells indicate duplicate analyses.

TABLE 1
SUMMARY OF RADIOLOGICAL ANALYTICAL RESULTS FOR
LA CROSSE BOILING WATER REACTOR (LACBWR)
GENOA, WISCONSIN

Location	MW-200A	MW-200A	MW-200B	MW-200B	MW-200B	MW-200B
Sample ID	MW-200A-052217	MW-200A-120617	MW-200B-06172014	MW-200B-09242014	MW-200B-03242015	MW-200B-D-03242015
Sample Date	05/22/2017	12/06/2017	06/17/2014	09/24/2014	03/24/2015	03/24/2015
Radiological (pCi/L)						
Americium-241	-	-	0.37 ± 0.232	0.229 ± 0.249	-	-
Carbon-14	-	-	4.84 ± 7.48	-4.98 ± 6.99	-	-
Cesium-137	-1.68 U ± 2.61	0.559 U ± 5.19	-0.364 ± 2.2	1.94 ± 2.8	2.34 ± 2.44	0.725 ± 2.43
Cobalt-60	0.176 U ± 1.98	-1.24 U ± 4.48	-1.26 ± 3.1	0.619 ± 2.47	0.676 ± 2.4	0.388 ± 1.84
Europium-152	-	-	-11.5 ± 17.1	-13.4 ± 19.1	3.81 ± 13.9	-2.24 ± 17.4
Europium-154	-	-	0.559 ± 7.46	-1.53 ± 7.96	2.98 ± 6.58	0.376 ± 7.28
Europium-155	-	-	-3.44 ± 4.39	-1.64 ± 4.2	-2.74 ± 6.91	1.33 ± 6.85
Gross Alpha Analytes	-	-	-0.226 ± 2.12	2.01 ± 1.87	0.958 ± 0.995	1.51 ± 1.19
Gross Beta Analytes	-	-	-1.79 ± 3.42	9.1 ± 3.35	2.17 ± 1.6	1.66 ± 2.51
Iron-55	-	-	-41.6 ± 78.4	-45.5 ± 75.9	-	-
Nickel-59	-	-	33.1 ± 75.2	23.7 ± 70.8	-	-
Nickel-63	-2.58 U ± 16.5	0.184 U ± 18.3	-4.68 ± 3.36	-0.787 ± 2.77	-	-
Niobium-94	-	-	0.847 ± 2.48	-0.268 ± 2.69	1.22 ± 2.58	0.332 ± 1.97
Plutonium-238	-	-	0.015 ± 0.0628	-0.00649 ± 0.076	-	-
Plutonium-239/240	-	-	-0.0156 ± 0.0628	0 ± 0.105	-	-
Plutonium-241	-	-	4.49 ± 6.55	8.49 ± 10.4	-	-
Strontium-90	-0.567 U ± 0.981	1.31 U ± 0.935	0.998 ± 0.758	1.54 ± 0.731	2.14 ± 0.813	3.68 ± 1
Technetium-99	-	-	5.08 ± 3.18	-1.53 ± 3.13	-	-
Tritium	-174 U ± 221	244 U ± 355	123 ± 144	51.7 ± 140	-121 ± 141	-104 ± 142

Notes:

1	Regulatory criteria from NR 140.10 Subchapter II
2	USEPA MCLS, 40 CFR Part 141
#	Result between Detection & Quantification Limit
-	Not Analyzed
A	Matrix Spike Recovery outside control limits
J	Value is estimated
R	Result is rejected
NA	Not Applicable
pCi/L	picoCuries per liter
U	Not detected above laboratory reporting limit
	Exceeds one or more regulatory criteria
	Exceed DNR Table 2 - Public Welfare Groundwater Quality Standards only.
	Shaded cells indicate duplicate analyses.

TABLE 1
SUMMARY OF RADIOLOGICAL ANALYTICAL RESULTS FOR
LA CROSSE BOILING WATER REACTOR (LACBWR)
GENOA, WISCONSIN

Location	MW-200B	MW-200B	MW-200B	MW-200B	MW-201A	MW-201A
Sample ID	MW-200B-11112015	MW-200B-120816	MW-200B-052217	MW-200B-120617	MW-201A-06172014	MW-201A-D-06172014
Sample Date	11/11/2015	12/08/2016	05/22/2017	12/06/2017	06/17/2014	06/17/2014
Radiological (pCi/L)						
Americium-241	-	-	-	-	0.0945 ± 0.123	0.03 ± 0.0792
Carbon-14	-	-	-	-	4.83 ± 7.47	0 ± 7.06
Cesium-137	1.49 ± 2.35	0.608 U ± 1.55	-0.176 U ± 2.10	-2.36 U ± 3.41	0.309 ± 1.84	-1.13 ± 2.25
Cobalt-60	-0.506 ± 2.35	0.114 U ± 1.80	0.257 U ± 2.56	3.19 U ± 3.2	-0.0604 ± 1.68	1.42 ± 1.99
Europium-152	15.1 ± 14	-	-	-	4.15 ± 11.1	1.41 ± 18.4
Europium-154	0.619 ± 6.92	-	-	-	-2.39 ± 4.89	1.15 ± 7.85
Europium-155	2.79 ± 6.37	-	-	-	-2.92 ± 4.61	1.75 ± 4.34
Gross Alpha Analytes	1.06 ± 3.46	-	-	-	0.383 ± 1.59	0.636 ± 2.16
Gross Beta Analytes	5.1 ± 4.36	-	-	-	7.25 ± 3.54	6.75 ± 3.17
Iron-55	-	-	-	-	-32 ± 73.4	0.717 ± 67.6
Nickel-59	-	-	-	-	-16.7 ± 60.4	16.4 ± 61.7
Nickel-63	-	11.2 U ± 24.6	0.622 U ± 19.2	-3.58 U ± 17.2	1.81 ± 2.72	-1.8 ± 2.62
Niobium-94	1.1 ± 2.34	-	-	-	0.373 ± 2.03	0.348 ± 2.4
Plutonium-238	-	-	-	-	0.0532 ± 0.115	-0.0739 ± 0.0898
Plutonium-239/240	-	-	-	-	-0.00685 ± 0.0802	-0.00671 ± 0.0785
Plutonium-241	-	-	-	-	-0.485 ± 6.95	0 ± 8.85
Strontium-90	0.829 ± 0.896	0.531 U ± 0.485	1.44 U ± 1.14	0.548 U ± 0.849	0.0686 ± 0.708	1.53 ± 0.748
Technetium-99	-	-	-	-	3.91 ± 3.15	6.95 ± 3.3
Tritium	-52 ± 147	-107 U ± 357	38.5 U ± 233	128 U ± 346	70.2 ± 142	87 ± 141

Notes:

1	Regulatory criteria from NR 140.10 Subchapter II
2	USEPA MCLS, 40 CFR Part 141
#	Result between Detection & Quantification Limit
-	Not Analyzed
A	Matrix Spike Recovery outside control limits
J	Value is estimated
R	Result is rejected
NA	Not Applicable
pCi/L	picoCuries per liter
U	Not detected above laboratory reporting limit
	Exceeds one or more regulatory criteria
	Exceed DNR Table 2 - Public Welfare Groundwater Quality Standards only.
	Shaded cells indicate duplicate analyses.

TABLE 1
SUMMARY OF RADIOLOGICAL ANALYTICAL RESULTS FOR
LA CROSSE BOILING WATER REACTOR (LACBWR)
GENOA, WISCONSIN

Location	MW-201A	MW-201A	MW-201A	MW-201A	MW-201A	MW-201A	MW-201A
Sample ID	MW-201A-09242014	MW-201A-03252015	MW-201A-11112015	MW-201A-120816	MW-201A-052317	MW-201A-120617	MW-201A-020118
Sample Date	09/24/2014	03/25/2015	11/11/2015	12/08/2016	05/23/2017	12/06/2017	2/1/2018
Radiological (pCi/L)							
Americium-241	0.14 ± 0.14	-	-	-	-	-	-
Carbon-14	2.69 ± 7.06	-	-	-	-	-	-
Cesium-137	-1.09 ± 2.07	0.346 ± 3.79	0.388 ± 2.38	-0.629 U ± 2.60	-2.08 U ± 2.95	2.45 U ± 4.14	-
Cobalt-60	-0.0723 ± 1.85	3.58 ± 3.2	0.258 ± 2.38	3.57 U ± 3.10	-2.05 U ± 3.15	2.8 U ± 4.44	-
Europium-152	4.79 ± 13.2	10 ± 20.5	-10.4 ± 11.3	-	-	-	-
Europium-154	-3.08 ± 6.44	4.57 ± 7.38	-2.9 ± 7.7	-	-	-	-
Europium-155	-1.47 ± 4.43	0.338 ± 7.79	0.845 ± 6.8	-	-	-	-
Gross Alpha Analytes	1.18 ± 2.31	0.873 ± 2.48	3.26 ± 2.55	-	-	-	-
Gross Beta Analytes	7.36 ± 3.27	2.37 ± 3.78	3.4 ± 4.95	-	-	-	-
Iron-55	-21.8 ± 77	-	-	-	-	-	-
Nickel-59	-19.8 ± 63.9	-	-	-	-	-	-
Nickel-63	4.99 ± 2.96	-	-	9.55 U ± 24.4	14.3 U ± 19.0	0.537 U ± 18	-
Niobium-94	0.655 ± 1.92	0.0628 ± 3.24	1.15 ± 2.17	-	-	-	-
Plutonium-238	-0.0358 ± 0.0887	-	-	-	-	-	-
Plutonium-239/240	0 ± 0.117	-	-	-	-	-	-
Plutonium-241	-0.691 ± 10	-	-	-	-	-	-
Strontium-90	0.92 ± 0.716	0.866 ± 0.662	1.24 ± 0.705	0.301 U ± 0.615	1.47 U ± 1.03	0.343 U ± 0.599	-
Technetium-99	-0.794 ± 3.24	-	-	-	-	-	-
Tritium	86.6 ± 141	52 ± 144	-17.3 ± 147	-375 U ± 331	-115 U ± 225	-192 U ± 322	264 U ± 255

Notes:

1	Regulatory criteria from NR 140.10 Subchapter II
2	USEPA MCLS, 40 CFR Part 141
#	Result between Detection & Quantification Limit
-	Not Analyzed
A	Matrix Spike Recovery outside control limits
J	Value is estimated
R	Result is rejected
NA	Not Applicable
pCi/L	picoCuries per liter
U	Not detected above laboratory reporting limit
	Exceeds one or more regulatory criteria
	Exceed DNR Table 2 - Public Welfare Groundwater Quality Standards only.
	Shaded cells indicate duplicate analyses.

TABLE 1
SUMMARY OF RADIOLOGICAL ANALYTICAL RESULTS FOR
LA CROSSE BOILING WATER REACTOR (LACBWR)
GENOA, WISCONSIN

Location	MW-201B	MW-201B	MW-201B	MW-201B	MW-201B	MW-201B
Sample ID	MW-201B-06172014	MW-201B-09242014	MW-201B-03252015	MW-201B-11112015	MW-201B-120816	MW-201B-052317
Sample Date	06/17/2014	09/24/2014	03/25/2015	11/11/2015	12/08/2016	05/23/2017
Radiological (pCi/L)						
Americium-241	0.00398 ± 0.0726	0.028 ± 0.0777	-	-	-	-
Carbon-14	4.51 ± 6.97	0.927 ± 7.25	-	-	-	-
Cesium-137	-0.62 ± 2.07	1.84 ± 2.12	2.18 ± 2.63	0.067 ± 2.77	2.40 U ± 2.65	1.31 U ± 2.11
Cobalt-60	1.72 ± 1.83	0.95 ± 1.94	1.46 ± 2.11	0.977 ± 2.3	1.08 U ± 2.13	0.927 U ± 2.36
Europium-152	11.2 ± 12.4	2.52 ± 10.4	-8.2 ± 15.1	12.7 ± 15.4	-	-
Europium-154	-2.43 ± 5.38	1.93 ± 5.49	-0.9 ± 7.37	-4.44 ± 6.84	-	-
Europium-155	-2.6 ± 4.38	4.12 ± 4.66	0.169 ± 6.35	0.269 ± 6.65	-	-
Gross Alpha Analytes	-1.03 ± 2.67	1.42 ± 1.33	2.25 ± 1.76	0 ± 2.93	-	-
Gross Beta Analytes	-1.03 ± 3.17	3.67 ± 2.74	2.77 ± 2.63	-0.121 ± 4.14	-	-
Iron-55	15.7 ± 72.3	27.6 ± 78.9	-	-	-	-
Nickel-59	-71.1 ± 123	30.8 ± 74.3	-	-	-	-
Nickel-63	-1.91 ± 2.78	2.15 ± 2.82	-	-	10.3 U ± 24.5	-3.85 U ± 18.9
Niobium-94	1.79 ± 1.87	0.643 ± 1.48	0.208 ± 2.23	1.32 ± 2.17	-	-
Plutonium-238	-0.0501 ± 0.11	0.0854 ± 0.128	-	-	-	-
Plutonium-239/240	0.0236 ± 0.0986	0.141 ± 0.146	-	-	-	-
Plutonium-241	-1.41 ± 10.1	-0.584 ± 8.48	-	-	-	-
Strontium-90	1.01 ± 0.716	0.541 ± 0.708	1.27 ± 0.735	0.875 ± 0.732	-0.208 U ± 0.474	1.06 U ± 0.834
Technetium-99	1.17 ± 3.06	-1.94 ± 3.16	-	-	-	-
Tritium	105 ± 142	-34.1 ± 137	17.2 ± 142	34 ± 146	-123 U ± 307	106 U ± 235

Notes:

1	Regulatory criteria from NR 140.10 Subchapter II
2	USEPA MCLS, 40 CFR Part 141
#	Result between Detection & Quantification Limit
-	Not Analyzed
A	Matrix Spike Recovery outside control limits
J	Value is estimated
R	Result is rejected
NA	Not Applicable
pCi/L	picoCuries per liter
U	Not detected above laboratory reporting limit
	Exceeds one or more regulatory criteria
	Exceed DNR Table 2 - Public Welfare Groundwater Quality Standards only.
	Shaded cells indicate duplicate analyses.

TABLE 1
SUMMARY OF RADIOLOGICAL ANALYTICAL RESULTS FOR
LA CROSSE BOILING WATER REACTOR (LACBWR)
GENOA, WISCONSIN

Location	MW-202A	MW-202A	MW-202A	MW-202A	MW-202A	MW-202A
Sample ID	MW-202A-06172014	MW-202A-09232014	MW-202A-03242015	MW-202A-11112015	MW-202A-120716	MW-202A-D-120716
Sample Date	06/17/2014	09/23/2014	03/24/2015	11/11/2015	12/07/2016	12/07/2016
Radiological (pCi/L)						
Americium-241	0.116 ± 0.118	0.0662 ± 0.126	-	-	-	-
Carbon-14	0 ± 7.09	4.94 ± 7.14	-	-	-	-
Cesium-137	-0.463 ± 2.12	-0.433 ± 2.18	1.68 ± 3	2.1 ± 3.24	-1.33 U ± 2.62	-0.0139 U ± 1.97
Cobalt-60	-0.891 ± 1.66	0.972 ± 1.6	3.46 ± 3.23	0.236 ± 3.4	2.01 U ± 2.65	-2.49 U ± 2.64
Europium-152	4.1 ± 11	9.4 ± 12.6	3.66 ± 22.4	0 ± 7.83	-	-
Europium-154	-1.11 ± 5.46	-0.367 ± 5.23	-8.38 ± 12.1	-0.635 ± 4.36	-	-
Europium-155	-1.58 ± 4.39	-2.08 ± 4.54	-1.96 ± 8.13	-1.31 ± 7.86	-	-
Gross Alpha Analytes	1.05 ± 1.29	1.03 ± 0.574	0.106 ± 0.86	0.475 ± 1.72	-	-
Gross Beta Analytes	4.33 ± 2.12	0.486 ± 1.56	1.47 ± 1.77	2.51 ± 2.74	-	-
Iron-55	-3.26 ± 74.7	-54.3 ± 81	-	-	-	-
Nickel-59	24.8 ± 68.3	-11.7 ± 65.4	-	-	-	-
Nickel-63	-1.93 ± 2.81	0.824 ± 2.94	-	-	-4.11 U ± 21.5	0.983 U ± 22.2
Niobium-94	-0.355 ± 1.63	-0.0647 ± 1.96	-0.125 ± 2.64	0.926 ± 2.8	-	-
Plutonium-238	-0.00846 ± 0.0956	0.0113 ± 0.0731	-	-	-	-
Plutonium-239/240	-0.0226 ± 0.091	0.0586 ± 0.0998	-	-	-	-
Plutonium-241	2.19 ± 10.5	0 ± 9.65	-	-	-	-
Strontium-90	1.12 ± 0.755	1.71 ± 0.741	0.0945 ± 0.741	1.21 ± 0.81	0.236 U ± 0.626	0.430 U ± 0.825
Technetium-99	0.388 ± 3.02	0.797 ± 3.29	-	-	-	-
Tritium	335 ± 149	-51.7 ± 138	498 ± 153	174 ± 152	-182 U ± 350	-192 U ± 317

Notes:

1	Regulatory criteria from NR 140.10 Subchapter II
2	USEPA MCLS, 40 CFR Part 141
#	Result between Detection & Quantification Limit
-	Not Analyzed
A	Matrix Spike Recovery outside control limits
J	Value is estimated
R	Result is rejected
NA	Not Applicable
pCi/L	picoCuries per liter
U	Not detected above laboratory reporting limit
	Exceeds one or more regulatory criteria
	Exceed DNR Table 2 - Public Welfare Groundwater Quality Standards only.
	Shaded cells indicate duplicate analyses.

TABLE 1
SUMMARY OF RADIOLOGICAL ANALYTICAL RESULTS FOR
LA CROSSE BOILING WATER REACTOR (LACBWR)
GENOA, WISCONSIN

Location	MW-202A	MW-202A	MW-202A	MW-202B	MW-202B	MW-202B
Sample ID	MW-202A-052317	MW-202A-120717	MW-202A-020118	MW-202B-06172014	MW-202B-09232014	MW-202B-03242015
Sample Date	05/23/2017	12/07/2017	2/1/2018	06/17/2014	09/23/2014	03/24/2015
Radiological (pCi/L)						
Americium-241	-	-	-	0.0391 ± 0.0652	0.0947 ± 0.121	-
Carbon-14	-	-	-	4.7 ± 7.27	-2.71 ± 7.02	-
Cesium-137	0.143 U ± 1.96	-0.896 U ± 5.42	-	2.86 ± 2.36	2.3 ± 2.61	-0.704 ± 2.64
Cobalt-60	-0.0306 U ± 2.45	-2.38 U ± 4.99	-	1.02 ± 2.89	1.17 ± 2.98	0.862 ± 2.46
Europium-152	-	-	-	10.8 ± 17.9	6.51 ± 17.3	-7.32 ± 14.4
Europium-154	-	-	-	-1.18 ± 2.55	4.18 ± 8.87	1.09 ± 5.78
Europium-155	-	-	-	-3.48 ± 4.19	-0.841 ± 4.47	4.96 ± 6.54
Gross Alpha Analytes	-	-	-	0.406 ± 1.49	-0.209 ± 1.59	0.553 ± 1.4
Gross Beta Analytes	-	-	-	1.48 ± 2.84	2.3 ± 2.77	1.4 ± 2.57
Iron-55	-	-	-	-45.4 ± 77.9	33.6 ± 76.7	-
Nickel-59	-	-	-	-10.4 ± 65.4	-44.6 ± 87.3	-
Nickel-63	17.0 U ± 18.4	2.46 U ± 18.1	-	-3.73 ± 2.68	-0.829 ± 2.92	-
Niobium-94	-	-	-	0.104 ± 1.99	-1.02 ± 2.07	-0.556 ± 2.45
Plutonium-238	-	-	-	0.148 ± 0.179	0.0363 ± 0.0909	-
Plutonium-239/240	-	-	-	-0.0453 ± 0.0729	0.0524 ± 0.0892	-
Plutonium-241	-	-	-	2.72 ± 7.87	-1.75 ± 8.48	-
Strontium-90	0.576 U ± 0.818	-0.359 U ± 0.512	-	0.604 ± 0.701	1.57 ± 0.748	1.04 ± 0.732
Technetium-99	-	-	-	2.72 ± 2.89	-0.194 ± 3.19	-
Tritium	113 U ± 239	-11.3 U ± 338	13200 ± 785	105 ± 143	103 ± 141	-52 ± 141

Notes:

1	Regulatory criteria from NR 140.10 Subchapter II
2	USEPA MCLS, 40 CFR Part 141
#	Result between Detection & Quantification Limit
-	Not Analyzed
A	Matrix Spike Recovery outside control limits
J	Value is estimated
R	Result is rejected
NA	Not Applicable
pCi/L	picoCuries per liter
U	Not detected above laboratory reporting limit
	Exceeds one or more regulatory criteria
	Exceed DNR Table 2 - Public Welfare Groundwater Quality Standards only.
	Shaded cells indicate duplicate analyses.

TABLE 1
SUMMARY OF RADIOLOGICAL ANALYTICAL RESULTS FOR
LA CROSSE BOILING WATER REACTOR (LACBWR)
GENOA, WISCONSIN

Location	MW-202B	MW-202B	MW-202B	MW-202B	MW-203A	MW-203A
Sample ID	MW-202B-11112015	MW-202B-120716	MW-202B-052317	MW-202B-120717	MW-203A-06172014	MW-203A-09232014
Sample Date	11/11/2015	12/07/2016	05/23/2017	12/07/2017	06/17/2014	09/23/2014
Radiological (pCi/L)						
Americium-241	-	-	-	-	0.0293 ± 0.085	0.25 ± 0.304
Carbon-14	-	-	-	-	4.54 ± 7.02	-3.95 ± 7.64
Cesium-137	4.26 ± 4.28	-1.88 U ± 2.71	-0.914 U ± 2.38	-1.72 U ± 5.69	1.48 ± 1.67	1.55 ± 2.53
Cobalt-60	1.33 ± 4.06	-2.07 U ± 3.19	2.17 U ± 1.73	-3.67 U ± 4.29	0.0348 ± 1.98	3.66 ± 2.85
Europium-152	4.37 ± 21.8	-	-	-	-0.958 ± 9.46	4.06 ± 21.1
Europium-154	-10.5 ± 14.2	-	-	-	1.93 ± 6.1	-3.32 ± 9.28
Europium-155	-2.16 ± 7.53	-	-	-	-4.9 ± 4.39	-0.0953 ± 4.4
Gross Alpha Analytes	1.46 ± 2.04	-	-	-	1.74 ± 1.05	1.36 ± 1.04
Gross Beta Analytes	4.79 ± 4.47	-	-	-	2.26 ± 1.74	1.51 ± 1.56
Iron-55	-	-	-	-	-49.5 ± 75.1	-49.4 ± 79.5
Nickel-59	-	-	-	-	-27.1 ± 69.2	53 ± 90.8
Nickel-63	-	2.79 U ± 23.1	16.5 U ± 19.0	-0.455 U ± 17.5	-3.69 ± 2.65	1.61 ± 2.9
Niobium-94	-0.253 ± 3.95	-	-	-	1.58 ± 1.66	0.0853 ± 2.05
Plutonium-238	-	-	-	-	-0.0567 ± 0.0747	0.0708 ± 0.106
Plutonium-239/240	-	-	-	-	-0.0226 ± 0.0691	0.0915 ± 0.12
Plutonium-241	-	-	-	-	4.06 ± 8.43	0.504 ± 7.33
Strontium-90	1.54 ± 0.792	0.145 U ± 0.687	1.30 U ± 1.17	0.39 U ± 0.606	1.17 ± 0.708	1.52 ± 0.782
Technetium-99	-	-	-	-	4.36 ± 3.2	-1.23 ± 3.37
Tritium	0 ± 147	-197 U ± 349	54.5 U ± 236	-193 U ± 320	279 ± 146	-34.3 ± 138

Notes:

1	Regulatory criteria from NR 140.10 Subchapter II
2	USEPA MCLS, 40 CFR Part 141
#	Result between Detection & Quantification Limit
-	Not Analyzed
A	Matrix Spike Recovery outside control limits
J	Value is estimated
R	Result is rejected
NA	Not Applicable
pCi/L	picoCuries per liter
U	Not detected above laboratory reporting limit
	Exceeds one or more regulatory criteria
	Exceed DNR Table 2 - Public Welfare Groundwater Quality Standards only.
	Shaded cells indicate duplicate analyses.

TABLE 1
SUMMARY OF RADIOLOGICAL ANALYTICAL RESULTS FOR
LA CROSSE BOILING WATER REACTOR (LACBWR)
GENOA, WISCONSIN

Location	MW-203A	MW-203A	MW-203A	MW-203A	MW-203A	MW-203A
Sample ID	MW-203A-03242015	MW-203A-11112015	MW-203A-120716	MW-203A-052317	MW-203A-120717	MW-203A-020118
Sample Date	03/24/2015	11/11/2015	12/07/2016	05/23/2017	12/07/2017	2/1/2018
Radiological (pCi/L)						
Americium-241	-	-	-	-	-	-
Carbon-14	-	-	-	-	-	-
Cesium-137	3.68 ± 3.45	-2.32 ± 2.54	-0.403 U ± 2.93	-0.355 U ± 1.89	1.08 U ± 4.46	-
Cobalt-60	2.59 ± 3.43	0.467 ± 2.42	1.34 U ± 2.20	-0.0464 U ± 1.81	0.389 U ± 5.62	-
Europium-152	23.6 ± 24.9	-0.672 ± 14.2	-	-	-	-
Europium-154	-0.997 ± 10.5	2.94 ± 5.41	-	-	-	-
Europium-155	5.47 ± 6.26	3.09 ± 5.19	-	-	-	-
Gross Alpha Analytes	1.39 ± 0.803	0.819 ± 1.6	-	-	-	-
Gross Beta Analytes	3.87 ± 1.89	1.26 ± 3.21	-	-	-	-
Iron-55	-	-	-	-	-	-
Nickel-59	-	-	-	-	-	-
Nickel-63	-	-	1.09 U ± 25.2	16.0 U ± 20.2	7.03 U ± 17.8	-
Niobium-94	0.0209 ± 3.33	1.67 ± 2.05	-	-	-	-
Plutonium-238	-	-	-	-	-	-
Plutonium-239/240	-	-	-	-	-	-
Plutonium-241	-	-	-	-	-	-
Strontium-90	0.177 ± 0.665	1.37 ± 1.3	1.01 U ± 0.834	-0.44 U ± 1.03	-0.517 U ± 0.526	-
Technetium-99	-	-	-	-	-	-
Tritium	-34.7 ± 142	104 ± 150	-303 U ± 340	-6.35 U ± 227	13000 ± 874	24200 ± 1040

Notes:

1	Regulatory criteria from NR 140.10 Subchapter II
2	USEPA MCLS, 40 CFR Part 141
#	Result between Detection & Quantification Limit
-	Not Analyzed
A	Matrix Spike Recovery outside control limits
J	Value is estimated
R	Result is rejected
NA	Not Applicable
pCi/L	picoCuries per liter
U	Not detected above laboratory reporting limit
	Exceeds one or more regulatory criteria
	Exceed DNR Table 2 - Public Welfare Groundwater Quality Standards only.
	Shaded cells indicate duplicate analyses.

TABLE 1
SUMMARY OF RADIOLOGICAL ANALYTICAL RESULTS FOR
LA CROSSE BOILING WATER REACTOR (LACBWR)
GENOA, WISCONSIN

Location	MW-203B	MW-203B	MW-203B	MW-203B	MW-203B	MW-203B
Sample ID	MW-203B-06172014	MW-203B-09232014	MW-203B-D-09232014	MW-203B-03242015	MW-203B-11112015	MW-203B-D-11112015
Sample Date	06/17/2014	09/23/2014	09/23/2014	03/24/2015	11/11/2015	11/11/2015
Radiological (pCi/L)						
Americium-241	0.0763 ± 0.0979	0.102 ± 0.124	-0.00498 ± 0.0564	-	-	-
Carbon-14	4.54 ± 7.03	0.489 ± 7.64	-2.74 ± 7.09	-	-	-
Cesium-137	1.38 ± 2.57	0.683 ± 1.92	0.335 ± 2.92	-1.65 ± 2.64	-0.0708 ± 2.71	2.83 ± 2.59
Cobalt-60	-0.955 ± 2.82	1.99 ± 1.84	1.21 ± 2.65	-0.949 ± 2.48	0.613 ± 2.56	2.15 ± 2.31
Europium-152	4.98 ± 21.5	-1.15 ± 12.3	-4.86 ± 18.4	9.69 ± 12	-3.14 ± 16.9	-10.8 ± 18.3
Europium-154	-3.69 ± 7.71	-0.231 ± 5.18	-1.53 ± 7.34	0 ± 7.55	-2.96 ± 4.19	-1.28 ± 6.61
Europium-155	4.04 ± 4.44	-0.365 ± 3.81	-4 ± 4.13	6.5 ± 6.46	2.79 ± 6.32	1.5 ± 6.23
Gross Alpha Analytes	-0.228 ± 2.14	-0.668 ± 2	0.785 ± 1.54	1.09 ± 1.02	3.32 ± 2.68	-1.41 ± 2.42
Gross Beta Analytes	5.53 ± 2.99	1 ± 3.02	2.4 ± 2.63	1 ± 2.22	3.04 ± 4.83	-0.386 ± 4.16
Iron-55	-49.5 ± 73.2	43.2 ± 74.5	28.4 ± 80.2	-	-	-
Nickel-59	-4.66 ± 56.1	-43.4 ± 90.8	2.7 ± 61	-	-	-
Nickel-63	-3.8 ± 2.73	-1.77 ± 3.1	-3.1 ± 2.86	-	-	-
Niobium-94	1.5 ± 2.33	2.16 ± 1.92	0.565 ± 2.32	0.806 ± 1.57	1.51 ± 2.28	-0.947 ± 2.32
Plutonium-238	-0.0586 ± 0.128	0.0812 ± 0.113	-0.0264 ± 0.106	-	-	-
Plutonium-239/240	-0.0394 ± 0.125	0.0596 ± 0.0915	-0.00882 ± 0.103	-	-	-
Plutonium-241	10.2 ± 13.6	-3.71 ± 8.92	-6.33 ± 13	-	-	-
Strontium-90	0.822 ± 0.671	1.91 ± 0.765	1.93 ± 0.734	1.12 ± 0.682	0.737 ± 0.781	1.21 ± 0.823
Technetium-99	4.16 ± 3.19	-3.32 ± 3.16	-1.37 ± 3.21	-	-	-
Tritium	278 ± 145	121 ± 142	68.7 ± 140	-139 ± 140	-153 ± 143	-120 ± 145

Notes:

1	Regulatory criteria from NR 140.10 Subchapter II
2	USEPA MCLS, 40 CFR Part 141
#	Result between Detection & Quantification Limit
-	Not Analyzed
A	Matrix Spike Recovery outside control limits
J	Value is estimated
R	Result is rejected
NA	Not Applicable
pCi/L	picoCuries per liter
U	Not detected above laboratory reporting limit
	Exceeds one or more regulatory criteria
	Exceed DNR Table 2 - Public Welfare Groundwater Quality Standards only.
	Shaded cells indicate duplicate analyses.

TABLE 1
SUMMARY OF RADIOLOGICAL ANALYTICAL RESULTS FOR
LA CROSSE BOILING WATER REACTOR (LACBWR)
GENOA, WISCONSIN

Location	MW-203B	MW-203B	MW-203B	MW-204A	MW-204A	MW-204A
Sample ID	MW-203B-120716	MW-203B-052317	MW-203B-120717	MW-204A-06172014	MW-204A-09232014	MW-204A-03242015
Sample Date	12/07/2016	05/23/2017	12/07/2017	06/17/2014	09/23/2014	03/24/2015
Radiological (pCi/L)						
Americium-241	-	-	-	0.155 ± 0.149, 0.0362 ± 0.0955	0.105 ± 0.115	-
Carbon-14	-	-	-	4.65 ± 7.19	0.473 ± 7.39	-
Cesium-137	-2.13 U ± 3.72	-0.161 U ± 2.80	-0.562 U ± 3.3	-0.303 ± 2.02	-1.14 ± 2.49	-0.633 ± 4.54
Cobalt-60	2.40 U ± 2.63	-2.19 U ± 2.64	-1.54 U ± 4.27	0.19 ± 3.23	-0.377 ± 2.42	0.23 ± 4.16
Europium-152	-	-	-	2.11 ± 18.3	-19.2 ± 18.2	19.1 ± 23.6
Europium-154	-	-	-	2.36 ± 8.67	-4.94 ± 8.1	-8.09 ± 12.2
Europium-155	-	-	-	-0.433 ± 4.28	-2.02 ± 4.49	-2 ± 5.32
Gross Alpha Analytes	-	-	-	0.758 ± 1.96	0.599 ± 1.66	0.978 ± 1.5
Gross Beta Analytes	-	-	-	2.68 ± 2.98	5.28 ± 2.21	10.9 ± 3.06
Iron-55	-	-	-	-40.3 ± 79.2	34.5 ± 75.3	-
Nickel-59	-	-	-	-6.22 ± 59.1	-31.2 ± 74.8	-
Nickel-63	11.7 U ± 25.7	5.62 U ± 17.2	-5.67 U ± 17.4	0 ± 2.75	-0.183 ± 2.6	-
Niobium-94	-	-	-	0.225 ± 1	0.118 ± 2.46	-0.241 ± 3.76
Plutonium-238	-	-	-	-0.0512 ± 0.115	-0.000645 ± 0.0685	-
Plutonium-239/240	-	-	-	-0.0248 ± 0.0757	-0.00548 ± 0.0641	-
Plutonium-241	-	-	-	4.07 ± 8.44	-3.97 ± 8.17	-
Strontium-90	0.210 U ± 0.593	0.287 U ± 0.796	-0.256 U ± 0.538	2 ± 0.675	1.94 ± 0.734	4.52 ± 1.07
Technetium-99	-	-	-	6.95 ± 3.3	-1.95 ± 3.18	-
Tritium	-297 U ± 335	101 U ± 241	13.1 U ± 338	105 ± 143	68.7 ± 140	-52 ± 141

Notes:

1	Regulatory criteria from NR 140.10 Subchapter II
2	USEPA MCLS, 40 CFR Part 141
#	Result between Detection & Quantification Limit
-	Not Analyzed
A	Matrix Spike Recovery outside control limits
J	Value is estimated
R	Result is rejected
NA	Not Applicable
pCi/L	picoCuries per liter
U	Not detected above laboratory reporting limit
	Exceeds one or more regulatory criteria
	Exceed DNR Table 2 - Public Welfare Groundwater Quality Standards only.
	Shaded cells indicate duplicate analyses.

TABLE 1
SUMMARY OF RADIOLOGICAL ANALYTICAL RESULTS FOR
LA CROSSE BOILING WATER REACTOR (LACBWR)
GENOA, WISCONSIN

Location	MW-204A	MW-204A	MW-204A	MW-204A	MW-204B	MW-204B
Sample ID	MW-204A-11112015	MW-204A-120716	MW-204A-052217	MW-204A-120617	MW-204B-06172014	MW-204B-09232014
Sample Date	11/11/2015	12/07/2016	05/22/2017	12/06/2017	06/17/2014	09/23/2014
Radiological (pCi/L)						
Americium-241	-	-	-	-	0.0824 ± 0.146	0.268 ± 0.351
Carbon-14	-	-	-	-	12.9 ± 10.2, 4.61 ± 7.13	0.946 ± 7.39
Cesium-137	4.4 ± 5.41	-3.09 U ± 3.17	-2.7 U ± 3.51	1.72 U ± 5.24	1.92 ± 2.24, 2.46 ± 2.15	1.24 ± 2.09
Cobalt-60	2.52 ± 3.46	0.909 U ± 2.68	-0.666 U ± 3.02	-0.771 U ± 5.63	-0.231 ± 1.83, 0.665 ± 1.8	2.05 ± 2.11
Europium-152	0 ± 12.2	-	-	-	7.67 ± 11.1, 4.91 ± 10.4	2.23 ± 12.8
Europium-154	-1.27 ± 12.8	-	-	-	0.605 ± 6.39, -3.23 ± 5.89	2.36 ± 5.6
Europium-155	1.39 ± 8.05	-	-	-	1.66 ± 4.52, -0.45 ± 4.2	0.945 ± 4.76
Gross Alpha Analytes	1.97 ± 2.62	-	-	-	1.26 ± 2.15, 1.92 ± 3.21	3.52 ± 2.03
Gross Beta Analytes	11.1 ± 4.57	-	-	-	0.256 ± 4.48, 1.25 ± 4.09	0 ± 3.39
Iron-55	-	-	-	-	8.68 ± 68.2, -3.98 ± 78.7	-92.5 ± 89.8
Nickel-59	-	-	-	-	-24.7 ± 71.8, -22 ± 65.7	-18.6 ± 67
Nickel-63	-	11.3 U ± 23.6	11.6 U ± 20.3	-7.5 U ± 17.8	-1.97 ± 2.86, -1.95 ± 2.84	0.393 ± 2.79
Niobium-94	1.52 ± 2.09	-	-	-	1.28 ± 1.65, -0.511 ± 0.624	-1.88 ± 1.76
Plutonium-238	-	-	-	-	0.00928 ± 0.108, 0.0143 ± 0.092	-0.0326 ± 0.0806
Plutonium-239/240	-	-	-	-	0.0627 ± 0.157, -0.0381 ± 0.094	0.0701 ± 0.107
Plutonium-241	-	-	-	-	-1.89 ± 9.01, 6.16 ± 9.99	-6.46 ± 10.3
Strontium-90	0.76 ± 0.703	0.428 U ± 0.958	0.463 U ± 1.18	0.38 U ± 0.595	0.61 ± 0.637, 0.355 ± 0.681	1.26 ± 0.741
Technetium-99	-	-	-	-	6.3 ± 3.25, 4.96 ± 3.22	0.389 ± 3.2
Tritium	17.2 ± 147	-206 U ± 340	22.4 U ± 236	211 U ± 356	34.9 ± 140, 139 ± 142	-120 ± 136

Notes:

1	Regulatory criteria from NR 140.10 Subchapter II
2	USEPA MCLS, 40 CFR Part 141
#	Result between Detection & Quantification Limit
-	Not Analyzed
A	Matrix Spike Recovery outside control limits
J	Value is estimated
R	Result is rejected
NA	Not Applicable
pCi/L	picoCuries per liter
U	Not detected above laboratory reporting limit
	Exceeds one or more regulatory criteria
	Exceed DNR Table 2 - Public Welfare Groundwater Quality Standards only.
	Shaded cells indicate duplicate analyses.

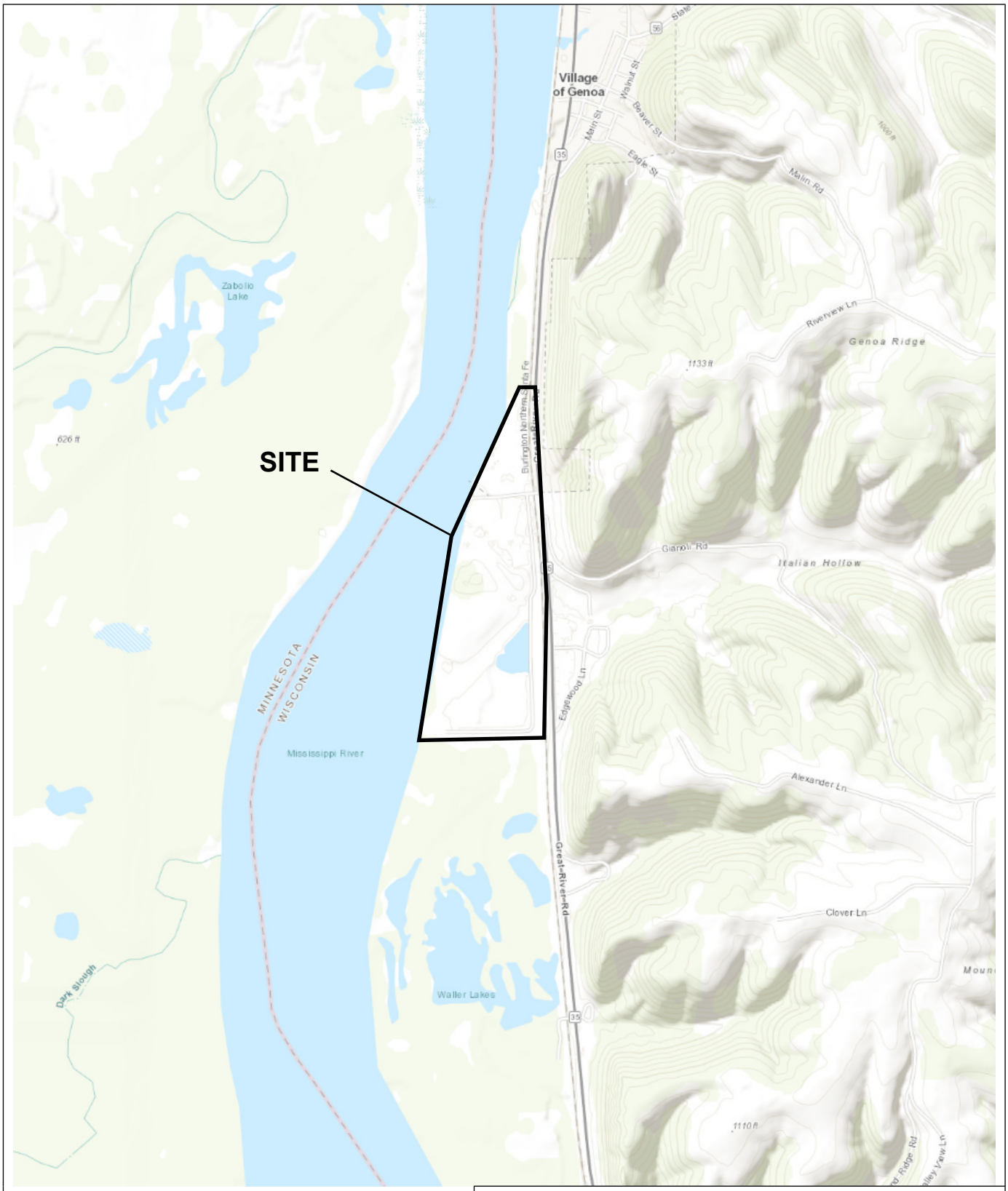
TABLE 1
SUMMARY OF RADIOLOGICAL ANALYTICAL RESULTS FOR
LA CROSSE BOILING WATER REACTOR (LACBWR)
GENOA, WISCONSIN

Location	MW-204B	MW-204B	MW-204B	MW-204B	MW-204B
Sample ID	MW-204B-03242015	MW-204B-11112015	MW-204B-120716	MW-204B-052217	MW-204B-120617
Sample Date	03/24/2015	11/11/2015	12/07/2016	05/22/2017	12/06/2017
Radiological (pCi/L)					
Americium-241	-	-	-	-	-
Carbon-14	-	-	-	-	-
Cesium-137	1.87 ± 3.73	-4.15 ± 3.09	-0.257 U ± 2.60	-0.721 U ± 2.41	0.793 U ± 3.77
Cobalt-60	2.63 ± 3.78	-0.162 ± 2.53	-0.0975 U ± 2.11	-0.0548 U ± 1.95	1.96 U ± 4.73
Europium-152	7.43 ± 28.1	8.74 ± 10.9	-	-	-
Europium-154	-0.428 ± 11.8	-1.76 ± 6.92	-	-	-
Europium-155	-1.87 ± 7.28	3.68 ± 6.73	-	-	-
Gross Alpha Analytes	-0.537 ± 2.88	3.65 ± 3.4	-	-	-
Gross Beta Analytes	1.8 ± 3.64	15 ± 6.28	-	-	-
Iron-55	-	-	-	-	-
Nickel-59	-	-	-	-	-
Nickel-63	-	-	-2.04 U ± 24.6	6.34 U ± 17.3	4.95 U ± 16.1
Niobium-94	0.0185 ± 1.66	2.3 ± 2.03	-	-	-
Plutonium-238	-	-	-	-	-
Plutonium-239/240	-	-	-	-	-
Plutonium-241	-	-	-	-	-
Strontium-90	0.654 ± 0.728	1.25 ± 0.745	0.719 U ± 0.652	1.00 U ± 0.908	0.937 U ± 0.801
Technetium-99	-	-	-	-	-
Tritium	-120 ± 140	-17.3 ± 147	-453 U ± 327	-124 U ± 228	-179 U ± 325

Notes:

1	Regulatory criteria from NR 140.10 Subchapter II
2	USEPA MCLS, 40 CFR Part 141
#	Result between Detection & Quantification Limit
-	Not Analyzed
A	Matrix Spike Recovery outside control limits
J	Value is estimated
R	Result is rejected
NA	Not Applicable
pCi/L	picoCuries per liter
U	Not detected above laboratory reporting limit
	Exceeds one or more regulatory criteria
	Exceed DNR Table 2 - Public Welfare Groundwater Quality Standards only.
	Shaded cells indicate duplicate analyses.

FIGURES



MAP SOURCE: ESRI

SITE COORDINATES: 43°33'21"N, 91°13'52"W

HALEY ALDRICH

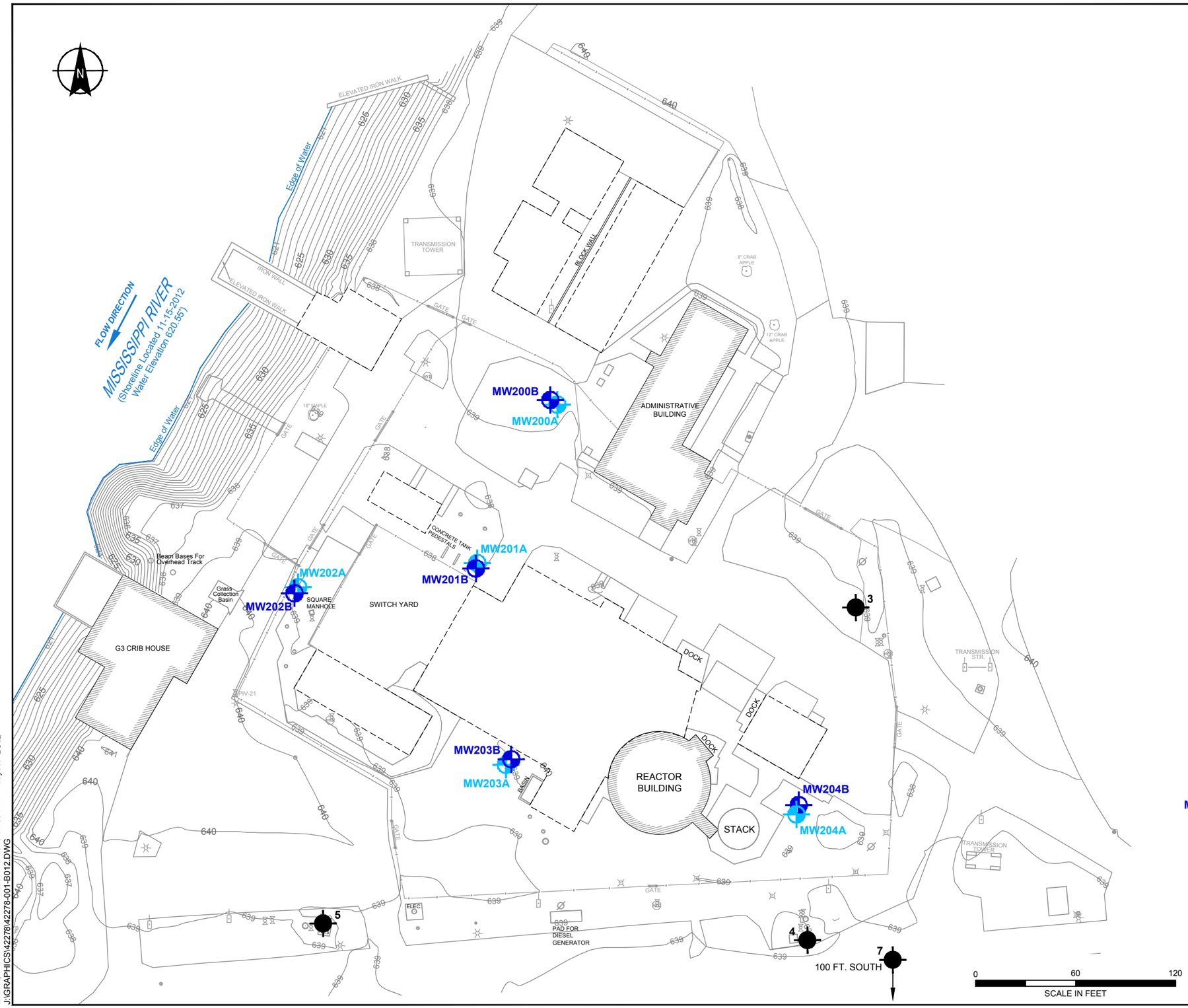
LACBWR
LACROSSE SOLUTIONS
GENOA, , WISCONSIN

PROJECT LOCUS

APPROXIMATE SCALE: 1 IN = 2000 FT
MAY 2018

FIGURE 1

42278-001 A011.PDF



LEGEND

- MW200A — DESIGNATION AND APPROXIMATE LOCATION OF MONITORING WELL IN SHALLOW AQUIFER
- MW200B — DESIGNATION AND APPROXIMATE LOCATION OF MONITORING WELL IN DEEP AQUIFER
- 3 — DESIGNATION AND APPROXIMATE LOCATION OF DOMESTIC WELL
- 639 — MINOR ELEVATION CONTOUR LINE
- 640 — MAJOR ELEVATION CONTOUR LINE
- LIGHT POLE
- TRANSMISSION LINE STRUCTURE
- GP — GUY/STUB POLE
- ANCHOR
- ELECTRIC PEDESTAL
- SECURITY CAMERA ON PEDESTAL
- MAN HOLE
- STORM INLET
- HYDRANT
- WATER VALVE
- CHAIN-LINK FENCE
- DEMOLISHED BUILDING

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. BASE PLAN CREATED FROM PLAN TITLED "TOPOGRAPHIC/SITE SURVEY, DAIRYLAND POWER COOPERATIVE, LACBWR, GENOA, WISCONSIN", DATE 26 NOVEMBER 2012, BY LAMPMAN & ASSOCIATES, OF DE SOTO, WISCONSIN.
3. DOMESTIC WELL LOCATIONS DIGITIZED FROM PLAN TITLED "LACBWR SITE GROUNDWATER WELLS, GENOA, WI", DRAWING 14052187.A, DATED 20 MAY 2014, PREPARED BY ENERGYSOLUTIONS AND SHOULD BE CONSIDERED APPROXIMATE.

HALEY ALDRICH

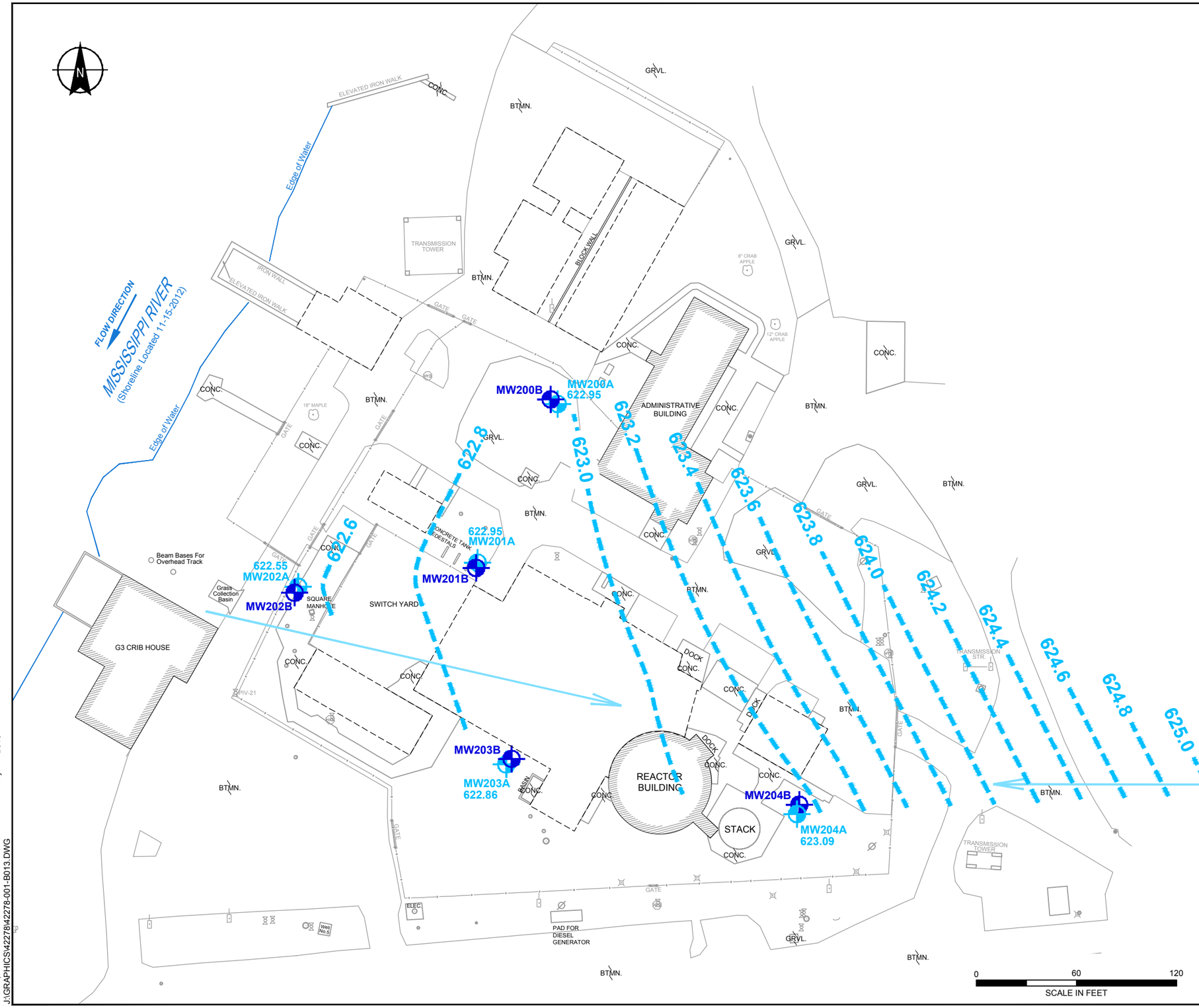
LACBWR
LACROSSESOLUTIONS
GENOA, WISCONSIN

SITE PLAN

SCALE: AS SHOWN
MAY 2018

FIGURE 2

ERVIN, DAYNA
J:\GRAPHICS\42278\42278-001-B012.DWG
Printed: 1/16/2018 11:00 AM
Layout: B012



LEGEND

MW200A	DESIGNATION AND APPROXIMATE LOCATION OF MONITORING WELL IN SHALLOW AQUIFER
625.57	INDICATES GROUNDWATER ELEVATION (IN FEET) OBSERVED ON 22 MAY 2017
MW200B	DESIGNATION AND APPROXIMATE LOCATION OF MONITORING WELL IN DEEP AQUIFER
622.5	INFERRED GROUNDWATER CONTOUR
	INFERRED GROUNDWATER FLOW DIRECTION
CONC.	CONCRETE SURFACE OR CONCRETE PAD
GRVL.	GRAVEL SURFACE
BTMN.	BITUMINOUS SURFACE
– – – – –	DEMOLISHED BUILDING

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. BASE PLAN CREATED FROM PLAN TITLED "TOPOGRAPHIC/SITE SURVEY, DAIRYLAND POWER COOPERATIVE, LACBWR, GENOA, WISCONSIN", DATE 26 NOVEMBER 2012, BY LAMPMAN & ASSOCIATES, OF DE SOTO, WISCONSIN.
3. WELL MW200A WAS NOT USED IN PREPARATION OF THE GROUNDWATER CONTOURS DUE TO ANOMALOUS WATER LEVEL READING

HALEY ALDRICH

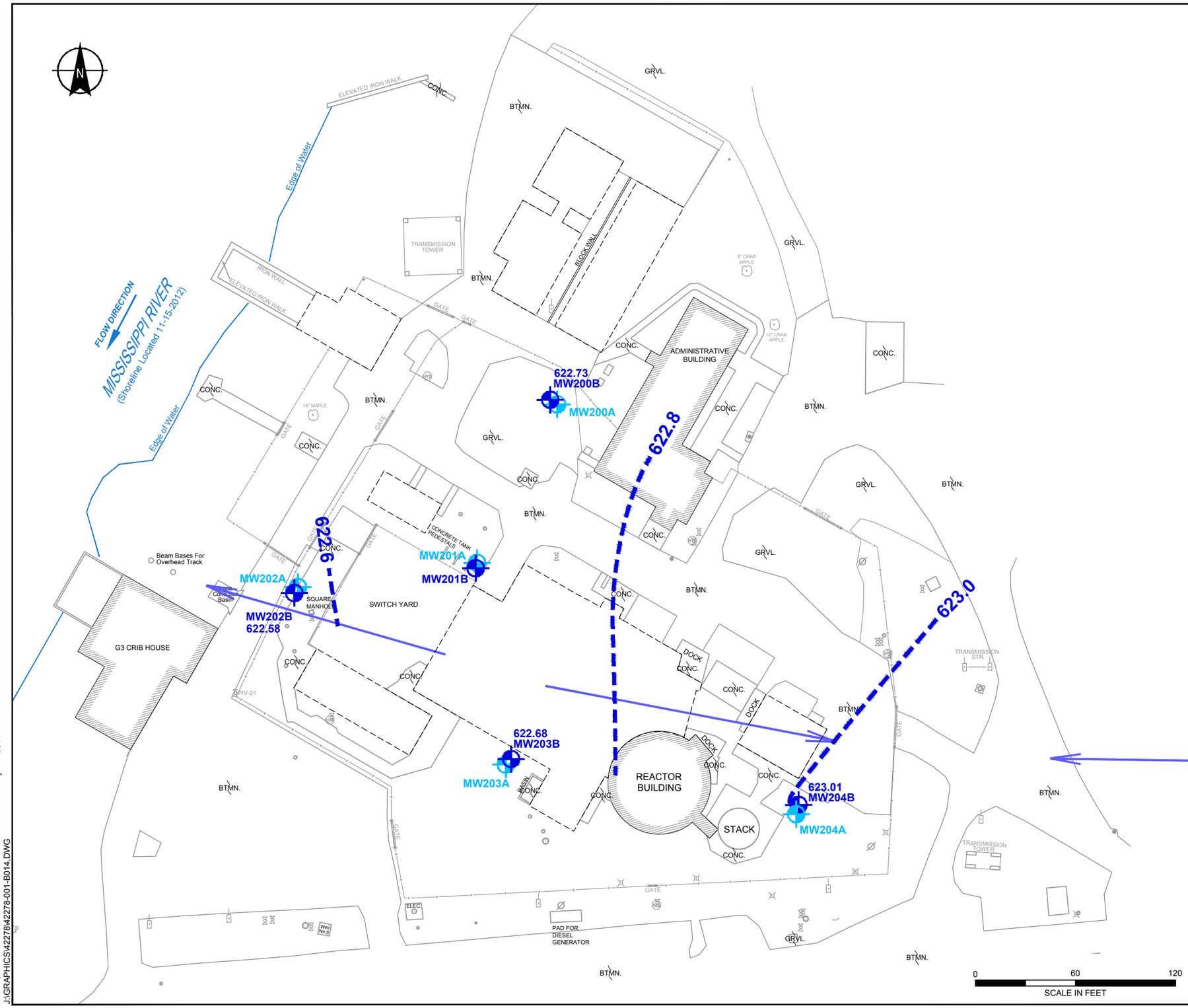
LACBWR
LACROSSESOLUTIONS
GENOA, WISCONSIN

GROUNDWATER CONTOURS
SHALLOW AQUIFER
DECEMBER 2017

SCALE: AS SHOWN
MAY 2018

FIGURE 3

ERVIN, DAYNA Printed: 1/18/2018 1:21 PM Layout: B013
J:\GRAPHICS\42278\42278-001-B013.DWG



LEGEND

MW200A	DESIGNATION AND APPROXIMATE LOCATION OF MONITORING WELL IN SHALLOW AQUIFER
MW200B	DESIGNATION AND APPROXIMATE LOCATION OF MONITORING WELL IN DEEP AQUIFER
626.10	INDICATES GROUNDWATER ELEVATION (IN FEET) OBSERVED ON 22 MAY 2017
622.5	INFERRED GROUNDWATER CONTOUR
	INFERRED GROUNDWATER FLOW DIRECTION
CONC.	CONCRETE SURFACE OR CONCRETE PAD
GRVL.	GRAVEL SURFACE
BTMN.	BITUMINOUS SURFACE
– – – – –	DEMOLISHED BUILDING

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. BASE PLAN CREATED FROM PLAN TITLED "TOPOGRAPHIC/SITE SURVEY, DAIRYLAND POWER COOPERATIVE, LACBWR, GENOA, WISCONSIN", DATE 26 NOVEMBER 2012, BY LAMPMAN & ASSOCIATES, OF DE SOTO, WISCONSIN.

HALEY ALDRICH

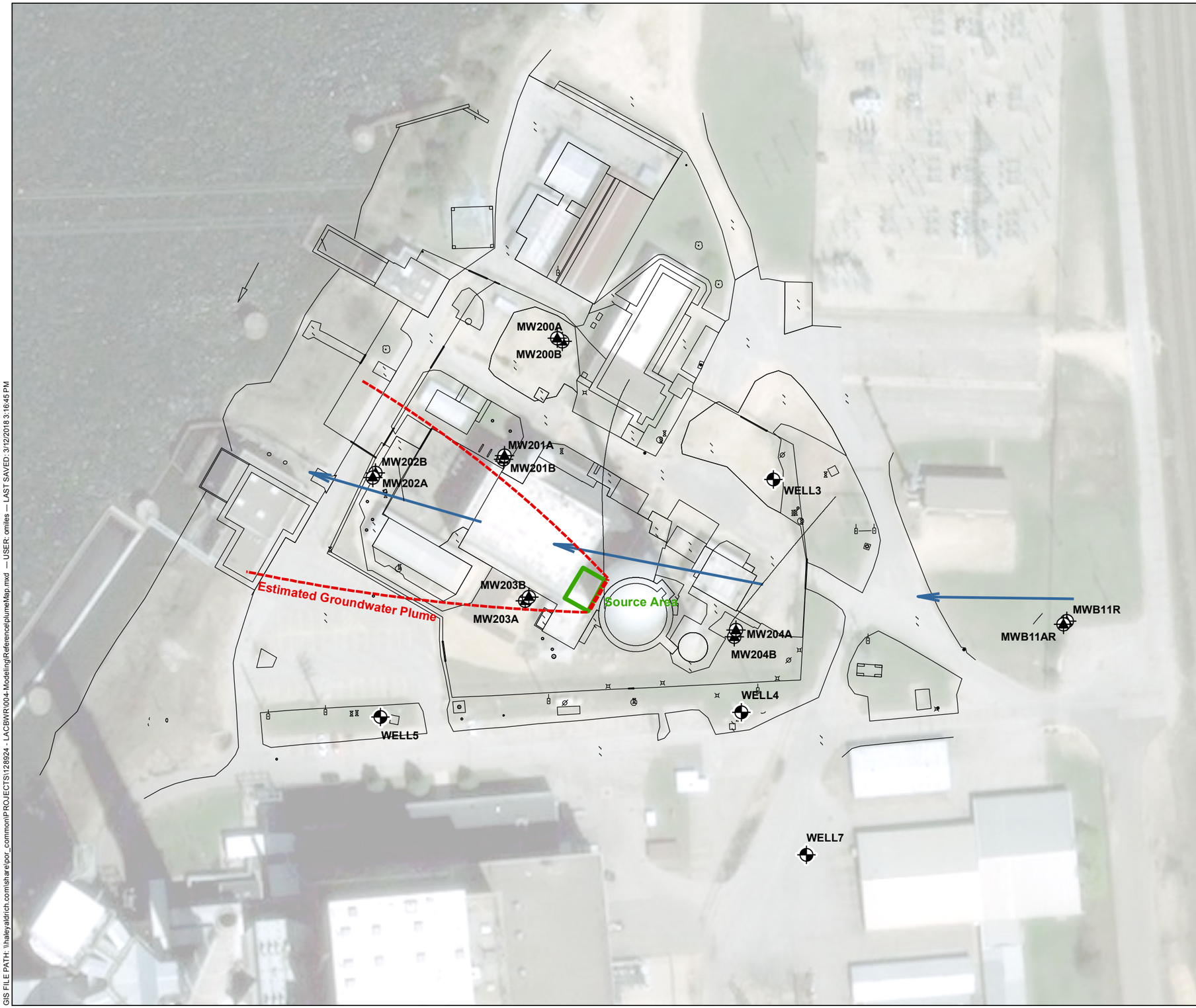
LACBWR
LACROSSESOLUTIONS
GENOA, WISCONSIN

GROUNDWATER CONTOURS
DEEP AQUIFER
DECEMBER 2017

SCALE: AS SHOWN
MAY 2018

FIGURE 4

ERVIN, DAYNA Printed: 1/18/2018 1:19 PM Layout: B014
J:\GRAPHICS\422784\42278-001-B014.DWG



LEGEND

APPROXIMATE LOCATION OF SUPPLY WELL

APPROXIMATE LOCATION OF MONITORING WELL

NOTES

1. PLUME AREA ESTIMATED FROM GROUNDWATER CONCENTRAITONS AND GROUNDWATER FLOW DIRECTION.

2. GENERAL GROUNDWATER FLOW DIRECTION ESTIMATED BY GRADIENTS

N

0 80 160

SCALE IN FEET

HALEY ALDRICH

LACBWR
LACROSSESOLUTIONS
GENOA, WISCONSIN

ESTIMATED EXTENTS OF TRITIUM IMPACTED GROUNDWATER

MAY 2018

FIGURE 5

GIS FILE PATH: \\haleyaldrich.com\share\por_common\PROJECTS\128924 - LACBWR\004-Modeling\Reference\plumeMap.mxd — USER: omiles — LAST SAVED: 3/12/2018 3:16:45 PM

APPENDIX A

LC-RP-PR-057 Revision No. 2

LACROSSE SOLUTIONS

LACBWR Site Restoration Project Work Control Procedure

Groundwater Sampling

Procedure No. LC-RP-PR-057

Revision No. 2

Preparer: Joe Jacobsen _____ Date: 4/2/18

Secondary Reviewer: Austin Zander _____ Date: 03/27/2018

Regulatory Affairs assigned program & regulatory reviews (***new only***): Initials/Date _____N/A	
Regulatory Required Reviews (attach completed LC-RA-PR-001 and QTR forms, as applicable)	
Part 50 License: 10 CFR 50.59 and 50.90	☐ YES ☒ NO
Fire Protection: 10 CFR 50.48(f)	☐ YES ☒ NO
Conditions of License: PSP: 10 CFR 50.54(p)	☐ YES ☒ NO
Conditions of License: E-Plan: 10 CFR 50.54(q)	☐ YES ☒ NO
Termination of License: 10 CFR 50.82(a)(6) and 50.82(a)(7)	☐ YES ☒ NO
Part 72 License: 10 CFR 72.48	☐ YES ☒ NO

Program Required Reviews

RP: ☒ YES ☐ NO SIGNATURE _____ DATE: 4/2/18

QA: ☐ YES ☒ NO SIGNATURE _____ DATE: _____

QTR: ☐ YES ☒ NO SIGNATURE _____ DATE: _____

Approval Section

PROJECT MANAGER: SIGNATURE _____ DATE: 4/2/2018

Effective Date: 4/2/18 (assigned by Document Control or Project Manager)

TABLE OF CONTENTS

1. PURPOSE AND SCOPE 5
1.1. Purpose 5
1.2. Scope 5
2. REFERENCES 6
2.1. None 6
3. GENERAL 6
3.1. Background 6
4. REQUIREMENTS AND GUIDANCE 7
4.1. Method summary 7
4.2. Interferences and potential problems 8
4.3. Purging 8
4.4. Materials 8
4.5. Equipment 9
4.6. Reagents 10
4.7. Procedures 10
4.8. Well Inspection 12
4.9. Water-Level Measurement 12
4.10. Well Purging 12
4.11. Groundwater Sample Collection 12
4.12. Recording of Information 13
4.13. Sample Containers and Preservatives 14
4.14. Quality Control Samples 14
4.15. Sample Documentation 14
4.16. Personnel Qualifications 15
4.17. Health And Safety 15
4.18. Quality Assurance/Quality Control 15
5. Attachments 15
5.1. Attachment 1 – LACBWR Monitoring Well Map 15
5.2. Attachment 2 Low Flow Purge 15
5.3. Attachment 3 Equipment Calibration 15
5.4. Attachment 4 Manual Water Level Measurement 15
5.5. Attachment 5 Sample Management 15

5.6. Attachment 6 Equipment Decontamination.....15

Summary of Changes to Rev 1:

1.) Minor formatting that did not affect the technical content of this document.

2.) Minor clarifications and addition of (5) existing Work Instructions associated with this procedure's scope of work to address a QA concern over use of Work Instructions versus Procedures for groundwater sampling.

Summary of Changes to Rev 2:

1.) Added details to identify replacement wells.

2.) Minor formatting that did not affect the technical content of this document.

1. PURPOSE AND SCOPE

1.1. Purpose

1.1.1 The purpose of this procedure is to provide general guidance and direction on the proper procedures for sampling groundwater wells at the LACBWR site. This instruction's primary focus is the proper collection of representative groundwater samples from the saturated zone of the subsurface. The goal is to collect samples that are representative of the particular zone of water being sampled at the time of collection. This instruction and its appendices are to be used in conjunction with analyses for groundwater constituents (e.g., radionuclides).

1.2. Scope

1.2.1 This procedure is to be used by field samplers and others associated with performing field investigations at the LACBWR facility. It applies to the collection and handling of groundwater samples from monitoring wells. It addresses the specific activities to be performed prior to going to the field and upon arrival at each sampling location. This instruction also explains the process of groundwater sample collection, preparation or collection of quality control/quality assurance (QA/QC) samples, and sampling event documentation.

1.2.2 Guidelines for purging monitor wells using a low-flow purge method are presented in Attachment 2, Instruction for Low-Flow Purge.

1.2.3 Maintenance and calibration of sampling equipment are described in Attachment 3, Equipment Calibration.

1.2.4 The process for accurately determining the measurement of water levels is detailed in Attachment 4, Manual Water-Level Measurement.

1.2.5 Chain-of-Custody protocols for sample shipment to analytical laboratories are provided in Attachment 5, Sample Management.

1.2.6 Decontamination of sampling equipment is described in –Attachment 6, Equipment Decontamination.

1.2.7 Sample containers and preservatives for water samples are described in Table 1-1.

TABLE 1-1

SAMPLE CONTAINER, PERSERVATION, SHIPPING AND PACKAGING

REQUIREMENTS FOR GROUNDWATER SAMPLING

Analysis	Sample Containers per Analysis	Preservation	Maximum Holding Time from Sample Collection	Volume of Sample	Shipping
Tritium (H3)	1 L glass bottle or equivalent	Ambient Temperature	180 days	Fill to neck of bottle	Overnight or hand deliver
Strontium-90	1 L glass bottle or equivalent	Ambient Temperature	180 days	Fill to neck of bottle	Overnight or hand deliver
Cobalt-60	1 L glass bottle or equivalent	Ambient Temperature	180 days	Fill to neck of bottle	Overnight or hand deliver
Cesium-137	1 L glass bottle or equivalent	Ambient Temperature	180 days	Fill to neck of bottle	Overnight or hand deliver
HTDs	1 L glass bottle or equivalent	Ambient Temperature	180 days	Fill to neck of bottle	Overnight or hand deliver

HTDS = HARD-TO-DETECT RADIONUCLIDES: CARBON-14, IRON-55, NICKEL-59/63, TECHNETIUM-99,

2. REFERENCES

2.1. None

3. GENERAL

3.1. Background

3.1.1 Haley & Aldrich, Inc. (Haley & Aldrich) was contracted by Dairyland Power Cooperative (DPC) to develop a Hydrogeological Conceptual Site Model (CSM) of the La Crosse Boiling Water Reactor (LACBWR) site located near Genoa, Wisconsin. The purpose of the CSM was to acquire a better understand of both the hydrogeological setting of LACBWR as well as past operations that could have released site-related radiological constituents to the environment.

3.1.2 The Hydrogeological CSM was the first action involved in understanding both groundwater flow regimes as well as groundwater quality, with respect to radionuclides associated with LACBWR. The CSM was then used to identify data gaps that were used to develop a focused investigation to better define the hydrogeology.

3.1.3 At LACBWR, groundwater flows in a westerly direction from the bluffs on the east towards the river. Under typical river stage, groundwater gradients near the river are slightly upward; however, the vertical gradient reverses during flood stages. The geological and historic river stage data also suggests that the shallow aquifer is in direct hydraulic communication with the river and the river stage impacts the water table elevation.

3.1.4 Historic operations may potentially have released radionuclides to the environment. Generally, most of the potential releases are associated with the waste collection system in the Turbine Building, in which, radioactive liquid waste was collected by floor drains, pumped into wastewater tanks and then batch released into the circulating water line. In the late 1970s, voids were characterized below the building mostly in the northeast below the laundry area. When the voids were grouted, grout then entered the floor drains, plugging them. These data raise questions on the integrity of the Turbine Building subsurface floor drains. Other Areas of Interest (AOIs) include the Underground Gas Storage Tank Vault and Piping and the Contaminated Water Release Area. Based upon construction and the fact that there are not buried pipes, the soils and groundwater below the Reactor Building are not likely to be impacted.

3.1.5 Based upon the CSM and monitoring wells that Haley & Aldrich developed and installed, this procedure provides direction on the proper techniques to be used for groundwater sampling.

3.1.6 During 2018, two monitoring wells have been replaced due to significant damage, which negated their ability to continue to be used as monitoring wells. The wells that were replaced included MW-201B and MW-202A. The new wells were located within five feet of the abandoned wells and have the numbers MW-201BR and MW-202AR.

4. REQUIREMENTS AND GUIDANCE

4.1. Method summary

To obtain a representative groundwater sample for radiological analysis, it is important that the sample is formation water, originating from outside the well. This can be accomplished either by purging the complete volume of water in the borehole/casing one to three times, or alternatively, by purging the well at a rate approximately equal to recovery (i.e., low-flow purge). Pumping at a rate near or slightly greater than well capacity minimizes drawdown, and ensures that water will be pumped from the aquifer adjacent to the pump or tubing intake. Mixing of water from the borehole, above or below the intake, is minimized or eliminated in this manner. In the low-flow method to be used at LACBWR, the well is purged at the low-flow rate until a specified set of parameters (pH, temperature, specific conductance, dissolved oxygen, turbidity, oxidation reduction potential) are stabilized or up to three well volumes or four hours (whichever is achieved first) if parameters have not stabilized. At that point, samples are collected from the pump discharge.

4.2. Interferences and potential problems

4.2.1 General

The primary goal in performing groundwater sampling is to obtain a representative sample of the groundwater aquifer. Field personnel can compromise analysis in two primary ways: (1) taking an unrepresentative sample or (2) by incorrect handling of the sample.

4.3. Purging

In a non-pumping well, there may be little or no vertical mixing of the water and stratification may occur. Mixing may occur in the screened or open section of a well, but the well water above the screened or open section may remain isolated, become stagnant, and may not be representative of the groundwater. A non-representative sample can result from excessive pre-pumping of the monitoring well. Excessive pumping could dilute or increase the constituent concentrations from what is representative of the sampling point of interest.

To safeguard against collecting non-representative stagnant water, the following guidelines and techniques should be adhered to during sampling:

- As a general rule, monitor wells will be purged prior to sampling. Purging until the parameters have stabilized is recommended for a representative sample.
- When purging, the pump should generally be set at the approximate mid-point of the saturated screened interval, or saturated open borehole.
- The flow rate for pumped wells should be maintained at a rate that is approximately equal to the recharge rate of the well by following the procedures described in Attachment 2.

4.4. Materials

Equipment used in multiple wells should be decontaminated in accordance with Attachment 6 between uses. Disposable or dedicated equipment should be employed when practicable to help reduce the likelihood of cross-contamination.

Materials made from Teflon are considered the optimal material for use in sample tubing and other flexible components of groundwater sampling equipment. For rigid components, stainless steel is considered the optimum material of construction. Other materials may also be deemed appropriate for sampling apparatus.

4.5. Equipment

Planning for a sampling event entails assessing, selecting, and assembling the equipment, instruments, and supplies necessary to perform the work. Prior to going to the field, instrumentation shall be assembled, calibrated in a manner consistent with Attachment 3 and manufacturers recommendations (if applicable), and tested. Listed below are types of equipment, instruments, and supplies that may be used for groundwater sampling from LACBWR wells:

- Water-level indicator, 0.01 feet accuracy
- Discharge piping or tubing
- Flow meter or calibrated vessel
- Bladder pump, peristaltic pump, or small submersible centrifugal pump
- Pump controllers (Variable Frequency Drive, Peristaltic, and Bladder Pump controllers) for low-flow sampling pumps
- Compressed gas cylinder or oil-less compressor for bladder-pump operation
- Generator for Variable Frequency Drive style low-flow pump operation
- Twin-line Teflon®-lined polyethylene tubing
- Flow cell for measurement of groundwater parameters
- Multi-parameter instrument
- Turbidity Meter
- Air-hoses, couplers and adaptors, as needed
- Tools necessary for set-up and field maintenance of pumping equipment
- Fuel for generator or compressor
- Calibrated vessel or flow meter to measure water volume purged

- Labeled containers (e.g., drums and/or tanks) for purged well water, if needed
- Personal Protective Equipment (PPE), including nitrile gloves and safety glasses
- Measuring tape
- Sample containers and preservatives supplied by the laboratory
- Coolers for samples
- Keys to well box locks
- Cellular phone and/or radio to communicate with project managers and other field staff
- Watch with a stopwatch function
- Calculator
- Pen or marker with indelible ink
- Chain-of-Custody forms
- Custody seals
- Instrument calibration supplies and forms (see Attachment 3)
- Manual water-level measurement supplies (see Attachment 4)
- Sample collection, labeling and documentation supplies (see Attachment 5)
- Decontamination supplies (see Attachment 6)
- Safety Data Sheets (SDS)
- Health and Safety Plan (HASP)

4.6. Reagents

Reagents may be used for preservation of samples and for decontamination of sampling equipment. The preservatives required are specified by the analysis to be performed, and summarized in Attachment 5. The analytical laboratory that will perform the sample testing should provide the reagents required for sample containers. Decontamination solutions are specified in Attachment 6, Equipment Decontamination.

4.7. Procedures

This procedure addresses the specific activities to be performed to accomplish a groundwater sampling event or round at the LACBWR site. The procedure includes:

- Preparation of a delivery order for analytical laboratory services
- Procurement of equipment and supplies
- Field inspection of wells to be sampled
- Well water-level measurement
- Well purging and measurement of field parameters
- Groundwater sample collection
- Field documentation requirements

4.7.1 Schedule

A complete set of groundwater samples will be taken twice per year at times when groundwater conditions are representative of the LACBWR norm. The tentative scheduled sampling activities should be during the months of May-June and November-December and continue until the conditions of the License Termination plan are fulfilled.

4.7.2 Preparation

In preparation for a groundwater sampling event, the field sampler shall review the following information:

- Identification number(s) of the well(s) to be sampled
- Locations of the wells
- Well location access requirements (e.g., locked gates, road conditions)
- Field data recording requirements
- Field and analytical parameters to be tested
- Type and number of sample containers needed
- Volume of sample required for analysis
- Type and number of QA/QC samples to be collected (e.g., duplicates, splits, and blanks)
- Anticipated weather conditions

- Type of equipment needed for the scheduled sampling activity

A well location map and summaries of well completion data and pump specifications are available for field reference.

A request for sample containers, which specifies the sample media, number of samples, and analytical parameters to be tested shall be prepared with sufficient advance notice and forwarded to the offsite analytical laboratory to complete the analyses. The analytical laboratory, in accordance with the sampling schedule and the sample volume requirements, will provide sample containers, preservatives, and quality control samples, as requested.

Equipment shall be calibrated according to Attachment 3 and the equipment manufacturers' protocols prior to use.

4.8. Well Inspection

Prior to sampling a well, its condition shall be inspected and recorded. Signs of vandalism, unauthorized entry, settlement, or ponding around the well shall be documented, along with the well identification number and the date.

4.9. Water-Level Measurement

The depth to water shall be measured from the well reference point in accordance with Attachment 4, Manual Water-Level Measurement. The water level shall be recorded to the nearest 0.01 foot along with the time of day when the measurement was obtained.

4.10. Well Purging

Wells will generally be purged according to the process described in Attachment 2, Low Flow Purge.

4.11. Groundwater Sample Collection

Samples collected from dedicated pump systems (low-flow or submersible) will be collected from the pump discharge in accordance with Attachment 2. For low-flow purge systems, the sample point is prior to the flow cell. Water samples cannot pass through the flow cell. If there is no sample port "upstream" of the flow cell, remove the in-line parameter flow cell and associated plumbing before sampling. For wells with submersible pumps, the sample point is prior to the flow meter and any flow control valves.

The wells shall be minimally sampled for Co-60, Cs-137, Ni-63, H-3, and Sr-90 and analyses performed for same at an approved off site lab.

Whenever feasible, samples should be collected in the following recommended sampling order by sample type:

1. Equipment rinse blank samples, if applicable
2. Primary samples
3. Matrix duplicate samples, if applicable
4. Field duplicate samples
5. Field split samples, if applicable
6. Field blank samples, if applicable

Prior to placement into the cooler, each sample should be double-checked to make certain it is properly identified and appropriately labeled. Sample handling, labeling, and transportation are discussed in Attachment 5.

4.12. Recording of Information

Relevant information pertaining to field activities should be recorded on a regular basis. In order to avoid the potential to not document important information, the record should be in plain sight near the work area and be readily accessible so that observations, readings, and other pertinent information can be easily recorded whenever possible. Observations and other information should be recorded as soon as practicable, or at a minimum, a brief note and the time recorded for later elaboration. The types of information to be recorded may include:

- Arrival and departure times at the site and at individual wells. Dates should be recorded in the format MM/DD/YY. Times should be based on a 24-hour military type format for the given time zone (Central Standard Time or Central Daylight Time). For example, 8:45 a.m. should be recorded as 0845. The time 2:45 p.m. should be recorded as 1445.
- Information regarding instrument calibrations and the calibration standards used
- Depth to water
- Damage or concerns regarding wells or access
- Method and equipment used to purge wells
- Pump depths
- Method and equipment used to collect samples
- Groundwater parameters
- Purge volumes, times and estimated flow rates

- Dates, times and volumes of samples collected
- Decontamination procedures, if required
- Times and names of visitors on the site and their purpose
- Problems or potential problems with equipment
- Potential health or safety issues that may require revision to the HASP
- Accidents or injuries

4.13. Sample Containers and Preservatives

Requirements for groundwater sample containers, preservation requirements, and holding times are addressed in Table 1-1.

4.14. Quality Control Samples

For each sampling event, additional samples are required for quality assurance and quality control (QA/QC) purposes. Quality assurance and quality control samples shall be collected, preserved, and handled at the same time and in the same manner as the other groundwater samples collected. The various types of QA/QC samples are discussed in Attachment 5.

4.15. Sample Documentation

4.15.1 Chain of Custody

The appropriate sample custody documentation shall be completed in accordance with Attachment 5, Sample Management. Entries on the Chain-of-Custody form shall be entered using indelible ink. Identified errors shall be lined out with a single line, initialed, and dated. Chain-of-Custody forms shall be fully completed, with applicable blocks having entries and the signatures of samplers and recipients. An example Chain-of-Custody form is presented in Attachment 5.

4.15.2 Field Activities Record

The groundwater samples collected from each well, along with the QA/QC samples prepared or collected, shall be identified in the field record. The field sampler shall be responsible for completing the entries. The record shall be submitted to the project manager for review and kept in the project file.

4.15.3 Well Conditions

Any observations by the sampler on the condition of the well pad, well vault, well seal or downhole equipment should be noted on the Groundwater Monitoring Report form in Attachment 4 and the field sampling record in Attachment 5.

4.16. Personnel Qualifications

Field samplers shall obtain the following site specific training prior to engaging in field collection activities.

- LACBWR Site Restoration Project NGET
- LACBWR Site Restoration Project Radiation Worker Training
- LACBWR Site Restoration Project Radiation Worker Practical Factors

In addition, field personnel should be trained in the appropriate methods before initiating the procedure alone.

4.17. Health And Safety

Site personnel shall comply with the site Health and Safety Plan and Appendices A through E of this Work Instruction. Potential health and safety concerns include working with compressed gases, compressed gas cylinders, fueling air-compressors or generators, pH buffers and standard solutions, non-phosphate detergent, and decontamination liquid waste.

4.18. Quality Assurance/Quality Control

The following general quality assurance/quality control (QA/QC) procedures apply:

- Pertinent data and activities will be recorded.
- Equipment will be calibrated and operated in accordance with operating instructions as supplied by the manufacturer.

5. ATTACHMENTS

5.1. Attachment 1 – LACBWR Monitoring Well Map

5.2. Attachment 2 Low Flow Purge

5.3. Attachment 3 Equipment Calibration

5.4. Attachment 4 Manual Water Level Measurement

5.5. Attachment 5 Sample Management

5.6. Attachment 6 Equipment Decontamination

ATTACHMENT 1 – LACBWR MONITORING WELLS

Attachment 2

Low Flow Purge

1. SCOPE AND APPLICATION

The purpose of this Work Instruction is to provide guidelines and direction for the purging of LACBWR monitor wells using the low-flow method. Generally, purging of wells will be conducted based on U.S. Environmental Protection Agency guidelines described in Low-Flow (Minimal Drawdown) Ground-water Sampling Procedures, dated April 1996.

The low-flow purge method entails pumping a well at a flow rate approximately equal to the recharge rate of the aquifer, which may be near or slightly greater than the capacity of the well. The flow rate should not result in significant drawdown within the well. Minimal drawdown should inhibit vertical mixing within the well and result in drawing water directly from the aquifer media. The water level will be monitored regularly during the purging process to determine that the well is not being purged at a rate that induces drawdown in excess of the thresholds described in this Work Instruction.

Exceptions to low-flow sampling protocols may include monitor wells sampled by bailing. These standard operating procedures may be varied or changed as required, dependent on site conditions, and equipment limitations.

2. INTERFERENCES AND POTENTIAL PROBLEMS

2.1. Placing the low-flow purge pump at the vertical midpoint of the water column in a well may be difficult for wells that experience large water level fluctuations.

2.2. Drawdown may be induced in low-yield wells at even the lowest flow rates produced by purge pumps. This may result in wells being purged to dryness.

2.3. Parameters may not stabilize within a reasonable time period. Groundwater sample collection may proceed if groundwater stabilization has not occurred after the removal of three well volumes or four hours, whichever is achieved first.

3. EQUIPMENT

Prior to going to the field, instrumentation shall be assembled, calibrated in accordance with Attachment 3 and a manner consistent with manufacturers recommendations (if applicable), and tested. Additional equipment needed for manual water level measurement, sample management, and equipment decontamination is listed in Attachment 4-6 respectively. Listed below are types of equipment, instruments, and supplies necessary for well purging:

- Bladder pump, peristaltic pump, or small submersible centrifugal pump
- Pump controllers (Bladder Pump, Peristaltic Pump, and/or Variable Frequency Drive controllers) for low-flow sampling pumps
- Compressed gas cylinder or oil-less compressor for bladder-pump operation

- Twin-line Teflon®-lined polyethylene tubing
- Generator for Variable Frequency Drive style low-flow pump operation
- Air-hoses, couplers and adaptors, as needed
- Stainless steel compression fittings or dedicated grab plates
- Disposable polyethylene bladders
- Tools necessary for set-up and field maintenance of pumping equipment
- Fuel for generator or compressor
- Multi-parameter instrument
- Turbidity meter
- Flow cell for measurement of groundwater parameters
- Discharge tubing, hose or piping
- Calibrated vessel or flow meter to measure water volume purged
- Labeled vessels (e.g., drums or tanks) for containing purge water, if needed
- Water-level indicator, 0.01 feet accuracy
- Calculator
- Keys to well box locks
- Measuring tape
- Cellular phone or radio to communicate with project managers and other field staff
- Watch with a stopwatch function
- Personal Protective Equipment (PPE), including nitrile gloves and safety glasses
- Paper towels
- Garbage bags
- Pen or marker with indelible ink
- Safety Data Sheets (SDS)
- Decommissioning Work Plan (DWP)

- Quality Assurance Project Plan (QAPP)
- Instrument calibration supplies and forms (see Attachment 3)
- Manual water-level measurement supplies (see Attachment 4)
- Sample collection, labeling and documentation supplies (see Attachment 5)
- Decontamination supplies (see Attachment 6)

4. REAGENTS

No chemical reagents are used in this work instruction; however, calibration solutions and decontamination solutions may be necessary for the equipment used.

5. PROCEDURES

5.1. Preparation

5.1.1 Review past purging information for equipment types, well size, purge depth, purge rates, purge volumes, pump inlet interval set point, etc.

5.1.2 Determine the low-flow purge pumps to be used, and the number and type of samples needed.

5.1.3 Obtain the equipment and supplies needed to operate the pumps, to contain and transport purge water, and to collect, handle, and transport the samples.

5.1.4 Decontaminate or pre-clean non-dedicated equipment, and ensure that it is in working order.

5.2. Procedures

Procedures for low-flow purging are described below.

5.2.1 Setting Up Low-Flow Purge Equipment

1.) Clean non-dedicated sampling equipment in accordance with Equipment Decontamination Work Instruction.

2.) Unlock the well vault. If the presence of volatile organic vapors was indicated in a well during water-level monitoring activities, remove the well cap and allow the well to vent for approximately 2 minutes prior to purging and sampling.

3.) Measure the water level in accordance with Attachment 4, Manual Water-Level Measurement.

4.) If the well is dry or the measured difference in depth between the depth to water and the well depth is less than three feet, the well contains insufficient water for sampling. Remove the water-level indicator and secure the well. Document the condition on the associated well log record.

5.) If using a portable pump, retrieve dedicated tubing, connect to the pump apparatus according to the manufacturer's instructions, and install the non-dedicated pump intake at a depth halfway between the depth to water and the bottom of the saturated screened or open interval of the well.

6.) Install the appropriate power supply and controls for the specific type, manufacturer, size, and model of the pump.

7.) Install the in-line parameter monitoring equipment flow cell. Prior to performing purging, make sure the parameter monitoring equipment is calibrated in accordance with Attachment 3 at the beginning of each day.

8.) Set up an in-line flow meter or a calibrated container to monitor volume purged.

9.) Initiate operation of the low-flow purge pump.

5.2.2 Low-Flow Purge Set-up Using Electric Submersible Pumps

Dedicated electric submersible Variable Frequency Drive (VFD) pumps are installed in some wells. Pumps are installed on steel or PVC column pipe, which conveys water from the pump to the surface. Power is supplied by a portable generator or fixed electrical source. The procedure for setting up the sampling apparatus on a well equipped with a dedicated VFD pump is the same as described above with the following additional procedures and considerations:

- If using a portable generator to power the well, ensure that the generator is downwind of the well.

- Connect discharge piping at the wellhead; usually a riser pipe that threads into the top of the column pipe with an elbow or tee above the top of the well vault. Downstream from the tee is the typical location of the flowmeter used to measure flow rate and total volume evacuated. Between the tee and the flowmeter and gate valve should be connections to divert flow through a flow cell for parameter measurements and a sample port for collection of samples.

- A garden hose or similar should be used to convey water from the discharge piping to the appropriate waste containment vessel.

- To operate the submersible pump, the electrical lead from the motor is plugged into the pump control box. The pump control box controls the flow rate at which the well will be pumping. The control box is then plugged into the generator or fixed power source. DO NOT plug in the control box until the generator has been

started and allowed to warm up. The control boxes are very sensitive to power fluctuations and could be damaged if the generator creates power surges or dips.

- When the equipment is properly connected and the generator is warmed up, the power to the control box may be switched on, starting the pump.

5.2.3 Purging

The goal of low-flow purge methodology is to pump water from the well at a rate that is, to the extent practicable, equal to the rate of recharge to the well. This is accomplished by implementing the following methodology:

1.) The water level in the well is measured immediately after the pump starts to determine if drawdown is occurring in the well.

2.) If there is drawdown greater than 0.3 foot upon start-up of the well, the discharge from the pump should be decreased using the pump control box until the water level becomes stable.

3.) If no drawdown is observed, the pumping rate should be increased until drawdown is observed. The pumping rate should then be reduced to the level at which the water level is stable. The purging rate for the wells will target approximately 100 milliliters per minute (ml/min) to minimize groundwater drawdown and will not exceed 500 ml/min.

4.) If the pump cannot withdraw water at a rate that induces noticeable drawdown, the maximum pump capacity should be utilized.

5.) After a sufficient volume of water has been pumped to purge the discharge piping or tubing once, parameter measurements shall commence. Parameter measurements shall be recorded every three to five minutes, until parameter stabilization occurs, as specified below.

6.) Measure and record the depth to water at intervals not greater than five minutes. Dates should be recorded in the format MM/DD/YY. Times should be based on a 24-hour military type format for the given time zone (Central Standard Time or Central Daylight Time). For example, 8:45 a.m. should be recorded as 0845. The time 2:45 p.m. should be recorded as 1445.

7.) Adjust the pump flow rate as necessary so that excessive drawdown, greater than 0.3 feet, does not occur in the well screen or open hole interval of the well.

8.) Monitor the following groundwater parameters at intervals not exceeding five minutes: pH, specific conductance, ORP, turbidity, dissolved oxygen (DO) and temperature. Record the measurements until stabilized.

Stabilization has been achieved when three successive readings are within:

– +/- 0.1 for pH

- +/- 3% for conductivity
- +/-10 mV for ORP
- +/-10% for turbidity, and
- +/-10% for DO

Temperature should be monitored even though it is not considered for stabilization.

9.) If parameters do not stabilize within three well volumes or four hours of the commencement of purging, whichever comes first, even if flow rates have been minimized, samples will be collected and a notation will be made on the sampling form.

10.) Water samples cannot pass through the in-line parameter flow cell. If there is no sample port "upstream" of the flow cell, remove the flow cell and associated plumbing before sampling.

11.) Collect the required groundwater samples. When sampling, make sure the sampler maintains the same flow rate sustained during the purging process. Label and store the samples on ice in an ice chest.

12.) Turn off pump and remove the non-dedicated equipment, pump power supply and controls, if necessary.

13.) Secure well cap and lock the well box.

14.) Decontaminate non-dedicated equipment in accordance with Attachment 6.

15.) Remove equipment, supplies, and wastes from the well site. At all times during purging, sampling, and clean-up, care must be taken to prevent accidental spillage of purged groundwater.

16.) Complete field record as necessary and in accordance with the requirements of this Work Instruction, the Work Plan and the QAPP.

6. HEALTH AND SAFETY

Low-flow purging techniques with bladder pumps involve the use of compressed gases supplied either by a compressor or by a compressed gas cylinder. Compressed gas cylinders present special hazards due to the low temperature of the gas under high pressure and the potential for sudden uncontrolled release of the compressed gas.

Care will be taken when handling and transporting compressed gases. When transporting compressed gas cylinders in a vehicle, the cylinders will be adequately secured to prevent shifting, and regulators should be removed and valve caps secured before moving.

If the sampling crew is utilizing a gas-powered air-compressor, note the fire hazards associated with gas powered equipment. When operating the air compressor, make sure the compressor is placed downwind from the location where the samples will be collected and make sure the compressor is not located in close proximity to dry brush or grass. When refueling gas-powered equipment, use the proper PPE for personal protection and to eliminate the chance of cross contamination. Never refuel the compressor while it is still hot.

7. QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance/quality control (QA/QC) procedures apply:

7.1. Pertinent data will be recorded.

7.2. Low-flow purge and parameter measurement equipment will be operated in accordance with operating instructions as supplied by the manufacturer.

Attachment 3

Equipment Calibration

1. PURPOSE AND SCOPE

The purpose of this work instruction is for maintaining the accuracy of the instruments and measuring equipment used for conducting field tests and analyses. The instruments and equipment will be calibrated prior to each use or according to a periodic schedule.

This procedure is applicable to instruments and equipment used during sampling activities at the LACBWR site. A list of field instruments (make, model, serial number) used during environmental sampling activities will be maintained. This equipment includes, but is not limited to, water-level indicators and meters to measure temperature, specific conductance, pH, dissolved oxygen, oxidation-reduction potential (ORP), and turbidity.

In general, a calibration verification of field instruments will be performed daily, prior to initial use in the field. Additional calibration may be required if signs of instrument malfunction or questionable readings are observed.

2. TERMS AND DFINITIONS

Buffer solution: A solution in which the pH is resistant to small additions of either a strong base or strong acid.

Multi-parameter Instrument with Flow-through Cell: A multi-parameter instrument with a flow cell through which purge water passes and is monitored continuously for groundwater quality parameters such as pH, specific conductance, temperature, dissolved oxygen, ORP, and turbidity.

Standard solution: A solution containing a precisely known concentration of a substance.

3. RESPONSIBILITIES

Field Personnel - Performance of field activities as detailed in this procedure.

Project Manager - Assure field activities comply with this procedure.

Safety Manager - Assure safety at the facility through activities associated with this procedure, and review of this procedure on an ongoing basis. Coordinate use of this procedure to ensure all local, state, and federal environmental regulations are met.

4. PROCEDURE

4.1. Calibration Equipment and Supplies

- Manufacturer instructions and recommendations.
- Instruments and equipment used to gather environmental data would be calibrated

as specified by manufacturer instructions and recommendations.

- Standard solutions
- pH buffer solutions
- Squirt bottles containing deionized or distilled water
- 100-foot steel tape
- Field Log Book or Calibration Sheet
- Manufacturer calibration documentation, if applicable
- Nitrile gloves
- Safety glasses

4.2. Turbidity Meter

- If the instrument is not rented, calibrate the equipment in accordance with manufactures directions at the start of the monitoring event. Rented instruments may be pre-calibrated by the vendor and supplied with the calibration documentation.
- After the initial calibration, check instrument readings at the start of each day and, if needed, re-calibrate.
- Record expiration dates of standard solutions in Field Log Book or Calibration Sheet.
- Calibrate by referring to manufacturer specifications for step-by-step instructions.
- Do not store the instrument in areas that are below 55ºF. If the instrument is to be used in cold weather, keep it in a warm area (i.e. vehicles) when not in use.
- At the end of the day, check that the instrument is still providing reasonably accurate readings by measuring the concentrations of the standard solutions.

4.3. Multi-parameter Instrument with Flow-through Cell

- Calibrate the parameter probes at the start of each day in accordance with manufactured directions.
- Record expiration dates of pH buffer solutions and standard solutions in Field Log Book.
- Calibrate by referring to manufacturer specifications for step-by-step instructions.

- Do not store the probes in areas that are below 55ºF. If the probes are to be used in cold weather, keep it in a warm area (i.e., vehicles) when not in use.

- At the end of the day, check that the probes are still providing reasonably accurate readings by measuring the concentrations of the pH buffer solutions and standard solutions.

4.4. Water-Level Indicator

- Select a well that has had the historically deepest water level.

- Prior to each event, measure depth to water in the well using a 100-foot steel tape measure and chalk (D_{ST}).

- Measure depth to water in the same well using a water-level indicator with at least a 100-foot length (D_{WLI}).

- Calculate the Calibration Correction Factor:

$$C = D_{ST} - D_{WLI}$$

- Record the Calibration Correction Factor (feet) on a Calibration Sheet or in the Field Log Book.

- Refer to Attachment 4, Manual Water-Level Measurement, for the formula to calculate groundwater elevation using the Calibration Correction Factor.

5. DOCUMENTATION AND RECORDS

All calibration information must be documented in a Field Log Book.

Information to be recorded includes:

- Date and time
- Field personnel
- Location
- Equipment make, model, and serial number
- Calibration solution lot and expiration date
- Calibration results
- Weather conditions
- Any deviations from established procedure

- Readings of buffer and standard solutions at the end of the day

If the instrument or equipment manufacturer has additional calibration documentation, it is to be included with the project files.

Attachment 4

Manual Water Level Measurement

1. INTRODUCTION

This work instruction describes the measurement of water levels in groundwater monitoring wells using an electric water-level indicator. This work instruction does not cover automated measurement of water levels with a transducer/datalogger.

Water levels will be acquired using a methodology selected to provide accurate and precise data. This data may then be used to calculate groundwater elevations, determine hydraulic gradients and construct groundwater elevation contour maps. Accuracy and precision in obtaining the measurements are critical to the usability of the data.

2. BACKGROUND

Water-level measurements should be made from a fixed reference point marked on the well. The fixed reference mark will be located on the top of the well casing or on the top of the water-level access point into the well, depending on the completion of the well at the surface. Following well installation, a survey mark is placed on the top of the well casing as a reference point for groundwater-level measurements. If a survey mark is not present, the reference point is typically established and marked on the north side of the well casing.

If possible, the use of steel protective casings or flush-mounted road boxes as a measurement reference point should be avoided due to the greater potential for damage. Field personnel shall be made aware of the measurement reference point being used in order to ensure the collection of comparable data. The well reference point elevation is surveyed to the nearest 0.01 foot for later use in calculating groundwater elevation.

Before measurements are made, water levels in monitor wells should be allowed to stabilize for a minimum of 24 hours after well construction and development. In low-yield situations, recovery of water levels to equilibrium may take longer. Measurements will be made to an accuracy of 0.01 foot. Water-level measuring equipment will be decontaminated prior to measurement activities at each well in accordance with Attachment 6, Equipment Decontamination.

To ensure reliable data, water levels should be collected within the shortest time practical. Certain situations may produce rapidly changing groundwater levels that require taking measurements as close in time as possible. Large changes in water levels within wells may be indicative of such conditions. Rapid groundwater level changes may occur due to:

- Barometric pressure changes
- Tidal fluctuations
- Navigation controls on rivers

- Rainfall events
- Groundwater pumping

The time of data collection at each station should be accurately recorded on Attachment 1, Groundwater Monitoring Report. Personnel collecting water-level data shall record if the above conditions are known or suspected to be occurring during the groundwater-level collection period.

In conjunction with groundwater-level measurements, surface water elevations (e.g., ponds, lakes, rivers, and lagoons) may be monitored as well.

3. EQUIPMENT

An electric water-level indicator (i.e., sounder) consists of a battery-operated, non-stretch, electric water-level probe with permanent markings. Water level indicators will be operated and maintained pursuant to the manufacturers' instructions.

The calibrated cable will be checked against a surveyor's steel tape prior to field activities. The difference between the electric water-level indicator calibrated cable and the surveyor's steel tape (the Calibration Correction Factor) will be used to calculate the water- level elevation as indicated in Section 5 of this Work Instruction.

A new cable will be installed if the water-level indicator cable becomes difficult to read. Other field equipment may include:

- Steel survey tape for calibration
- Pocket tape
- Paper towels and trash bags
- Decontamination supplies, if applicable to the project
- Groundwater Monitoring Report Form (Form 1)

4. PREPARATION/PROCEDURE

4.1. Preparation

4.1.1 Review the Health and Safety Plan to determine project health and safety requirements. Determine and obtain the equipment and supplies needed. Obtain well depths and previous water-level monitoring data, if available.

4.1.2 Obtain site access, and necessary well keys or well wrenches.

4.1.3 Decontaminate or pre-clean equipment in accordance with Attachment 6, and ensure that it is in working order and calibrated in accordance with Attachment 3. Calibration of water sounders will be performed prior to each monitoring event.

4.1.4 Identify water-level monitoring locations on site plan prior to going into the field.

4.2. Procedures

Procedures for determining water levels are as follows:

4.2.1 Remove exterior lock and steel protective cover. Bail down or remove precipitation or surface water that may have accumulated in the well vault or the annulus between the steel protective cover and the casing, to prevent the water from draining into the well when opened.

4.2.2 Remove interior lock and cap or plug. Record the well ID, time of day (military format) and other pertinent information.

4.2.3 Turn on the electric water-level indicator and adjust the sensitivity, if necessary. Care should be taken to prevent contact of the water-level indicator with the ground prior to insertion in the well. Lower the water-level measuring device into the well until the audible or visual signals indicate that the probe has contacted the water surface.

4.2.4 Measure and record the depth to water from the marked reference point and also record a description of the reference point used for the measurement (e.g., top of four-inch PVC casing). Dates should be recorded in the following format MM/DD/YY. Times should be based on a 24-hour military type format for the given time zone (Central Standard Time or Central Daylight Time. For example, 8:45 a.m. should be recorded as 0845. The time 2:45 p.m. should be recorded as 1445.

4.2.5 If groundwater contact is not indicated by the audio signal, visual signal or meter, compare the total depth probed with the previously measured well depth. If the probed depth is at least equal to the well depth, the well is dry and this and the probed depth shall be recorded on the Groundwater Monitoring Report Form in the comments. If the probed depth is less than the well depth, remove the water- level indicator from the well and test it for proper operation by submersing the probe in water to confirm that it is functioning. If proper operation is determined, repeat the measurement. If the water-level measuring devise continues to indicate the well is “dry” at a probed depth less than the well total depth, the condition will be recorded and recommendations for evaluating maintenance or repair will be made.

4.2.6 Record the distance from the water surface (as determined by the audio signal, visual signal or meter) to the reference measuring point.

4.2.7 Two water-level readings should be collected and the results compared. If results do not agree to within 0.01 foot, additional measurements will be taken until two readings within 0.01 foot are obtained. Consistent failure of readings to agree could suggest an anomalous condition with the well or equipment is precluding a correct measurement. Such an occurrence will be noted in the Groundwater Monitoring Report Form and the proper operation of the electric water-level indicator shall be determined prior to measuring additional water levels with that equipment.

4.2.8 Remove the down-hole measurement equipment; replace well caps, plugs, locks, and protective steel cover.

4.2.9 Record physical changes, such as evidence of tampering with the well or cover, vandalism, erosion or cracks in protective concrete pad.

5. CALCULATIONS

To calculate groundwater elevation above mean sea level when using a water-level indicator, use the following equation:

$$\boldsymbol{E_W = E - D + C}$$

Where:

E_W = Elevation of water above mean sea level (feet) or local datum

E = Elevation above sea level or local datum at point of measurement (feet)

D = Depth to water (feet)

C = Calibration correction factor (feet) = D_{ST} - D_{WLI}

Where:

D_{ST} = Depth to water measured by steel tape (feet)

D_{WLI} = Depth to water measured by water-level indicator (feet)

Form 1

	GROUNDWATER MONITORING REPORT	WELL NUMBER Page of

PROJECT _____ FILE NO. _____
LOCATION _____ FIELD REP. _____
_____ _____
CONTRACTOR _____ DATE
ELEVATION OF REFERENCE POINT, E (FEET)_____ REFERENCE POINT Ground Su [redacted] PVC [redacted] the r [redacted]
CALIBRATION CORRECTION FACTOR, C (FEET): _____

Date	Time	Depth of Water, D (ft)	Previous Depth of Water (ft)	Groundwater Elevation, Ew = E - D + C	Remarks	Well Depth (ft)

Attachment 5

1. SCOPE AND APPLICATION

The purpose of this work instruction is to provide guidance and direction for sample handling, shipping of samples from the field to the laboratory, and documentation of sample shipment using chain-of-custody protocols.

Sample handling and shipping (also known as sample management) is the continuous care given to each sample from the point of collection to receipt at the analytical laboratory.
Good sample management is intended to result in samples that are properly recorded, properly labeled, and not lost, broken, or exposed to conditions that affect the sample's integrity.

The sample submissions will be accompanied with a Chain-of-Custody document to record sample collection and submission.

2. EQUIPMENT

- Groundwater sampling records (Form 2)
- Chain-of-Custody forms (example form provided in Form 3)
- Custody seals
- Water-proof re-sealable bags
- Indelible markers, preferably fine-point
- Nitrile gloves
- Laboratory-supplied, pre-preserved sample containers and coolers
- Sample labels
- Bubble wrap, packing material, and packing tape
- Shipping forms and labels
- Material safety data sheets (MSDS) for preservatives

3. PROCEDURES

3.1. Preparation

Prior to entering the field area where sampling is to be conducted the sampler should ensure that materials necessary to complete the sampling are available.

When sampling in extremely cold weather, proper protection of water samples, equipment rinse blanks, and field blanks from freezing will be considered.

Personnel performing groundwater-sampling tasks will check the sample preparation and preservation requirements presented in the Quality Assurance Project Plan.

The sampling personnel will also confirm before the sample event the amount of bottle filling required for the respective sample containers.

3.2. Procedures

Samples will be properly labeled as soon as practical after collection.

3.2.1 Field Custody Procedures

Field personnel will be required to keep written records of field activities on applicable preprinted field forms or in a bound field notebook. These records will be written legibly in ink and will contain pertinent field data and observations. Entry errors or changes will be crossed out with a single line, dated and initialed by the person making the correction.

The Project Manager will periodically review field forms and notebooks. Each logbook will include the field team member's name, project name, project start date, project end date, and unique logbook number.

3.2.2 Field Procedures

The following field procedures will be followed for sample collection:

1.) Upon collection, samples are placed in the proper containers. The sample container, preservation methods, shipping, and packaging requirements are presented in Table 1-1 of LC-RP-PR-057 "Groundwater Sampling."

2.) Samples will be assigned a unique sample number as described in Section 3.2.4 below and will be affixed to a sample label. Information on the labels will be completed with a ballpoint pen or indelible marker.

3.) Samples will be preserved by field personnel in order to minimize loss of the constituent(s) of interest due to physical, chemical or biological mechanisms.

4.) Appropriate volumes will be collected to ensure that the requested detection limits can be successfully achieved and that the required Quality Control (QC) Sample Analyses can be completed.

3.2.3 Quality Control Samples

The following QC samples should be collected:

1.) One field duplicate per 20 samples will be collected and analyzed for each target analyte.

2.) One field equipment rinse blank will be collected for each type of field equipment used for the sampling effort. If disposable sampling equipment is used, equipment rinse samples may not be collected. Equipment rinse blanks consist of deionized or distilled water that has been routed through decontaminated sampling equipment and collected into the appropriate containers. Field equipment rinse blanks will be analyzed for each target analyte.

3.2.4 Sample Labels/Sample Identification The samples will be labeled with:

1.) A unique sample name

2.) Grab or composite sample

3.) Date and time

4.) Analyses to be performed

5.) Preservative (no preservative indicated as “none”)

6.) Analytical laboratory

7.) File number and project

8.) Comments, if any

9.) Company name

10.) Sampler's initials

Labels should be secured to the bottle and should be written in indelible ink. Note that the data identified for the sample label are the minimum required.

The unique sample identification number may follow the format recommended below, or a specific sample protocol for labeling may be determined prior to sampling. Recommended sample names will include the following:

Groundwater samples:

- Well identifier
- Dash
- If applicable, "D" for field duplicate samples
- Dash
- Date, "*mmddyy*"

Equipment rinse blank samples:

- "Equipment-rinse"
- Dash
- Date, "*mmddyy*"

The following table provides sample name examples.

Type of Sample	**Well ID**	**Duplicate Sample**	**Sample Date**	**Sample Name**
Primary sample	MW-201A-		042313	MW-201A-042313
Duplicate sample	MW-201A-	D-	042313	MW-201A-D-042313
Equipment rinse blank	Equipment-rinse-		042313	Equipment-rinse-042313

Duplicate samples will follow the same naming convention with a unique sample number (i.e., MW-201A-D-mmddyy) but blind duplicates are not needed. Notes will also be kept in the field logbook and/or sampling record to identify which samples are primary and field duplicate pairs.

3.2.5 Packaging

Whenever possible, sample container preparation and packing for shipment should be completed in a well-organized and clean area, free of potential cross- contaminants.

Sample containers should be prepared for shipment as follows:

1.) Don nitrile gloves.

2.) Containers should be wiped clean of debris and water using paper towels.

3.) If the container size and number of containers allow, the sample containers collected from an individual well for an individual laboratory will be placed into one cooler.

4.) Tighten the bottle caps to prevent leakage.

The following packing guidelines should be followed:

1.) Line the bottom of the cooler with packing material. Line the cooler with a plastic bag to prevent leakage and tie shut around samples.

2.) Do not bulk pack. Each container will be individually padded and will stand upright in the cooler.

3.) One-liter or larger glass containers require much more space between containers.

4.) Glass containers will be individually wrapped in bubble wrap and sealed.

5.) Enclose the Chain-of-Custody form in a plastic re-sealable bag and attach to the inside top of the cooler.

6.) Place custody seals (two, minimum) on each cooler if the cooler is shipped by means other than laboratory supplied courier. Coolers with hinged lids should have both seals placed on the opening edge of the lid. Coolers with "free" lids should have seals placed on opposite diagonal corners of the lid. Place clear tape over custody seals.

7.) Ensure that the stickers, markings and prior address labels have been removed from coolers being used that previously contained such materials.

3.2.6 Chain-of-Custody Records

Chain-of-Custody forms will be completed for the samples collected. The form documents the transfer of sample containers. An example Chain-of-Custody is attached as Form 3.

The Chain-of-Custody record, completed at the time of sampling, will contain, but not be limited to:

- Sample name (corresponding to the sample ID on the sample labels)
- Project or file number
- Project/client name and location
- Sampler signature(s)
- Date/time of sample collection
- Type of samples (composite or grab; soil or water matrix)
- Analytical requirements
- Number and type of containers
- Remarks (e.g., “analyze HTDs only if tritium detected”, “analyze MS/MSD”, etc.)
- Date and time samples were relinquished
- Date and time samples were received

Each sample cooler being shipped to the laboratory will contain an original Chain-of-Custody form. The sampler will make and retain a copy. The original Chain-of-Custody form will be enclosed in a waterproof envelope taped inside to the inside of the lid of the cooler containing the samples. The cooler will then be sealed for shipment. The laboratory, upon receiving the samples, will complete the original Chain-of-Custody form and prepare a copy. The laboratory will retain the copy for their records. The original Chain-of-Custody form will be returned with the data deliverables package.

The following list provides guidance for the completion and handling of Chain- of-Custody forms.

1.) Custody forms used should be standard forms or those supplied by the analytical laboratory. Do not use custody forms from other labs, even if the heading is blocked out.

2.) Custody forms will be completed in indelible ink only.

3.) Custody forms will be completed neatly using printed text.

4.) Do not use "Ditto" or quotation marks to indicate repetitive information in columnar entries. If repetitive entries will be made in the same column, place a continuous vertical arrow between the first entry and the next different entry.

5.) If necessary, place additional instructions directly onto the custody form. Do not enclose separate loose instructions.

6.) When shipping samples via an overnight express service (i.e., Federal Express), the air-bill number for the shipment should be noted on the custody form.

7.) Include a contact name and phone number on the custody form in case there is a problem with the shipment.

8.) Before using an acronym on a custody form, define clearly the full interpretation of your designation [i.e., tritium (H-3)].

3.2.7 Shipment

The samples will be delivered to the laboratory by the samplers, transported by a laboratory-supplied courier or shipped to the laboratory using an overnight carrier. Prior to the start of the field sampling, the laboratory or shipper should be contacted to determine if pickup can be made at the field site location. If pickup at the field site can be made, the "no-later-than" time for having the shipment ready will be determined.

If pickup is unavailable at the site, the nearest pickup or drop-off location should be determined. Again, the "no-later-than" time for each location should be determined.

Sufficient time will be allowed not only for packaging but also for delivery of samples.

Sample shipments will not be left at unsecured drop locations (i.e., if the cooler will not fit in a remote drop box, do not leave the cooler unattended next to the drop box).

Some overnight carriers do not provide "overnight" shipment to/from some locations. Do not assume. Call the carrier in advance before the start of the fieldwork.

4. HEALTH AND SAFETY

In some instances, sample containers may contain preservatives that can cause bodily injury if they come in contact with eyes or skin, or are ingested. Care should be taken to wear the appropriate personal protective equipment (PPE) during sample handling, in conformance with the Health and Safety Plan and Safety Data Sheets (SDS).

5. QUALITY ASSURANCE/QUALITY CONTROL

The following general quality assurance/quality control (QA/QC) procedures apply:

- The data will be documented in the record on Form 2, Low-Flow Groundwater Sampling Record.
- Any corrections to entries on the chain of custody will have a single line through the information being corrected along with the correct information and the person's initials and date.
- Dates should be recorded in the format MM/DD/YY. Times should be based on a 24-hour military type format for the given time zone (Central Standard Time or Central Daylight Time). For example, 8:45 a.m. should be recorded as 0845. The time 2:45 p.m. should be recorded as 1445.

6. ATTACHMENTS

6.1 Form 2, Low-Flow Groundwater Sampling Record

6.2. Form 3, Chain of Custody and Analytical Request

Form 2

LOW-FLOW GROUNDWATER SAMPLING RECORD	**Page of**

PROJECT		**FILE NO.**	
LOCATION		**FIELD REP**	
SAMPLER		**DATE**	

GROUNDWATER SAMPLING INFORMATION		
Well ID		
Depth Of Well (ft.) per Log		
Reference Mark		
Depth to Water from Reference Mark (ft.)		
Time		
Depth to Product (ft.)		
Field Measured Depth Of Well (ft.)		
Inside Diameter (in.)		
Standing Water Depth (ft.)		
Volume Of Water In Well (gallons/liters)		
Purging Device		
Volume of Bailer/Pump Capacity		
Cleaning Procedure		
Bails Removed/ Volume Removed		
Time Purging Started		
Time Purging Stopped		
Instrument Used to Monitor Field Parameters		
Sampling Device		
Cleaning Procedure		
Color		
Odor		

Form 2

LOW-FLOW GROUNDWATER SAMPLING RECORD	**Page of**

PROJECT		**FILE NO.**	
LOCATION		**FIELD REP**	
SAMPLER		**DATE**	

GROUNDWATER SAMPLING INFORMATION

TIME SAMPLES TAKEN	Tritium		
	Gamma		
	Cobalt-60		
	Strontium-90		
	Cesium-137		
	HTDs		

PARAMETERS	Time												
	Temp. C												
	Conductivity (umhos/cm)												
	Dissolved Oxygen (mg/L)												
	pH												
	ORP (mV)												
	Drawdown Ft												
	Volume purged/Gals												
	Turbidity (NTU)												

Remarks: (ie: field filtrations, persons communicated with at site, etc.)

Form 3 - Chain of Custody and Analytical Request EXAMPLE

Page:_____of _____ Project #: Quote #: _____ COC Number: PO Number:	**Work Order Number:**	Laboratory Address: Phone: Fax:

Client Name:	Phone #:					**Sample Analysis Requested** (5) (Fill in the number of containers for each test)														
Project/Site Name:	Fax #:					**Should this sample be considered:**		**Total number of containers**												<-- Preservative Type (6)
Address:																				**Comments** Note: extra sample is required for sample specific QC
Collected by:	Send Results To:					**Radioactive**	**TSCA Regulated**													
Sample ID ** For composites - indicate start and stop date/time*	*Date Collected **(mm-dd-yy)**	*Time Collected **(Military) (hhmm)**	QC Code (2)	Field Filtered (3)	Sample Matrix (4)															

Form 3 - Chain of Custody and Analytical Request EXAMPLE

									1 L poly	1 L poly									

TAT Requested: Normal: 10 Rush:_____Specify: _____(Subject to Surcharge)	Fax Results: Yes/ **No (see project setup)**	Circle Deliverable: C of A / QC Summary / Level 1 / Level 2 / Level 3 / **Level 5**

Remarks: *Are there any known hazards applicable to these samples? If so, please list the hazards*	Sample Collection Time Zone Eastern Pacific Central Other **Mountain X**

Chain of Custody Signatures		**Sample Shipping and Delivery Details**	
Relinquished By (Signed) Date Time	Received by (signed) Date Time		
1	1	Method of Shipment: FedEx	Date Shipped:
2	2	Airbill #:	
3	3	Airbill #:	

1.) Chain of Custody Number=Client Determined
2.) QC Codes: N=Normal Sample, TB=Trip Blank, FD=Field Duplicate, EB: Equipment Blank, MS=Matrix Spike Sample, MSD: Matrix Spike Duplicate Sample, G=Grab, C=Composite
3.) Field Filtered: For liquid matrices, indicate with a Y for yes the sample was field filtered or N for sample was not field filtered.
4.) Matrix Codes: DW=Drinking Water, GW=Groundwater, SW=Surface Water, WW=Waste Water, W=Water, ML=Misc Liquid, SO=Soil, SD=Sediment, SL=Sludge, SS=Solid Waste, O=Oil, F= Filter, P=Wipe, U= Urine, F= Fecal, N=Nasal
5.) Sample Analysis Requested Analytical method requested (i.e. 8260B,6010B/7470A) and number of containers provided for each (i.e.8260B-3, 6010B/7470A-1).
6.) Preservative Type: HA= Hydrochloric Acid, NI= Nitric Acid, SH= Sodium Hydroxide, SA= Sulferic Acid, HX=Hexane, ST= Sodium Thiosulfate, If no preservatives added= leave field blank.

For Lab Receiving Use Only

Custody Seal Intact?

YES *NO*

Cooler Temp:

_____*C*

Attachment 6

Equipment Decontamination

1. SCOPE AND APPLICATION

The purpose of this Work Instruction is to provide a description of the methods used for preventing, minimizing, or limiting cross-contamination of samples due to inappropriate or inadequate equipment decontamination. This Work Instruction also provides general guidelines for developing decontamination procedures for sampling equipment to be used during hydrogeologic investigations. This Work Instruction does not address personnel decontamination.

2. METHOD SUMMARY

Equipment utilized for groundwater sampling at multiple locations requires decontamination prior to reuse.

The decontamination procedure may be summarized as follows:

1. Physical removal
2. Non-phosphate detergent wash
3. Tap water rinse
4. Distilled/deionized water rinse
5. Air dry

3. EQUIPMENT

The following standard materials and equipment are recommended for decontamination activities:

3.1. Decontamination Solutions

- Non-phosphate detergent
- Potable or tap water
- Distilled or deionized water

3.2. Decontamination Tools/Supplies

- Brushes
- Drop cloth/plastic sheeting

- Paper towels
- Plastic or galvanized tubs or buckets or other suitable containers
- Sprayers, squirt bottles, or pressurized sprayers (H_2O)
- Aluminum foil
- Tables, plastic sheeting, or other devices to keep equipment off of the ground

3.3. Health and Safety Equipment

- Personal protective equipment shall include safety glasses or splash shield, and appropriate gloves (as per the Health and Safety Plan).
- SDS for non-phosphate detergent

3.4. Waste Disposal

- Trash bags or containers
- Labeled drums provided by the facility-contracted waste-handler
- Containers for storage of decontamination solutions
- Container labels and permanent markers

4. REAGENTS

Water and non-phosphate detergent are utilized for decontamination purposes.

5. PROCEDURES

This Work Instruction was established to minimize the potential for contamination. The following actions may be taken to minimize contamination potential:

1. Work practices that minimize contact with potential contaminants
2. Using remote sampling techniques
3. Covering monitoring and sampling equipment with plastic, aluminum foil, or other protective material
4. Watering down dusty areas
5. Avoid laying down equipment in areas of obvious contamination
6. Use of disposable sampling equipment

5.1. Field Sampling Equipment Decontamination Procedures

Steps 1 and 2: Physical Removal and Detergent Wash

Place plastic sheeting on the ground to minimize impacts from spillage of decontamination fluids.

Fill a wash basin, a large bucket, or other suitable container with non-phosphate detergent and tap water. A brush or brushes to physically remove contamination should be dedicated to this station. The volume of water required will depend upon the amount of equipment to decontaminate and the amount of contamination. If necessary, use a brush to physically remove foreign materials from the surface of the equipment. Scrub equipment with a mild solution of non-phosphate detergent and potable or tap water using brushes.

Step 3: Potable or Tap Water Rinse

Fill a washbasin, a large bucket, or other suitable container with potable or tap water. A brush or brushes should be dedicated to this station. Use a volume of water similar to that used for Step 1. Wash soap off equipment with water by immersing the equipment in the water while brushing.

Step 4: Distilled/Deionized Water Rinse

Fill a low-pressure sprayer with distilled/deionized water. Provide a 5-gallon bucket or basin to contain the water during the rinsing process. Rinse sampling equipment with distilled/deionized water with squirt bottles, sprayers, or a low-pressure sprayer.

Step 5: Air Dry

Lay clean equipment on a clean surface to dry. Once dry, the sampling equipment may be wrapped with aluminum foil, plastic, or other protective material.

Follow these steps at the completion of decontamination:

1.) Empty non-phosphate detergent and water liquid wastes from basins and buckets to the ground, or into an appropriate waste container if directed by LaCrosseSolutions personnel.

2.) Use low-pressure sprayers to rinse basins and brushes.

3.) Empty low-pressure sprayer water to the ground or into an appropriate waste container if directed by LaCrosseSolutions (LS) personnel.

4.) Place solid waste materials generated from the decontamination area (i.e., gloves and plastic sheeting, etc.) in a labeled drum provided by the LaCrosseSolutions personnel.

5.) Complete labels for waste containers and make arrangements for disposal by the LaCrosseSolutions personnel. Consult the facility's procedures for the appropriate label for each drum generated from the decontamination process.

6. HEALTH AND SAFETY

When working with potentially hazardous materials, follow OSHA, U.S. EPA, and LaCrosseSolutions regulations and guidelines, and the Health and Safety Plan.

Decontamination can pose hazards under certain circumstances. Hazardous substances may be incompatible with decontamination materials. For example, the decontamination solution may react with contaminants to produce heat, explosion, or toxic products. In addition, vapors from decontamination solutions may pose a direct health hazard to workers by inhalation, contact, fire, or explosion.

The decontamination solutions will be determined to be acceptable before use. Decontamination materials may degrade protective clothing or equipment. If decontamination materials do pose a health hazard, measures should be taken to protect personnel or substitutions should be made to eliminate the hazard.

Material generated from decontamination activities requires proper handling, storage, and disposal. Personal Protective Equipment may be required for these activities.

Safety Data Sheets (SDS) are required for the decontamination solutions.