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Madison Kipp Corporation

Bedrock Characterization Work Plan

BRRTS No. 02-13-001569
Facility ID No. 113125320

201 Waubesa Street, Madison, Wisconsin

May 2012

ARCADIS

Bedrock Characterization Work Plan

Madison Kipp Corporation
Madison, Wisconsin

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Date:
May 22, 2012

ARCADIS

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Appendix

A Submittal Certification

1. Introduction

ARCADIS has been retained by Madison Kipp Corporation to complete bedrock characterization activities at 201 Waubesa Street in Madison, Wisconsin (Site). Environmental investigation and remediation activities have been ongoing since 1994. These historical activities have focused on the use and potential releases of tetrachloroethene (PCE). Several phases of investigation have evaluated the presence and extent of PCE in soil, groundwater, and soil vapor/indoor air.

The ultimate goal for the Site is to develop and implement a long-term remedial strategy that prevents or eliminates the potential for vapor intrusion into structures; prevents or eliminates the potential for direct contact with soil and groundwater contamination; and facilitates groundwater restoration or containment. Development of a successful remedial strategy is dependent on the assembly and testing of the conceptual site model (CSM). A CSM synthesizes all relevant data (e.g., the facility and release history, geologic and hydrogeologic conditions, nature and extent of contamination, potential receptors and transport mechanisms, etc.) to provide a technical basis for remedial decision making.

Based on existing data, a key element of the CSM is that PCE released at the Site historically has migrated over time in groundwater to reach the fractured sandstone bedrock aquifer beneath the Site to depths of up to 170 feet. In order to design and implement an effective remedy, it is necessary to gather data to understand how PCE and associated volatile organic compounds (VOCs) have migrated, specifically:

- Understand the vertical distribution of VOCs, including whether significant VOC mass is stored in the rock's matrix porosity, a factor that directly influences the feasibility and clean-up time-frames of many remedial options.

- Determine whether VOCs have migrated vertically to greater depths than have been evaluated to date.

- Understand fracture frequency, interconnectivity or lack of interconnectivity of the bedrock fractures, and how this influences VOC mass transport both laterally and vertically.

- Evaluate hydrogeologic variability in the strata beneath the Site and how it may influence VOC mass transport and recoverability under potential remedial approaches.

- Understand spatial and temporal variability in hydraulic head to better understand patterns of groundwater flow.

This report presents a work plan for conducting a bedrock characterization study at the Site. The information provided herein is based on the requirements of NR 716. A NR 712.09 submittal certification is presented in Appendix A.

2. Project Background

2.1 Site Location, Contacts, and Description

The Site is located at a street address of 201 Waubesa Street in Madison, Wisconsin. The Site is located in the southwest quarter of Section 5, Township 7 North, Range 10 East in Dane County. The location of the site is illustrated on a topographic quadrangle presented as Figure 2-1.

The following contact information is provided for the facility and environmental consultant:

Facility Representative:	Mark W. Meunier, SPHR Madison Kipp Corporation 201 Waubesa Street Madison, Wisconsin 53704 608-244-3511 (telephone) 608-770-9401 (fax) mmeunier@madison-kipp.com
Attorney Representative for Facility:	David A. Crass, Michael Best & Friedrich LLP One South Pinckney Street, Suite 700 Madison, Wisconsin 53703 608-283-2267 (telephone) 608-332-5314 (fax) dacrass@michaelbest.com
Environmental Consultant:	Jennine Trask, PE ARCADIS 126 North Jefferson Street, Suite 400 Milwaukee, Wisconsin 53202 414-276-7742 (telephone) 414-277-6203 (fax) jennine.trask@arcadis-us.com

The Site is approximately 7.5 acres in size. A 130,000-square foot building occupies much of the Site. Asphalt parking lots are located in the northeastern, southwestern and southeastern portions of the Site. The building has a 25,000-square foot second floor and a 25,000-square foot basement. Figure 2-2 depicts the layout of the Site. The Site is zoned M-1 (industrial/manufacturing). The Site is currently used as a metals casting facility.

The Site is located in the eastern portion of Madison, in a mixed use area of commercial, industrial and residential land use. The Site is bounded by a bicycle trail (Capital City Trail) to the north, Atwood Avenue to the south, and Waubesa Street to the west. Residences are located adjacent to the east and west sides of the Site, and further west (across Waubesa Street) and east (across Marquette Street). Commercial properties are located to the south (across Atwood Street). The Goodman Community Center is located to the north (across the Capital City Trail).

The Site is also located at the northeast end of the Madison isthmus, approximately 1,500 feet north of Lake Monona and approximately 6,800 feet east of Lake Mendota. The topography of the Site is relatively flat and level, with an elevation ranging from approximately 870 to 880 feet above mean sea level. The Site and surrounding area is serviced by municipal water supply and sewerage systems.

3. Regional and Local Geologic Conditions

The Madison area lies in part of Wisconsin underlain by a thick sequence of Paleozoic sedimentary rock that was deeply eroded during Pleistocene glaciations. In the vicinity of the Site, bedrock surface lies beneath approximately 35 feet unconsolidated glacial sediments. Clayton and Attig (1997) have mapped the glacial sediments in the Site vicinity as a patchwork of glacial lake sediments (e.g., stratified sand, silt and clay) and till (much denser and poorly sorted gravelly, clayey silty sand). Soil borings completed at the Site describe the unconsolidated zone as a fining-upward sequence consistent with lake sediments. The typical unconsolidated stratigraphy includes:

- A veneer of surficial fill, generally less than 5 feet thick.
- Clay or silty clay, from approximately 5 to between 10 and 15 feet below ground surface.
- Sand, from approximately 10 feet to the top of rock at approximately 35 feet. The sand is typically fine-grained and variably silty, with occasional gravel beds, particularly in the bottom half of the unit.

While the sedimentary bedrock in the Madison area is nearly flat-lying, the bedrock surface was deeply eroded by glaciers. Lakes Mendota and Monona, located to the north and south of the Site, respectively, occupy deep glacial valleys that were scoured into bedrock at least 200 feet deeper than the bedrock surface at the Site (Bradbury and others, 1999).

The Site vicinity is underlain by approximately 750 feet of Cambrian-aged sandstone, shale and dolomite. The expected stratigraphy at the Site is as follows (after Ruekert/Mielke, 2011):

Estimated Depth	Formation/ Group	Description
35-120 feet	Tunnel City Group	Poorly to moderately-well cemented fine-to-medium sandstone, often Glauconitic (containing green/blue sand-sized clay nodules).

Estimated Depth	Formation/ Group	Description
120-245 feet	Wonewoc Formation	Medium to fine-grained sandstone
245-430 feet	Eau Claire Formation	The upper part of contains significant shale and siltstone. Deeper, the unit is chiefly dolomitic sandstone.
430-750 feet	Mount Simon Formation	Well-cemented, coarse to medium-grain sandstone

The hydrostratigraphy of the area is typically divided into four units:

- **Unconsolidated Zone (Upper Unconsolidated Aquifer)**, the zone of saturated glacial sediments overlying bedrock. At the Site this zone is discontinuous. The zone of saturation is thin to absent in the southern part of the Site (e.g., the water table is at or below the rock surface), to between 10 and 15 feet thick in the north of the Site. Typically, only the sandy portion of the unconsolidated zone is saturated, while the shallow clay is above the water table.

- **Upper Paleozoic Aquifer (Upper Bedrock Aquifer)**, encompassing the Tunnel City Group and Wonewoc Formation (approximately 210 feet total thickness). The unit is not used extensively for water supply, but is moderately permeable, with a hydraulic conductivity estimated at approximately 5 feet/day (Ruekert/Mielke, 2011).

- **Eau Claire Aquitard**, defined as the thin shaley facies found near the top of the Eau Claire Formation. Where present, this unit functions as an aquitard separating the Upper Paleozoic Aquifer from the Mt. Simon Aquifer below. The Eau Claire is present in the immediate Site vicinity, but is eroded in the glacial bedrock valleys beneath Lakes Monona and Mendota.

- **Mount Simon Aquifer (Lower Bedrock Aquifer)**, defined as the Mount Simon and Eau Claire Formations, starting below the Eau Claire Aquitard (approximately 500 feet total thickness). The Mt. Simon Aquifer is the chief water-supply aquifer in the region, and is the unit pumped by the city of Madison water-supply wells. The mean hydraulic conductivity of the aquifer is estimated at approximately 10 feet per day (Bradbury and others, 1999).

Though the sandstone aquifers have moderate porosity (typically 10 to 20 percent), the groundwater flow occurs predominantly in fractures such as bedding planes and joints. The porous matrix of the sandstone creates a secondary permeability, and provides a significant volume of storage.

The water table at the Site generally ranges between 15 and 35 feet below ground surface. Previous reports have shown shallow groundwater flow trending to the east and south; flow in the bedrock appeared to trend south, but has shown more variability than in the upper zones. Based on the groundwater levels measured from nested monitoring wells, the vertical gradient is downwards at the Site. Recently installed wells and additional groundwater level monitoring are anticipated to clarify the patterns of groundwater flow.

4. Bedrock Characterization Work Plan

The following sections present a description of the work to be completed during the bedrock characterization. The contents of this section were prepared in accordance with NR 716.09.

- Update the Health and Safety Plan (HSP) for the field activities and to clear subsurface utilities.

- Advance two borings, including one at the MW-3 well nest and one at the MW-5 well nest. A combination of hollow stem auger and mud rotary drilling methods will be used to characterize subsurface geologic and hydrogeologic conditions and evaluate the contaminant mass in the rock matrix and fracture surfaces. The borings will be advanced to approximately 250 feet. Split spoon samples will be collected to log the unconsolidated soils and HQ-3 wireline rock coring will be conducted to log the bedrock.

- Complete Characterization of Rock Environments utilizing a Discrete Fracture Network approach (CORE$^{\text{DFN™}}$) to evaluate the VOC contaminant mass in the rock matrix and fracture surfaces at depths up to 250 feet.

- Complete down-hole geophysical logging to identify and characterize fractures and water-bearing zones at depths up to 250 feet.

- Install and develop a piezometer in each of the borings for monitoring groundwater quality.

- Conduct hydraulic conductivity testing (i.e., slug tests) at up to 19 locations.

- Collect one round of groundwater levels from all Site wells.

- Collect groundwater samples from the two new bedrock wells for laboratory analysis of VOCs using low-flow sampling techniques.

- Survey the locations and ground elevations of all Site wells.

- Collect and dispose of investigative-derived waste (soil, rock, and water).

- Prepare a brief data summary. Complete details of the investigation activities will be provided in the Site Investigation Report as part of the Comprehensive Site Investigation Work Plan under NR700 Wis. adm. code.

4.1 Health and Safety

Prior to beginning the additional activities, the HSP will be updated to address the planned field activities. Utility marking arrangements will be made through Digger's Hotline (the State of Wisconsin Public Utility clearance service), a ground penetrating radar survey, a private utility locator, and discussions with property owners. Prior to beginning work each day, a "tailgate" health and safety briefing will be held to discuss the activities and identify ways to ensure the health and safety of Site workers. If conditions are encountered during Site investigation activities that differ from those outlined in the HSP, the Site activities will be revaluated to determine the appropriate actions that will ensure the health and well-being of the workers.

4.2 Drilling and Sampling Plan

Two borings will be advanced using hollow stem auger and mud rotary drilling methods, including one boring at the MW-3 well nest and one boring at the MW-5 well nest. The proposed locations are presented on Figure 2-2. The following is a brief list of the proposed activities at the MW-3 and MW-5 well nests.

- Continuous soil sampling of unconsolidated soils from ground surface to the top of bedrock using a hollow stem auger rig and split spoon sampling. Set 6-inch temporary casing approximately 2 feet into competent bedrock.

- Continuous rock coring from approximately 2 feet into the bedrock up to approximately 180 feet.

- Complete CORE^{DFN}™ and geophysical logging up to approximately 180 feet.

- Ream 4-inch borehole and set temporary casing up to approximately 180 feet to limit vertical migration and mixing of groundwater in the borehole.

- Continuous rock core the bedrock from approximately 180 feet to 250 feet.

- Complete CORE^{DFN}™ and geophysical logging from approximately 180 to 250 feet.

- Remove 4-inch temporary casing and ream 6-inch borehole.

- Set a vertical delineation piezometer based on analytical data from CORE^{DFN}™ and the geophysical logs.

4.2.1 Mud Rotary Drilling Methodology

Mud rotary drilling methods were previously used to install wells at the Site. Mud rotary drilling is accomplished by a hydraulically powered top head drive with a bit attached to the bottom of the pipe that rotates a drill pipe. Rock is broken up by the rotating bit as it is lowered into the formation. Mud and drilling fluid is pumped through the rotating drill pipe through holes in the drill bit. The drilling fluid then swirls at the bottom of the hole, picking up all the rock chips that have been broken by the drill bit and transports them to ground surface through the space between the drill pipe and borehole. The rock chips are deposited at the surface and the drilling fluids are recirculated back down to the bottom of the borehole through the drill bit.

Precautions to limit drag-down of contaminants are necessary when advancing boreholes through a known contaminated aquifer. The boreholes at the MW-3 and MW-5 well nests will be advanced up to approximately 180 feet and borehole testing as described above will be completed. Temporary casing will be installed before advancing to a depth up to approximately 250 feet. The depth of approximately 180 feet was selected based on the current Site well screen depths and the presence of impacts at this depth. The temporary casing seals the formation, thus minimizing/preventing vertical migration, and limits mixing of contaminated groundwater in the borehole. Additionally, as the borehole is advanced deeper, drilling fluid is not recirculated through the contaminated groundwater.

4.2.2 Soil and Rock Core Sampling

The borings will be advanced using hollow stem auger drilling in the unconsolidated soils and mud rotary drilling in the bedrock. Below is a summary of the soil and rock sampling methodology.

Split spoon soil samples will be collected from each of the borings at 2-foot vertical intervals to provide a continuous profile of the subsurface materials at each boring location to the top of competent bedrock. The soil samples will be screened with a flame ionization detector (FID). Once bedrock is encountered, a 6-inch temporary casing will be set approximately 2 feet into competent bedrock.

HQ-3 wireline rock coring techniques will be used to collect rock cores from each boring to provide a continuous profile of the bedrock. The rock will be sampled and characteristics logged at depths up to approximately 250 feet at each boring location. A HQ-3 rock core drill string consisting of a sample core barrel advanced inside a larger outer drive casing through the bedrock. This method allows for the retrieval of the inner drill pipe and sample core barrel while the outer casing remains in place to maintain the outer borehole.

Soil boring logs (Wisconsin Department of Natural Resources [WDNR] Form 4400-122) will be prepared for each well boring in accordance with WDNR requirements and will present both the classification and geologic properties of the materials encountered.

4.2.3 Characterization of Rock Environments – Discrete Fracture Network Approach

Characterization of Rock Environments utilizing a discrete fracture network approach (CORE^{DFN}) will also be completed at the two proposed boring locations. CORE^{DFN} is an approach to investigating contamination in fractured, porous bedrock aquifers. Contaminant distributions in chlorinated solvent plumes in fractured sedimentary rock have strong spatial variability due to heterogeneity in source zone contaminant mass distributions, the fracture network, rock matrix characteristics and temporal variability in groundwater flow. These dual porosity rock environments, such as found in the sandstone bedrock at the Site, has the potential for the majority of the contaminant mass to reside in the low permeability rock matrix, with down-gradient transport occurring in fractures. Since the contaminant concentrations in the fractures and the matrix are typically not in equilibrium, CORE^{DFN} technology will be utilized to evaluate concentrations in each.

CORE^{DFN} technology involves specialized techniques for sampling, extracting and analyzing contaminants in the bedrock at discrete locations. Approximately one rock sample will be collected per linear foot of cored rock and submitted for laboratory analysis of select VOCs using a Gas Chromatograph-Electron Capture Detector method developed at the University of Waterloo. The following analytes will be reported in the VOC scan: carbon tetrachloride, chloroform, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, methylene chloride, 1,1,1-trichloroethane, PCE, and trichloroethene. Nitrile gloves will be worn by the sampling personnel and discarded between each sampling interval and following any activity that may produce cross-contamination. This sampling frequency will be based on rock quality description, location and spacial distribution of fractures, and rock characterization. The rock VOC concentrations will be utilized to select the location of the piezometer well screen for the vertical delineation of groundwater quality.

4.2.4 Down-Hole Geophysical Logging

Down-hole geophysical logging will be conducted at the two proposed boring locations to depths up to approximately 250 feet. Multiple geophysical logging tools will be utilized including gamma, fluid temperature, fluid resistivity, caliper, heat plus flowmeter, and high resolution acoustic borehole televiewer. The purpose of geophysical logging is to determine the locations and thickness of fractures and identify the less and more permeable water-bearing zones where contaminant flow exists.

Below is a summary of each tool's purpose.

- Gamma - All rock and soils emit gamma radiation in varying amounts. Gamma logging records the amount of natural gamma radiation emitted from the rock to under the location of lower permeable zones.

- Fluid Temperature - Fluid temperature tool records water temperature. Since water flowing into or out of the well at a water-bearing zone, like a fracture, disturbs the natural conductivity and geothermal gradient of the water column, the locations of water-bearing zones and the sense of water movement can identify key fractures where contaminant flow exists.

- Fluid Resistivity - Fluid resistivity records electric conductivity of groundwater, and can identify and discriminate between different water-bearing zones if the total dissolved solids or ionic contact of the water in the two zones are different.

- Caliper - Caliper records borehole diameter sensitive to location and thickness of fractured zones where plucking of broken rock by the drill bit generally enlarges the hole beyond the nominal bit diameter.

- Heat Pulse Flowmeter - The heat pulse flowmeter will be conducted at static and dynamic conditions. The heat pulse flowmeter is used to record the vertical flow rate of water in the borehole.

- Acoustic Televiewer - The acoustic televiewer provides an accurately scaled image of the borehole walls, allowing for identification of fractures, solution openings, and an estimation of fracture orientation and thickness using sonar pluses.

4.3 Piezometer Installation and Development

The CORE$^{DFN™}$ analytical results will be used, in combination with borehole geophysics, to select locations for well installation for vertical groundwater delineation. The CORE$^{DFN™}$ analytical results and geophysical logs will ultimately aid in determining where the contaminant mass resides in the bedrock and where the predominant groundwater flow in the fractures is, which will lead to developing a groundwater remedial strategy to address the vertical extent of impacts.

Piezometers will be installed in the borings. The piezometers will be constructed in accordance with NR 141 Wis. adm. code. A 5-foot, 0.010-inch, stainless steel screen and Schedule 80 polyvinyl chloride casing will be used. However, a 10-foot stainless steel screen may be installed if multiple fractures are identified. A filter pack of coarse sand will rise 2 feet above the screen followed by 2 feet of fine sand topped with a minimum of a 5-foot bentonite seal. The remaining annular space will be filled with cement bentonite slurry. The wells will be completed at the surface with a flushmount well compartment set in concrete. Well construction forms (WDNR Form 4400-113A) will be completed for each of the new wells.

The goal of well development is to produce water free of sediment and all drill cuttings and drilling fluids. The new wells will be developed in accordance with NR 141 Wis. adm. Code. After a minimum waiting period of 12 hours after installation, the new wells will be developed using a surge and purge method or air lifting techniques. Well development forms (WDNR Form 4400-113B) will be completed for each of the new wells.

4.4 Hydraulic Conductivity Testing

In-situ hydraulic conductivity testing will be completed at up to 19 well locations using traditional slug testing or baildown testing techniques where the water table intersects the well screens and a pneumatic test method where the well screens are submerged. The purpose of hydraulic conductivity testing is to measure the ability of the rock to transmit water when subjected to a change in hydraulic gradient. The testing will also provide a means to evaluate whether existing wells are screened in low or high transmissivity portions of the aquifer (e.g., whether bedrock wells screen fractured or unfractured intervals of rock). These data help to interpret results from those wells both in terms of plume delineation and future remedial performance.

A pressure transducer will be set approximately 1 foot off the bottom of the wells where slug testing or baildown testing will be performed and approximately 20 feet below the water table where pneumatic testing will be performed. Slug testing involves inserting a solid polyvinyl chloride bar into the water column, the water level rises, and the recovery data is recorded. Once the slug is removed, the water column decreases, and this recovery data is recorded. Baildown testing involved rapid removal of water from the well, and recording recovery data. The pneumatic method involves ambient air being pumped into the sealed casing at the surface, displacing the casing water into the formation through the well screen. The well casing is subsequently depressurized, and the water level recovery data is recorded. The tests will be repeated up to three times on each well to confirm repeatability of the data.

4.5 Water Levels

Following a minimum of 24 hours after well development, one round of groundwater levels will be collected from all Site wells including the two new wells. The initial groundwater level and total depth at each well will be measured from a consistent point on each well (north side, top of casing) utilizing a clean water-level measuring tape. Groundwater levels will be measured to an accuracy of 0.01 feet.

4.6 Groundwater Sampling

Following the collection of one round of groundwater levels from all Site wells (including the two proposed wells); groundwater samples will be collected using low-flow sampling techniques from the two new wells. Low-flow sampling techniques are used to collect representative water samples in the formation adjacent to the well screen while 1) reducing water turbulence which may unnecessarily volatilize contaminants; 2) reduce turbidity levels that may bias analytical results high, and 3) reduce the volume of water requiring management.

Low-flow sampling consists of purging the groundwater at a low-flow rate (less than 150 milliliters per minute) until a set of field parameters (dissolved oxygen, temperature, pH, conductivity, oxidation-reduction potential, and turbidity) stabilize within 10 percent for three consecutive readings. Purging will be completed using a peristaltic pump or a stainless steel bladder pump with dedicated polyethylene tubing, depending on the depth to water. Field parameters will be measured using a calibrated YSI multi-parameter meter. Once the field parameters stabilized, the water sample will be collected. Groundwater samples will be submitted for laboratory analysis of VOCs using Method 8260B.

Nitrile gloves will be worn by the sampling personnel and discarded between each sampling location and following any activity that may produce cross-contamination. The samples will be placed into clean pre-preserved laboratory-supplied glass sample containers provided by the laboratory. The VOC samples will be collected without headspace. Samples will be labeled and placed into a cooler with ice pending shipment to the laboratory. Standard chain-of-custody procedures will be followed throughout sample collection, storage, and shipment.

4.7 Surveying

A Wisconsin-licensed surveyor will locate the horizontal location to Wisconsin state plane coordinates and vertical elevation for each boring location. Ground elevations will be surveyed to an accuracy of 0.01 feet.

4.8 Investigative-Derived Waste

Soil cuttings generated during the soil boring advancement will be containerized in appropriate roll-off containers. Water generated during soil boring advancement, sampling activities, and wash water generated during the cleaning of down-hole equipment will be containerized in polyethylene storage tanks. Arrangements will be made with a licensed disposal facility for the transportation and disposal of the wastes.

4.9 Reporting

This bedrock characterization study was designed to build the CSM that will be used to develop a successful groundwater remedial strategy. Three key components to developing a successful groundwater remedial strategy include 1) determining where the mass resides (rock matrix or fractures) at the source areas (MW-3 and MW-5 are assumed as predominant source areas); 2) understanding the network of fractures; and 3) understanding where the contaminant mass is being transported by groundwater flow. As part of this scope of work, a brief data summary will be provided; however, the results of this study will be presented in a Site Investigation Report prepared following implementation of the Comprehensive Site Investigation Work Plan under NR700 Wis. Adm. Code along with complete documentation of the work described herein.

5. Proposed Schedule

A final schedule for the commencement of the investigation activities presented in this Work Plan will be determined upon approval of this Work Plan by the WDNR, availability of the drilling company, and weather conditions. This work will also be phased with the work contemplated by the Comprehensive Site Investigation Work Plan which will be submitted on or before May 31, 2012 so as to maximize efficiencies and avoid duplicate mobilizations subject to those considerations.

Day 1-2	Mobilization, equipment/supply staging.
Days 2-10	Soil sampling to the top of bedrock at MW-3 and MW-5 well nests, HQ-3 wireline rock coring and CORE^{DFN} sampling to approximately 180 feet at MW-3 and MW-5 well nests.
Days 11-14	Geophysical logging.
Days 15-24	Set temporary casing in boreholes to approximately 180 feet, HQ-3 wireline rock coring and CORE^{DFN} sampling from approximately 180 to 250 feet at MW-3 and MW-5 wells nests.
Days 24-27	Geophysical logging.
Days 28-34	Set wells in boreholes at MW-3 and MW-5 well nests, well development, site cleanup, demobilization.
Days 34-40	Hydraulic conductivity testing, water levels, and groundwater sampling.

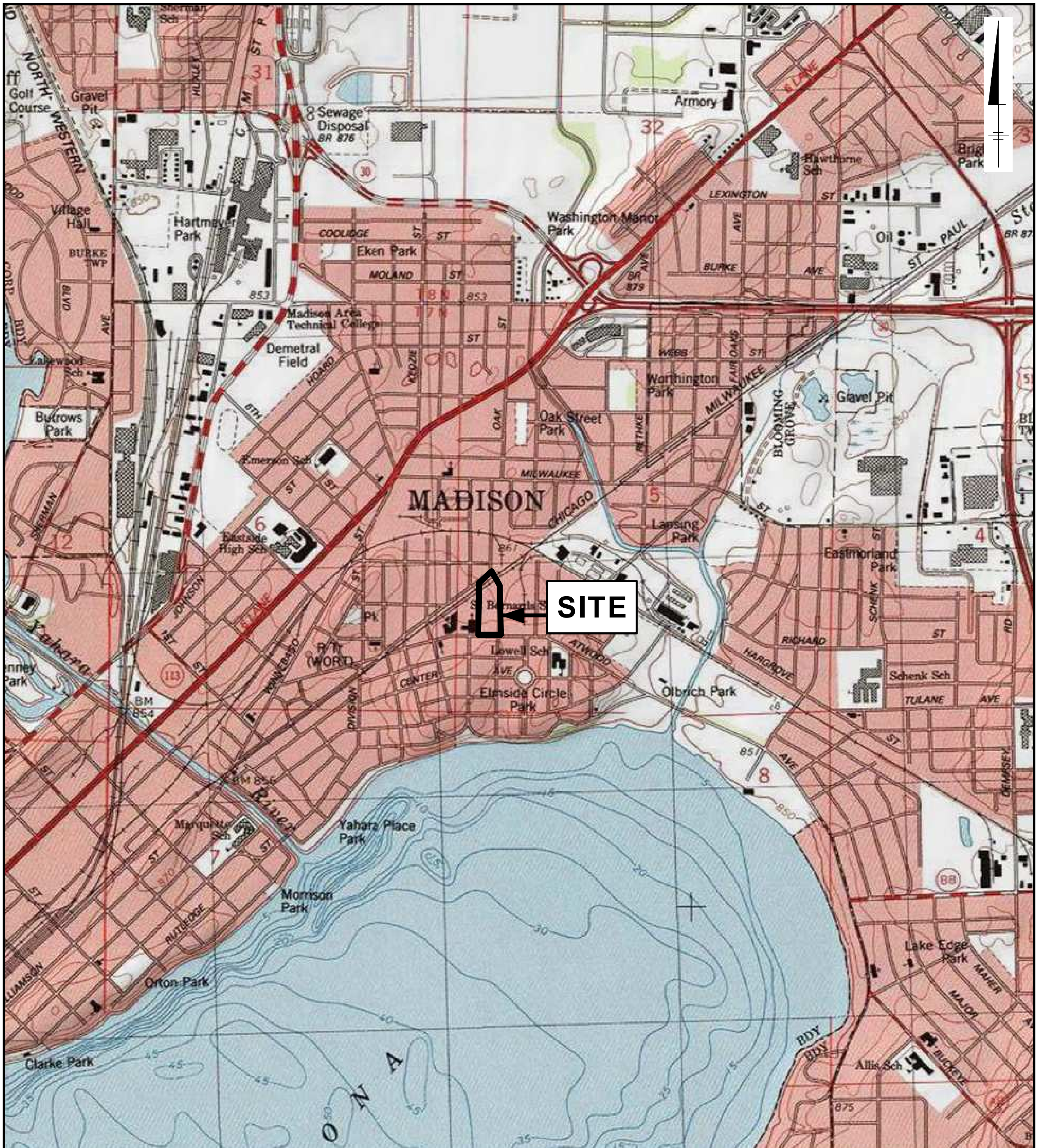
6. References

Bradbury, Kenneth R., Swanson, S.K., Krohelski, J.T., and Fritz, A.K., 1999, Hydrogeology of Dane County, Wisconsin. Wisconsin Geological and Natural History Survey Open-File Report 1999-04.

Clayton, Lee and Attig, J.W., 1997. Pleistocene Geology of Dane County, Wisconsin. Wisconsin Geological and Natural History Bulletin 95.

Ruekert/Mielke, Inc., 2011. Wellhead Protection Plan, Unit Well 8, City of Madison, Wisconsin. Prepared for Madison Water Utility, March 2011.

Figures



CITY: MPLS DIV/GROUP: IM DB: MG LD: CK
MADISON-KIPP PATH: E:\GIS\Madison Kipp\Madison Kipp\ArcMap\WorkPlanPCB\2-1 SiteLocation.mxd

SITE LOCATION

NOTE:
TOPO BASE MAP OBTAINED FROM ESRI ONLINE MAPPING, USING ARCMAP 10 ACCESSED 5/21/2012

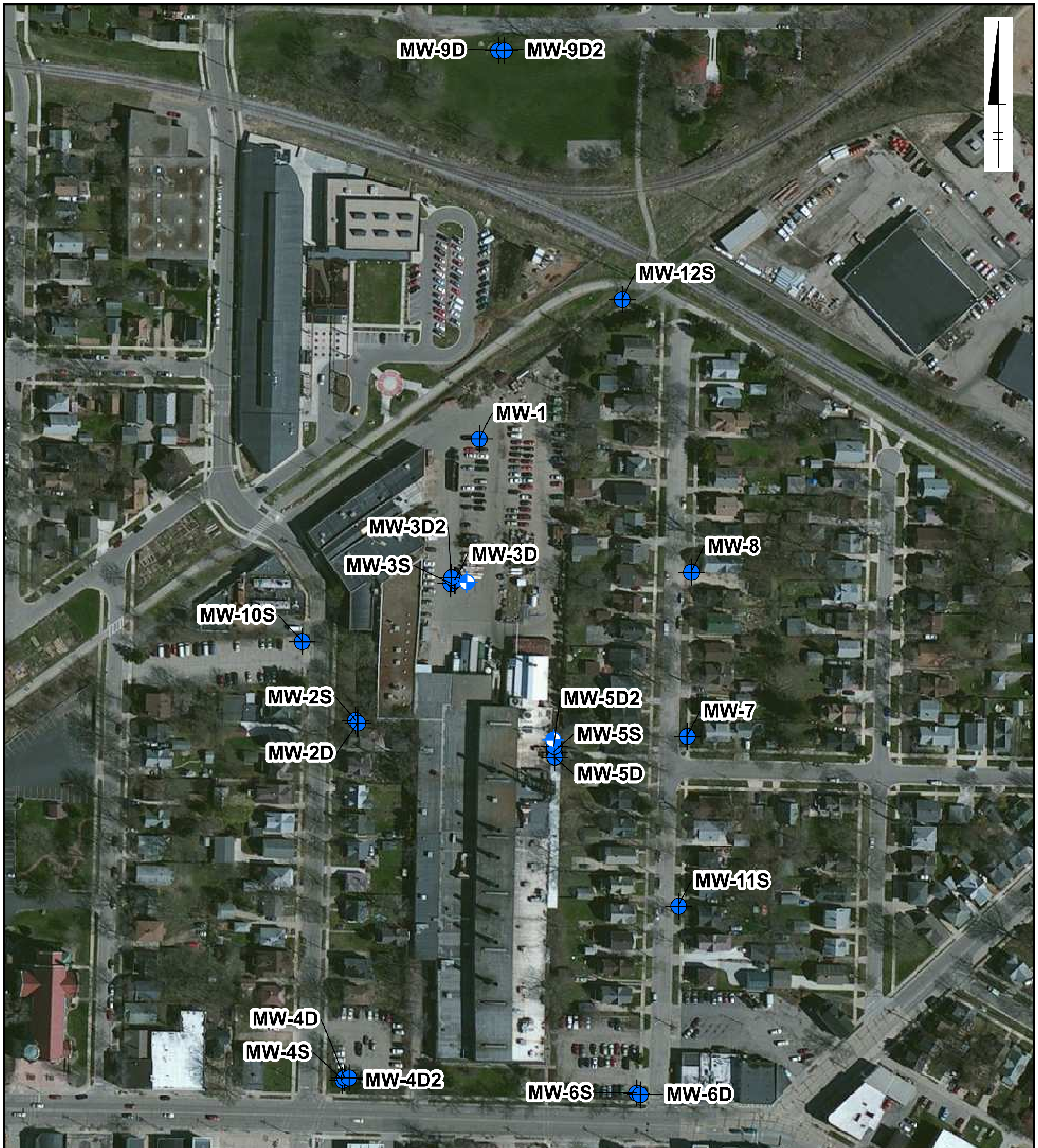
0 2,000 4,000 Feet
GRAPHIC SCALE

MADISON-KIPP CORPORATION
201 WAUBESA STREET
MADISON, WISCONSIN

SITE LOCATION MAP

ARCADIS

FIGURE
2-1



LEGEND:

MONITORING WELL

PROPOSED PIEZOMETER

NOTES:
1) AERIAL IMAGERY OBTAINED FROM BING IMAGERY SERVICE THROUGH ESRI ONLINE MAPPING, ACCESSED ON 5/22/2012

0 200 400 Feet
GRAPHIC SCALE

MADISON-KIPP CORPORATION
201 WAUBESA STREET
MADISON, WISCONSIN

PROPOSED PIEZOMETER LOCATIONS

ARCADIS

FIGURE
2-2

CITY: MPLS DIV/GROUP: IM DB: MG LD: CK
MADISON-KIPP PATH: D:\GIS\Madison Kipp\Madison Kipp\ArcMap\WorkPlanPCBI4-1 ProposedPiezometers.mxd

Appendix A

Submittal Certification

Submittal Certification

This attachment was prepared to satisfy the requirements of Wisconsin Administrative Code Chapter NR 712.09 and is applicable to the following document.

Bedrock Characterization Work Plan
Madison Kipp Corporation
201 Waubesa Street
Madison, Wisconsin

I, Jennine L Trask hereby certify that I am a registered professional engineer in the State of Wisconsin, registered in accordance with the requirements of ch. A-E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code."

WISCONSIN
JENNINE L. TRASK
#34959
WEST ALLIS, WI.
PROF

Jen Trask Project Manager 34959

Signature, title and P.E. number

P.E. stamp

I, TONI SCHOEN, hereby certify that I am a hydrogeologist as that term is defined in s. NR 712.03 (1), Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code."

Toni Schoen, Hydrogeologist

5-22-12

Signature and title

Date