SIXTH FIVE-YEAR REVIEW REPORT FOR FMC CORP. (FRIDLEY PLANT) SUPERFUND SITE ANOKA COUNTY, MINNESOTA

Prepared by

U.S. Environmental Protection Agency
Region 5
CHICAGO, ILLINOIS

9/16/2019

X

Douglas Ballotti, Director
Superfund & Emergency Management Div.
Signed by: DOUGLAS BALLOTTI

Table of Contents

LIST OF ABBREVIATIONS & ACRONYMS

AMR	Annual Monitoring Report
ARAR	applicable or relevant and appropriate requirement
BAE	BAE Systems Land and Armanents L.P.
bgs	below ground surface
BNR	Burlington Northern Railroad
BNSF	Burlington Northern Santa Fe
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	contaminants of concern
COI	constituents of interest
CTF	containment and treatment facility
CZA	capture zone analysis
EPA	United States Environmental Protection Agency
ERD	enhanced reductive dechlorination
ESD	Explanation of Significant Differences
FFP	Fridley Filter Plant
Focused RA	focused risk assessment
FS	Feasibility Study
FYR	five-year review
HBV	health-based value
HHRA	Human Health Risk Assessment
HRL	Health Risk Limit
IC	institutional control
ICIAP	Institutional Control Implementation and Assurance Plan
IRZ	in-situ reactive zone
LTS	long-term stewardship
MCL	maximum contaminant level
MDH	Minnesota Department of Health
mg/kg	milligrams per kilogram
µg/L	micrograms per liter
$\mu g/m^3$	micrograms per cubic meter
MPCA	Minnesota Pollution Control Agency
MSS	Minnesota State Statute
MWW	Minneapolis Water Works
NAPL	non-aqueous phase liquid
NCP	National Contingency Plan
NIROP	Naval Industrial Reserve Ordnance Plant
NPL	National Priorities List
O&M	operation and maintenance
OU	operable unit
PCE	tetrachloroethene
PRP	potentially responsible party
QAPP	quality assurance project plan
RAO	remedial action objective
RAP	Response Action Plan

RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
Site	FMC Corp. (Fridley Plant) Superfund Site
SLERA	Screening Level Ecological Risk Assessment
SWBCA	Special Well Boring and Construction Area
TBC	to be considered
TCE	trichloroethene
UU/UE	unlimited use and unrestricted exposure
VOC	volatile organic compound

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The United States Environmental Protection Agency (EPA) is preparing this FYR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP) (40 CFR Section 300.430(f)(4)(ii)), and considering EPA policy.

This is the sixth FYR for the FMC Corp. (Fridley Plant) Superfund Site ("Site"). The triggering action for this statutory review is the completion date of the previous FYR. The FYR has been prepared due to the fact that hazardous substances, pollutants, or contaminants remain at the Site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Site consists of one operable unit (OU), which is addressed in this FYR. OU1 addresses the groundwater remedy. Soil removal actions were conducted prior to the Site's listing on the National Priorities List (NPL) and implementation of the Record of Decision (ROD) and other decision documents for the Site. Although a CERCLA remedial action was not selected for soils, Site soils are evaluated in this FYR because it is now believed that the previous soil removal action did not clean up the soils to levels that allow for UU/UE. While EPA and the Minnesota Pollution Control Agency (MPCA) initially found the soil removal actions to be protective of human health and the environment, investigations conducted during this review period determined that either further actions may be needed to clean up Site soils to UU/UE or institutional controls (ICs) may be needed to assure that Site soils remain protective in the long term.

The FMC Corp. (Fridley Plant) Superfund Site FYR was led by Sheila Desai, EPA remedial project manager. Participants included Shanna Schmitt, MPCA project manager, and MPCA contractor support. MPCA and the potentially responsible party (PRP) were notified of the initiation of the FYR in October 2018. The review began on 10/2/2018.

Site Background

Historically, industrial and hazardous wastes generated from naval ordnance manufacturing, including plating wastes, paint, paint sludges, oils, bottom ash, and chlorinated and non-chlorinated solvents, were disposed of at the Site. Initial removal actions conducted in 1983 included excavation of soil above one part per million of total volatile organic compounds (VOCs) and construction of an on-site containment and treatment facility (CTF) to treat and contain the contaminated soils. Addressing contaminated soils in the CTF were deferred to the Resource Conservation and Recovery Act (RCRA) program prior to the Site's listing on the NPL.

On September 30, 1987, EPA signed a ROD documenting the selection of the remedial action for the contaminated groundwater (OU1) at the Site. Groundwater contamination was addressed through a groundwater extraction system, installed in 1987, and a monitoring well network. The groundwater extraction system continues to operate and VOCs remain in the groundwater at and downgradient of the Site. The PRP, BAE Systems Land and Armaments L.P. (BAE), is operating and maintaining the

remedy. A condensed summary of the chronology of significant events related to the Site is provided in Appendix B and a Site layout map is provided as Figure 1 of Appendix C.

FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: FMC Corp. (Fridley Plant)		
EPA ID: MND006481543		
Region: 5	**State:** MN	**City/County:** Fridley, Anoka County
SITE STATUS		
NPL Status: Final		
Multiple OUs? No	**Has the site achieved construction completion?** Yes	
REVIEW STATUS		
Lead agency: EPA		
Author name (Federal or State Project Manager): Sheila Desai		
Author affiliation: EPA		
Review period: 10/2/2018 - 5/6/2019		
Date of site inspection: 3/13/2019		
Type of review: Statutory		
Review number: 6		
Triggering action date: 9/29/2014		
Due date *(five years after triggering action date)*: 9/29/2019		

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

Previous waste disposal practices were identified as the cause of soil and groundwater contamination at the Site and the basis for taking action at the Site.

Groundwater

Contaminants of concern (COCs) in groundwater as stated in the ROD are: trichloroethene (TCE), tetrachloroethene (PCE), benzene, toluene, xylene, and other VOCs. TCE accounts for the majority of VOC mass in the Site's groundwater. Groundwater is the only OU addressed by the ROD. Groundwater at the Site generally flows to the west or southwest toward the Mississippi River. This section of river is classified for use as a domestic water supply (Class 1C) and as unlimited use recreational water to be protected as a drinking water supply (Class 2Bd) and for use as industrial consumption (Class 3C) by

Minnesota Rule 7050. VOC-contaminated groundwater enters the river immediately upstream of the Minneapolis Water Works (MWW) supply intake. The MWW is a municipal water supply for approximately 500,000 people within the Minneapolis area. Contaminated groundwater at the FMC Site migrating to the Mississippi River could potentially increase risks to human health and the environment due to current use, potential use, and exposure to the COCs entering the river. Ecological effects resulting from the discharge of VOC-impacted groundwater at two seeps on the riverbank are also possible.

Response Actions

Soil

In June 1983, a Consent Order regarding impacted soil at the Site was executed by FMC, MPCA, and EPA. Soil identified as having a total VOC concentration of one part per million or greater was excavated if above the groundwater table. The contaminated soil was placed into an on-site engineered CTF. The CTF was constructed in compliance with RCRA requirements for an in-ground storage facility in May and June of 1983. The CTF is currently managed under a RCRA permit. The CTF is double-lined and provides for leak detection and leachate collection. The CTF also includes a gas extraction system that was connected to a carbon filter system until November 2001. In 2001, the carbon filter system was bypassed due to low concentrations of VOCs being removed. Groundwater monitoring associated with the CTF is addressed in the RCRA permit for the CTF and reported in the FMC Site annual monitoring reports (AMRs). It was believed that the soil removal and containment successfully controlled risks to human health and the environment associated with soil contamination at the Site. However, additional sampling in 2016 indicated that the soil outside the CTF may not allow for UU/UE. The PRP is evaluating whether additional actions will be conducted to address soil or whether additional ICs are needed to assure that soil remains protective in the long term.

Groundwater

In October 1984, a Remedial Investigation (RI) report, entitled *Summary of Analytical Data*, was submitted by FMC pursuant to the Consent Order. FMC submitted a proposed Feasibility Study (FS) in January 1985. The FS was determined to be incomplete by the MPCA. An addendum to the proposed groundwater FS was submitted to the MPCA in May 1985. The MPCA accepted the FS as complete in August 1985.

The RI identified an unconfined aquifer separated from a confined alluvial aquifer by a clay layer at the Site. VOC concentrations were detected at the Site in both the confined and unconfined aquifers. Groundwater monitoring was initiated at that time and continues at the Site as part of the selected remedial action described in the ROD. Recent investigations have refined the conceptual site model, as described in Sections III and IV of the main body of this FYR.

Remedy Selection

The ROD for the FMC Site, dated September 30, 1987, addresses only groundwater (OU1).
The remedial action objective (RAO) in the ROD was to minimize ingestion of contaminated groundwater and river water contaminated by groundwater discharges to the river. The selected remedy described in the ROD includes three parts:

- Hydraulic capture through groundwater extraction and discharge to the sanitary sewer system;
- Monitoring to assure the effectiveness of the remedy and to define termination of the extraction

system; and

- Reliance on existing ICs to mitigate against usage of contaminated groundwater between the FMC and Burlington Northern Railroad (BNR) lands and the Mississippi River by private or municipal wells.

The ROD utilizes the TCE maximum contaminant level (MCL) (5 micrograms per liter (µg/l)) or health-based values (HBVs) for TCE as performance criteria at the downgradient Site boundary to determine system effectiveness. The Site monitoring program is described in the ROD and further detailed in the quality assurance project plan (QAPP) approved by MPCA in March 2004. The QAPP identifies Site monitoring frequency, procedure, analysis, and locations.

Extracted groundwater originally had been discharged to the sanitary sewer system for off-site treatment by the publicly-owned treatment works, but is now being treated by an on-site air stripper. Treated water is now discharged to the Mississippi River under a National Pollutant Discharge Elimination System permit. These changes to the selected remedy were detailed in an Explanation of Significant Differences (ESD) dated September 13, 2013. The ESD also addressed the discontinued operation of extraction well RW-1.

Status of Implementation

Remedial actions to address groundwater contamination at the Site were implemented as outlined in the Response Action Plan (RAP) dated October 28, 1986, and the 1987 ROD. The decision documents identify the selected remedy as a groundwater extraction system to reduce the migration of groundwater contamination in the unconfined and confined aquifers at and downgradient of the FMC Site boundary. The implemented remedy also utilizes a monitoring plan to monitor performance criteria established in the ROD to identify remedial progress at the site. ICs are in place to control groundwater use at and adjacent to the Site.

Groundwater Extraction System

Design plans for the groundwater extraction system are described in the RAP which was included as Exhibit A to the 1986 Response Order by Consent between the MPCA and FMC. In 1987, EPA adopted this selected remedy as described in the ROD. The groundwater extraction system originally consisted of five – and now consists of four – extraction wells positioned to limit off-site migration of contaminated groundwater. Extracted groundwater flow can be monitored for each individual well prior to passing through a spray nozzle. Once extracted groundwater passes through the spray nozzle, it is combined with the effluent from the other extraction wells and directed through the air stripper. In the event that the air stripper is not operational, the combined effluent is discharged to the sanitary sewer.

Construction of the groundwater extraction system was completed in early December 1987. Extraction wells RW-1 and RW-2 were completed in the upper alluvium aquifer in the Burlington Northern Santa Fe (BNSF; formerly BNR) portion of the Site. Extraction well RW-1 was found to continually run dry and has not operated since mid-December 1987. The discontinuation of RW-1 was officially documented in the September 2013 ESD. Extraction well RW-2 did not operate from September of 2012 to August of 2015 due to an enhanced reductive dechlorination (ERD) pilot test being conducted in the vicinity of monitoring well FMC-36. The groundwater extraction system construction is complete based on the specifications in the decision documents and its operation is ongoing; however plans to modify the system are being implemented as described in Section IV below.

Groundwater Monitoring

Groundwater monitoring is conducted utilizing a monitoring well network throughout the Site and adjacent downgradient properties. The monitoring well network is utilized to collect groundwater elevation data and groundwater samples for laboratory analysis. The groundwater monitoring program is discussed in the Remedy Selection section above. Groundwater monitoring is conducted at the Site in accordance with the QAPP. All collected samples are analyzed for VOCs.

Adjustments to the monitoring well network have been made since the previous FYR. These include well modifications and installation of additional wells. The changes to the monitoring well network were based on recommendations in the previous FYR. Monitoring well network modifications were necessary to collect more accurate information of aquifer conditions during sampling events. At this time, the monitoring portion of the ROD is ongoing.

Institutional Controls

ICs are non-engineered instruments, such as administrative and legal controls, that help to minimize the potential for exposure to contamination and that protect the integrity of the remedy. Governmental ICs have been implemented and are outlined in the 1987 ROD to restrict groundwater use, maintain the integrity of the remedy, and assure long-term protectiveness for areas which do not allow for UU/UE. A summary of the implemented and planned ICs for the Site is provided in Table 1 and further discussed below.

A Minnesota Department of Health (MDH) Special Well Boring and Construction Area (SWBCA) was implemented and made effective on October 1, 2015. A SWBCA is an IC issued by MDH at the request of MPCA to establish restrictions to limit access and exposure to groundwater in a designated area. A SWBCA requires that new wells and borings advanced within the subject area be subject to engineering controls and/or MDH and MPCA review prior to installation to protect against exposure to impacted groundwater. The SWBCA is not required to ensure long-term protectiveness and is not detailed in the 1987 ROD, but serves as an additional IC that provides an additional layer of protectiveness at the Site. The memorandum giving notice of designation of the SWBCA, which includes a map of the SWBCA area, is included in Appendix D.

Table 1: Summary of Planned and/or Implemented ICs

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed?	ICs Called for in the Decision Documents?	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
Groundwater at and proximal to the Site	Yes	Yes	State-Wide	Requires notification of proposed construction of a water-supply, dewatering or environmental well to the MDH commissioner	Minnesota Department of Health – Minnesota Statute 103I.205
Groundwater at and proximal to the Site	Yes	Yes	State-Wide	Addresses construction of water supply wells near contamination sources	Minnesota Department of Health – Minnesota Rule 4725.2020
Groundwater at and proximal to the Site	Yes	Yes	State-Wide	Requires all buildings to be connected to municipal water supply if one is available	Minnesota Plumbing Board, Minnesota Rule 4715.0310, Use of Public Sewer and Water Systems Required
Groundwater at and proximal to the Site	Yes	Yes	City-Wide	Requires all potable well installations to adhere to MDH regulations in the event connection to the municipal supply is not feasible	Fridley City Code Chapter 402.13
Groundwater at and proximal to the Site	Yes	No	Southwest Fridley	Restrict groundwater use and exposure within the vicinity of the Site. Requires written proposal and approval by MDH for any well/boring.	SWBCA effective 10/1/15. (This IC not necessary for protectiveness but adds an additional layer of protectiveness.)
Soil outside the CTF	To Be Determined	No	Soil	Restriction of land use to industrial/commercial	Potential Deed Restriction (under evaluation)

While not specifically addressed by the ROD, additional site-specific ICs include those specific to the containment and treatment facility. The CTF is managed under a RCRA post-closure hazardous waste permit . The permit issued for the CTF stipulates requirements for operation, monitoring, and maintenance of the CTF and an *Affidavit Concerning a Hazardous Waste Containment/Treatment Facility* (Affidavit). The Affidavit serves as a notice in the deed and notice to the local land authority and has been in place since November 9, 1983, with a revised Affidavit issued on February 23, 1984. These notices restrict land use under 40 CFR Section 264.117 and Minnesota State Statute (MSS) Section 115B.16 Subdivision 1 (MSS-115B), both of which generally provide that "no person shall use any property on or which hazardous waste remains after closure of the disposal (containment) facility in any way that disturbs the integrity of the final cover, liners or any other components of any containment system." In accordance with MSS-115B, an Affidavit was filed with the zoning authority of the City of Fridley, Minnesota, and with the Regional Administrator of EPA Region 5. An executed copy of the

Affidavit is also filed with the Registrar of Titles of Anoka County, Minnesota, as memorialized under Certificate of Title Number 51489. These ICs will continue to be managed under the RCRA program and not under CERCLA. However, additional ICs may be needed for the soil outside of the CTF. More information is needed to determine whether the soil removal actions previously conducted allow for UU/UE outside of the CTF or whether an IC is needed to restrict the land use to industrial/commercial.

Current Compliance:
Based on Site inspections, interviews, and annual monitoring reports, the Site is in compliance with the existing ICs.

IC Follow-up Actions Needed:
The following measures must be taken in order to ensure protectiveness of the remedy in the long term: (1) evaluation of the existing site-specific ICs and (2) development of an Institutional Control Implementation and Assurance Plan (ICIAP) that incorporates the results of the evaluation and plans for any additional IC activities needed, including development of long-term stewardship (LTS) procedures. An ICIAP should be developed by the PRP, in conjunction with EPA and MPCA. The purpose of the ICIAP is to conduct additional IC evaluation activities to ensure that the implemented ICs are effective, to explore whether additional ICs are needed and ensure their implementation, and to ensure that LTS procedures are in place so that ICs are properly maintained, monitored, and enforced. Specifically, the ICIAP shall explore whether additional ICs are needed to restrict the land and groundwater use on-site and off-site within the area of potential groundwater contamination in the deep bedrock aquifer.

Long-term protectiveness requires continued compliance with the land and groundwater use restrictions to ensure that the remedy continues to function as intended. LTS will ensure that the ICs are maintained, monitored, and enforced. Plans incorporating LTS procedures (e.g., an LTS Plan or Operation and Maintenance (O&M) Plan) should include the mechanisms and procedures for inspecting and monitoring compliance with the ICs as well as communications procedures. An annual report should be submitted to MPCA and EPA to demonstrate the following: that the Site was inspected to ensure no inconsistent uses have occurred; that ICs remain in place and are effective; and that any necessary contingency actions have been executed. Results of IC reviews should be provided to MPCA and EPA in an annual ICs report and with a certification that the ICs remain in place and are effective.

IC evaluation activities will include, as needed, updated maps depicting current conditions in areas that do not allow for UU/UE, and review of recording and title work to ensure the restrictions are still recorded, and that no prior-in-time encumbrances exist on the Site that are inconsistent with the ICs.

Long-Term Stewardship:
Long-term protectiveness at the Site requires compliance with implemented restrictions to ensure that the remedy continues to function as intended. Planning for LTS is required to ensure that the ICs are maintained, monitored, and enforced so that the remedy continues to function as intended. LTS involves assuring effective procedures are in place to properly maintain and monitor the Site. LTS will ensure effective ICs are maintained and monitored and the remedy continues to function as intended with regard to ICs. An LTS Plan (or amendment to the O&M Plan) should be developed containing procedures for monitoring and tracking compliance with existing ICs, communicating with MPCA and EPA, and providing an annual certification to MPCA and EPA that the ICs remain in place and are effective.

Systems Operations/Operation & Maintenance

BAE conducted groundwater extraction system O&M activities during this review period. O&M and groundwater monitoring activities are summarized in AMRs submitted to MPCA and EPA. During this review period O&M activities included cleaning and maintaining pump operations and well redevelopment. The groundwater extraction system was monitored on a weekly basis and included a visual inspection of system components and an evaluation of system flow rates. Maintenance activities were performed on individual pumps if flow rates were observed to be between 60 percent and 75 percent of the maximum nominal flow rate. Maintenance activities included cleaning of pumps and piping systems to remove iron and calcium precipitates that periodically accumulate and impede water flow.

Groundwater monitoring activities included monthly groundwater elevation monitoring at select monitoring wells to monitor the influence of the pumping wells. Groundwater elevations are also collected quarterly from a larger set of monitoring wells. Groundwater samples are collected annually from select wells, following the groundwater monitoring schedule as approved by MPCA.

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the last FYR as well as the recommendations from the last FYR and the current status of those recommendations.

Table 2: Protectiveness Determinations/Statements from the 2014 FYR

OU #	Protectiveness Determination	Protectiveness Statement
OU1 - Sitewide	Protectiveness Deferred	At this time, a protectiveness determination of the selected remedy at the FMC Corporation Superfund site cannot be made until further information is obtained. Vapor intrusion sampling was conducted at the Minneapolis Water Works and initial data shows that there may be a potential pathway for vapor intrusion. Further information will be obtained to determine whether the vapor intrusion pathway is complete and whether vapor intrusion poses an unacceptable risk. It is expected that these actions will take approximately twelve months to complete at which time a protectiveness determination will be made.
Soil	Protective	Soil removal actions were conducted prior to implementation of the ROD and decision documents for the site. EPA and MPCA have found the soil removal actions to be protective of human health and the environment. It is currently unclear whether the soil removal actions cleaned up site soil to levels that allow for unlimited use and unrestricted exposure. ICs may be needed to assure that soil remains protective in the long term.

Table 3: Status of Recommendations from the 2014 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description	Completion Date (if applicable)
1	ERD pilot study to evaluate ERD as a potential alternative remedy is ongoing.	Complete ERD pilot study evaluation and assess restart of groundwater extraction well RW-2.	Completed	The pilot study was completed and the final report concluded that ERD successfully created reducing conditions and daughter products. However, the hydrogeology does not allow for advective flow/transport. There is non-aqueous phase liquid (NAPL) present in the clay bowl which makes ERD not conducive as a short-term remedial strategy.	11/10/2015
1	Capture zone analysis indicates a limited percentage of the target groundwater capture zone is being captured.	Complete a capture zone analysis following installation of upgraded equipment.	Completed	The capture zone analysis determined that increased extraction rates improved the capture zone, but additional extraction wells will be needed to achieve compliance.	11/9/2015
1	An unrestricted exposure pathway exists in the area of the two seeps.	Evaluate potential access restrictions or signage for the seep area to restrict access by the public.	Completed	The PRP installed additional fencing around the seeps and put up signage to restrict access.	4/30/2016
1	Contaminant concentrations which exceed surface water standards are being discharged to the Mississippi River at the seeps.	Further evaluate remedial options, including system enhancement and ERD. Ecological effects resulting from the discharge of VOC-impacted groundwater at the seeps should also be evaluated.	Ongoing	The PRP conducted a comprehensive Site investigation in 2016. The investigation identified three source areas. The conceptual site model was vastly improved. A south source area pump test was conducted and the efforts are ongoing. The final report is expected in 2019. A seep risk assessment was conducted and concluded that no adverse effects are expected to human and ecological receptors from exposure to constituents in seep water or surface water of the river.	
1	A full evaluation of potential vapor intrusion has not been completed.	Evaluate potential vapor intrusion pathways which could be affected by site contaminants.	Addressed in Next FYR	The PRP has conducted a comprehensive review of two MWW vapor intrusion reports and determined that products that contained TCE were used at the MWW property during review which may have skewed results. The PRP negotiated with MWW	

				to conduct a vapor intrusion assessment based upon the prior reports' sampling location. The PRP has submitted a work plan for the vapor intrusion sampling at MWW to MPCA.	
1	Need to evaluate existing ICs, and need to develop and implement long-term stewardship procedures.	Develop an ICIAP to evaluate the effectiveness of the existing ICs, the need for any additional ICs, and to ensure that long-term stewardship procedures are developed and implemented.	Ongoing	The PRP evaluated ICs at the CTF and found them to be in compliance. Minnesota Department of Health established a "Special Well Boring and Construction Area" ordinance which established restrictions to limit access and exposure to groundwater in this area. The PRP intends to develop an ICIAP once the remedial actions are selected.	

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

A public notice was made available by a posting in the local newspaper, the "Fridley – Columbia Heights Sun Focus," on 11/9/2018, stating that there was a FYR and inviting the public to submit any comments to EPA. Notice of the start of the new FYR was also given directly to the Southwest Fridley Community Action Group (SW Fridley CAG) and the City of Minneapolis on November 13, 2018. Another notice will be placed to notify the public that the review has been completed and that the report is available to the public.

The results of the review and the final FYR report will be made available at the Site information repository located at:

MPCA St. Paul Office
520 Lafayette Avenue North
St. Paul, Minnesota 55155-4194
(651) 757-2728 or (844) 828-0942
Online requests: https://www.pca.state.mn.us/about-mpca/information-requests

EPA Region 5 Records Center
77 W. Jackson Blvd. (SRC-7J)
Chicago, IL 60604
(312) 353-1063
Mon-Fri: 8 am to 4 pm - Call for appointment

Site background, current Site status, cleanup information, and site-related documents can also be found on EPA's web page: https://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0503738

During the FYR process, interviews were conducted to document any perceived problems or successes with the remedy that has been implemented to date**.** The results of these interviews are summarized below.

An interview was conducted with the O&M Site Manager, Tim Ruda of BAE, during the FYR inspection. The interview was conducted on March 13, 2019, and is listed in the Site Inspection Checklist in Appendix F. The photo log from the Site inspection is in Appendix G. Mr. Ruda indicated that the PRP is planning to do the following actions to address effectiveness of the remedy:

- Conduct a vapor intrusion investigation at MWW's Fridley location in 2019;
- Install 4 more extraction wells in the lower alluvium;
- Increase the groundwater treatment system from 200 to 400 gallons per minute;
- Remediate the northern source area in 2019 (see *Source Investigation* discussion below, later in this Section IV of the FYR);
- Well treatment expansion for RW-6 in 2020 to address the Southern Source Area; and
- Evaluate how to address the central source area in 2019.

EPA and MPCA also conducted an interview with MWW on March 13, 2019. MWW expressed their concerns with the Site. MWW is located potentially downgradient or directly above the FMC groundwater plume. MWW expressed concerns regarding the lack of data to assess whether the OU1 remedy is effective in protecting human health and the environment. MWW's formal comments are attached in Appendix H and MWW's major concerns are summarized below:

- MWW believes the existing monitoring well network is inadequate and that it should be expanded in the upper alluvial formation to fully delineate the plume.
- MWW would like the monitoring program updated to measure COC concentrations beneath MWW's Fridley location to further assess potential vapor intrusion, and to update the conceptual site model.
- MWW was concerned about the capture zone analyses that have been conducted not being adequate and that MCLs are not achieved at the Site boundary.
- MWW expressed concern about the potential vapor intrusion at their location and the steps needed to resolve the issue.

Data Review

Data reviewed as part of this FYR include data submitted to MPCA and EPA by BAE, including AMRs submitted for the last five years. A supplemental investigation report, vapor intrusion results, ERD pilot test report, and a focused risk assessment report for the seep area were also reviewed during this FYR. The documents that were reviewed during the FYR are included in the Reference List in Appendix A.

Groundwater Monitoring

Groundwater monitoring data collected during the review period indicates that groundwater elevations at the Site generally increased in both the upper and lower alluvium. Some of this noted groundwater elevation increase in the upper alluvium in the more recent monitoring events may be attributed to suspended operation of extraction well RW-2 during the ERD pilot study. Groundwater elevation data

presented in AMRs submitted during this review period indicate that groundwater flow in the lower alluvium is to the west, toward the Mississippi River. The 2016 AMR presents a groundwater contour map of the lower alluvium, and this map is included as Figure 2 in Appendix C.

Groundwater monitoring was conducted annually, following the approved groundwater monitoring schedule. A total of 36 lower alluvium wells were sampled during at least one sampling event during this review period. Of the lower alluvium wells sampled during this review period, concentrations of TCE were detected above the MCL at 21 wells during at least one sampling event. Table E-1 in Appendix E summarizes groundwater analytical results from the 2016 AMR. Lower alluvium monitoring wells with detections which exceeded the MCL during this review period include: FMC-14, FMC-15, FMC-21B, FMC-30, FMC-35A, FMC-41, FMC-45, FMC-53, FMC-54, FMC-54A, FMC-57B, FMC-70, FMC-71, FMC-75, FMC-76, FMC-77, FMC-78, FMC-79, MW-1, MW-3, and MW-4. The TCE concentrations detected at all other lower alluvium wells were either below laboratory reporting limits or below the MCL.

Groundwater contaminant concentrations, primarily TCE, have been evaluated by BAE utilizing Mann-Kendall statistical trend analysis. Mann-Kendall analysis is a non-parametric test to evaluate groundwater monitoring data for increasing, decreasing or stable trends. Trend analysis presented in the 2016 AMR indicates that 8 of the 13 lower alluvium monitoring wells evaluated indicated decreasing trends since 2006. Three of the lower alluvium wells indicated stable trends and two lower alluvium wells had no statistical trend. Concentrations of TCE at MW-1, however, were below laboratory detection limits or the MCL during seven of eight sampling events during this review period.

Groundwater elevation data presented in AMRs submitted during this review period indicate that groundwater flow in the upper alluvium is west, toward the Mississippi River, but slightly skewed to the northwest. The 2016 AMR presents a groundwater contour map of the upper alluvium, and this map is included as Figure 3 in Appendix C.

A total of 15 upper alluvium monitoring wells were sampled during at least one sampling event during this review period. Of the upper alluvium wells sampled during this review period, concentrations of TCE were detected above the MCL at 14 monitoring wells. In general, TCE concentrations detected in the upper alluvium were higher than those detected in the lower alluvium. Monitoring wells where TCE concentrations exceeded the Health Risk Limit (HRL) include: FMC-20, FMC-21A, FMC-36, FMC-46, FMC-47, FMC-48, FMC-49, FMC-50, FMC-51, FMC-52, FMC-64, FMC-72, FMC-73, and FMC-74. The TCE concentration detected at the other upper alluvium well, FMC-19A, was below laboratory reporting limits.

A trend analysis presented in the 2016 AMR of 5 upper alluvium monitoring wells that were evaluated indicates that upper alluvium monitoring wells with increasing TCE trends according to Mann-Kendall analysis include FMC-48 and FMC-52. Also, according to Mann-Kendall analysis, a stable TCE trend occurs at FMC-21A, a decreasing TCE trend occurs at FMC-64, and no statistical TCE trend is present at FMC-36.

Groundwater Extraction and Treatment

The groundwater extraction and treatment system functioned to remove approximately 212 million gallons as reported by the four AMRs submitted during this review period (2013 through 2016). Approximately 292 pounds of TCE and 567 pounds of total VOCs were removed during the same

period. Table E-2 in Appendix E lists the totals per quarter of TCE mass removal. Statistics from the 2017 AMR were not available at the time this FYR Report was prepared.

A capture zone analysis (CZA) was also completed and included in each AMR reviewed as part of this FYR, as recommended by the 2009 FYR. Extraction well capture was evaluated in each CZA to determine whether extraction wells were functioning adequately to capture VOC-impacted groundwater. Each CZA evaluation utilized groundwater elevation data collected during annual groundwater monitoring to calculate the approximate groundwater capture envelope. The capture zone evaluation indicated that the interpreted horizontal capture zone, compared to the targeted capture area, for the lower alluvium increased from 40 percent of the targeted area in 2013 to 51 percent in 2015. In 2016, however, the estimated capture zones for the upper and lower alluvium extraction wells appeared smaller than historic capture zones. This is likely due to the overall decrease in pumping rates in 2016. Conclusions from the focused hydraulic analysis recommended that extraction wells RW-3 through RW-5 continue to operate at their increased flow rates and that additional extraction wells (two) be considered between RW-3 and RW-4 to improve hydraulic capture in this area.

Enhanced Reductive Dechlorination

From September 2012 through March 2015, BAE conducted a pilot test to evaluate ERD as a potential remedial technology for treating dissolved-phase chlorinated VOCs at the site. ERD is a method of in-situ remediation that modifies the biogeochemical environment of the subsurface to create conditions suitable for biological degradation of chlorinated VOCs. Pilot tests are utilized to evaluate the feasibility of a full-scale remedy based on results of a smaller study area. The ERD pilot test included installation of additional monitoring and injection wells. A total of 122,810 gallons of two-percent molasses solution and 2,865 gallons of 70-percent molasses solution was injected at three injection wells over four injection events. As the molasses solution disperses through the subsurface, it provides additional nutrients which encourage microbial activity. Increased microbial activity changes the biogeochemical environment to conditions which are favorable to anaerobic (oxygen deficient) degradation of chlorinated VOCs. Additionally, tracers were injected during events one (fluorescein) and two (rhodamine) to evaluate the radius of influence of the injected solution. ERD requires modification of biogeochemical conditions, and it can take a period of time for modifications to achieve favorable conditions. Bioaugmentation was used during the fourth injection event as a method of enhancing the subsurface microbial population of dechlorinating bacteria in order to increase the rate of dechlorination.

The results of the ERD study concluded that residual source mass, including NAPL, is present on top of and within the first two feet of the clay "bowl" that underlies the shallow alluvium (referred to as the Southern Source Area). The aerial extent of NAPL generally matches up with the extent of impacted soil addressed during a 1983 soil investigation and excavation. Groundwater flow within the clay "bowl" is relatively static. As a result of this and the residual source mass, significant rebound of chlorinated VOCs occurred following shutdown of the pumping system. ERD was able to successfully address some of the residual mass, but a fully functioning in-situ reactive zone (IRZ) was unable to be established over the pilot test period likely due to the significant amount of iron present within the soil matrix and the elevated concentrations of 1,1,1-TCA that appeared during the pilot test. Development of an IRZ was further complicated by the lack of advective flow within the clay "bowl."

Vapor Intrusion

During 2014 and 2015, MWW conducted a limited vapor intrusion investigation at five of its buildings. The MWW is located above and downgradient of the Site's groundwater plume. The vapor intrusion investigation, which was not conducted pursuant to an EPA- or MPCA-approved sampling plan,

included sub-slab soil vapor monitoring points and some indoor air sampling points. The 2014 data showed one sample point having sub-slab concentrations of TCE (542 micrograms per cubic meter [µg/m^{3J}) much greater than the screening levels for sub-slab TCE concentrations; however, the indoor air concentration was much lower (8.8 µg/m^3). The indoor air concentration at that sample location was above the MPCA screening level of 6.0 µg/m^3 for indoor air and corresponds with a human health risk just at the EPA risk threshold. In the 2014 data, there was only one location with paired sub-slab and indoor air data. The 2015 investigation was a follow-up to the 2014 activities and found sub-slab soil vapor concentrations similar to those measured in 2014, including one exceedance of MPCA's screening level for TCE in sub-slab soil vapor below the Fridley Filter Plant (FFP) building. The indoor air samples collected in 2015 in the FFP building had TCE concentrations exceeding the MPCA screening level at four locations; however an indoor air source was identified in the gallery area on the south side of the FFP building. Although the 2014 sampling effort was not conducted pursuant to an approved sampling plan, the initial data indicate that there could be a potential vapor intrusion pathway. More data under an EPA- or MPCA-approved sampling plan is needed to fully evaluate the vapor intrusion pathway and source of potential impacts.

Focused Risk Assessment

A focused risk assessment (Focused RA) for the seep area associated with the Site adjacent to the Mississippi River was conducted during this review period. The Focused RA was comprised of a Human Health Risk Assessment (HHRA) and a Screening Level Ecological Risk Assessment (SLERA). The goal of the Focused RA was to evaluate the potential current and future risks and hazards to human health and to the environment associated with exposure to constituents detected in seep water. Three constituents (TCE, cis-1,2-dichloroethylene, and PCE) had historical maximum concentrations detected in seep water at levels that exceeded the human health and ecological screening levels and were therefore considered constituents of interest (COIs). This Focused RA evaluated exposure to the COIs at the seep area as well as in surface water of the Mississippi River. The Focused RA relied on historical maximum concentrations of COIs in seep water and modeled concentrations of the COIs in Mississippi River surface water. Following the exposure and toxicity assessments, excess lifetime cancer risks and non-cancer hazards were estimated for each of the identified receptors from exposure to constituents of potential concern using EPA standard risk assessment equations. Results of the HHRA indicate that exposure to constituents in seep water or surface water of the river should not pose an unacceptable risk to human health. To evaluate potential exposure to aquatic life in the Mississippi River, modeled concentrations of the COIs in the Mississippi River were compared to ecological screening levels for Class 2Bd water from the Minnesota Administrative Rule Part 7050.0220. Estimated concentrations were below ecological screening values and therefore, constituents of potential ecological concern were not identified. The SLERA concluded that ecological receptor populations should not experience adverse health effects from exposure to Site-related constituents.

Source Investigation

In 2016, BAE conducted a comprehensive investigation at the Site primarily to identify potential residual chlorinated ethene hotspots that may be continuing to contribute mass to the dissolved phase plumes on-site, identify how potential impacts could migrate vertically from the sources to the lower alluvium, assess potential contaminant transport pathways at the Site boundary, and identify possible contaminant flow paths that may be daylighting as seeps that have been observed. The investigation identified the following conclusions:

- Three distinct potential source areas have been identified at the Site and are shown in Figure 4 of Appendix C.

- The Northern Source Area is characterized by borings BAE-26, BAE-30, and BAE-31. Impacts were observed at concentrations greater than 1 milligram per kilogram (mg/kg) of TCE from approximately 7 feet below ground surface (bgs) down to 20 feet bgs. Impacts were identified in the lower two to three feet of the Upper Alluvial Sand and into the clay layer. Impacts at boring BAE-26 were detected throughout the clay layer and into the uppermost two to three feet of the Lower Alluvial Sand. The groundwater table is generally encountered at approximately 20 to 25 ft bgs. The Northern Source Area is bounded by borings BAE-02, BAE-04, BAE-20, BAE-21, BAE-27, and BAE-29.
- The Central Source Area is defined by COC concentrations below the groundwater table above 1 mg/kg at borings BAE-05, BAE-10, BAE-16, BAE-17, BAE-24, and BAE-25 and by positive NAPL detections at borings BAE-05 and BAE-17. Impacts were observed at concentrations greater than 1 mg/kg from the top of the saturated zone at approximately 22 ft bgs down to 30 feet bgs. Only limited impacts were identified in the unsaturated zone which suggests the vadose zone source mass was removed as part of the historical excavation activities that were completed in 1983. Impacts are generally retained above the clay with the exception of boring BAE-16, which appears to be a potential migration pathway for impacts to migrate into the Lower Alluvium Sands.
- The Southern Source Area is defined by COC concentrations below the groundwater table above 1 mg/kg and positive NAPL detections at several borings. These results were initially presented and are discussed in more detail in the ERD Pilot Study, Tracer Test and Source Investigation Report. Only limited impacts were identified in the unsaturated zone which suggests the vadose zone source mass was removed as part of the historical excavation activities that were complete in 1983.

- Groundwater with COC concentrations was detected at many of the borings completed along the western property boundary of the Site.
  - Migration of COC-impacted groundwater in the Upper Alluvium Sands is physically limited to the north and south by the elevation of the top of the clay layer. Impacted groundwater in borings was detected in all borings from boring PBS-16 in the north to boring PB-11 in the south. COC concentrations tended to correlate with depth, with increasing concentrations measured at deeper depths. The highest concentrations were measured at the deepest samples collected from relative low spots in the top of the clay. The primary areas for contaminant flux appear to be at the relatively low areas in the top of the clay that were observed at borings PB-06, PB-09, and PB-11.
  - TCE concentrations were detected at the northernmost boring that was completed, boring PB-01. The extent of COC migration at the property boundary in the Lower Alluvium Sands is bounded to the south by PB-05 which was below detection limits for all COCs.
- The relative ratios of chlorinated ethene compounds in the Northern Source Area have similar concentrations as those in the seeps.

Site Inspection

The inspection of the Site was conducted on 3/13/2019. In attendance were Sheila Desai of EPA, Shanna Schmitt of MPCA, Andrew Fiskness and Joe Renier of Wood (MPCA contractor), Tim Ruda of BAE, and Ryan Oesterreich of Arcadis (BAE contractor). The purpose of the inspection was to assess the protectiveness of the remedy.

Monitoring wells, extraction wells, and the treatment system building were inspected. No issues affecting the operation of the selected remedy were observed. The Site Inspection Checklist is included as Appendix F. Photographs from the Site inspection are included as Appendix G.

V. TECHNICAL ASSESSMENT

QUESTION A: Is the remedy functioning as intended by the decision documents?

Question A Summary

Yes. The components of the remedy are functioning as intended by the decision documents. The groundwater extraction and treatment system is functioning to meet the remedial action objective described in the ROD in that it is reducing general off-site migration of groundwater containing elevated contaminant levels. Although groundwater remedial objectives (MCLs or HBVs) have not yet been achieved at the Site compliance boundary (the property boundary), the groundwater extraction system continues to remove and treat VOC-impacted groundwater.

Capture zone analysis performed during this review period indicates that the groundwater extraction system was capturing an estimated nearly 40 to 51 percent of the targeted plume area. The groundwater extraction wells are positioned to capture the areas of greatest impacts as specified in the ROD. These areas include the upper alluvium on the BNSF (formerly BNR) property (RW-2); and the lower alluvium at the extreme southern portion on the BAE property (RW-3). Operation of these extraction wells is a remedial action requirement of the ROD. The decision documents do not specify a capture efficiency but specify the necessary minimum components for the groundwater extraction system in order to meet the RAOs. Over time, the capture efficiency has declined and the PRP is planning to modify the system in the hopes of enhancing efficiency. At the time of this FYR, additional modifications to the system, including new extraction wells and piping, were in the process of being designed by the PRP in order to increase the effective capture zone of the extraction and treatment system and optimize the remedy.

At the time of this FYR, groundwater extraction from RW-3, RW-4, and RW-5 is ongoing. Groundwater extraction from RW-2 has been temporarily discontinued in order to evaluate the ERD pilot study in the vicinity of FMC-36, which is located within the estimated capture zone of RW-2, to assure pilot study results are representative, and to prevent damage to RW-2 or associated system components. RW-2 resumed operation in 2016. However, RW-2 was turned off again in early 2017 (and restarted in 2018) to complete a long-term pumping test on new extraction well RW-6, and replacement of RW-2 with RW-6 will be further addressed in the forthcoming RW-6 Pump Test Report, which was not completed during this review period.

While the system is continuing to remove impacted groundwater and reduce general off-site migration of elevated contaminant levels, downgradient concentrations remain elevated. In addition, two seeps are present on the Mississippi River bank on MWW property. The location of the seeps (known as the east seep and the west seep) is depicted in Figure 1 in Appendix C. Contaminant concentrations detected at the seeps (see Table E-3 in Appendix E) have exceeded the applicable surface water criteria[1] during this review period. The Mississippi River in the vicinity of the Site is classified as Class 2Bd and is utilized as a drinking water source for approximately 500,000 people. Since 2013, concentrations of TCE and

[1] Note that surface water criteria were not identified as applicable or relevant and appropriate requirements (ARARs) in the ROD; only MCLs were identified as ARARs.

PCE were detected at the east seep ranging from 130 µg/L to 37.1 µg/L (TCE) and from 154 µg/L to 34.2 µg/L (PCE). During that same period, concentrations detected at the west seep were below the Class 2Bd TCE standard of 25 µg/L, and generally were below the PCE standard of 3.8 µg/L, with two detections above the PCE standard, at 6.5 µg/L in 2015 and 11.3 µg/L in 2016. Access controls have been implemented in the vicinity of the seeps limiting human access to the seeps. TCE-impacted water exceeding the MCL and health-based cleanup values is discharged to the Mississippi River at all flow stages. A Focused RA was conducted and indicates that exposure to constituents in seep water or surface water of the river should not pose an unacceptable risk to human health and that ecological receptor populations should not experience adverse health effects from exposure to Site-related constituents.

ICs at the Site are functioning as anticipated by the ROD. The ICs in place and planned for the Site were presented earlier, in Table 1 within Section II of this FYR. However, the following measures must be taken in order to ensure protectiveness of the remedy in the long term: evaluating the existing ICs and developing an ICIAP that incorporates the results of the evaluation and plans for any additional IC activities needed, including development of an LTS plan.

QUESTION B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy selection still valid?

Question B Summary

No. Exposure assumptions, toxicity data and cleanup levels have changed since the time of remedy selection. The MDH has implemented a new HRL for TCE found in private drinking water supplies.

The ROD for the Site identified potential public and/or private supply wells installed between the Site and the Mississippi River as potential exposure pathways. While no wells have been installed between the Site and the river, drinking water criteria applicable to private supply wells have been revised since the time of remedy selection. Standards and criteria which are "to be considered (TBC)" identified in the ROD include Safe Drinking Water Act MCLs and other federal and state promulgated standards.
The MDH issues HRLs which are standards promulgated into law. The MCLs are applicable to public drinking water supplies as measured at the tap. The MDH HRLs are drinking water standards issued by the MDH and applied as groundwater cleanup goals enforceable by MPCA. The promulgated HRL is equivalent to the MCL and the MDH issued a new HRL for TCE in 2015 based on new toxicity data developed by EPA. The HRL for TCE is 0.4 µg/L. At the time of this FYR, the HRL is a TBC which would be applicable in the event that a private supply well would be installed between the Site and the Mississippi River.

Exposure assumptions in the ROD indicated that the primary exposure concern was either from directly ingesting groundwater or by ingesting river water that had been impacted by groundwater discharge to the river. Direct ingestion of groundwater was considered through monitoring of potential installation of drinking water wells between the Site and the Mississippi River. Ingestion of impacted river water was considered due to the MWW drinking water intake located approximately one-half mile downstream of the Site.

Two groundwater seeps have been identified downgradient of the Site on MWW property. During high water periods, the groundwater seeps are below the river level; however, the seeps are exposed during lower water periods. Previously, access to the seeps was considered difficult due to the steep riverbank. Changes to the river bank have occurred which allow for greater access to the seeps. In September 2009, the hillside surrounding a 96-inch stormwater drain located just to the north of the seeps collapsed.

The hillside and drain were reconstructed in the fall of 2009. Reconstruction of the hillside has resulted in a more gradual slope to the river and thus easier access to the seep area. The seeps present potential exposure points which were not considered by the ROD. Standards applicable to the seeps are surface water standards as promulgated under Minnesota Rule 7050.[2] The Mississippi River is classified as a Class 2Bd river adjacent to the Site which classifies the river for all commercial, recreational, and drinking water purposes. The established chronic standards for TCE and PCE for Class 2Bd waters are 25 µg/L and 3.8 µg/L, respectively. During this review period, the PRP installed fencing and signage around the seeps to limit access to the seeps. The PRP also conducted a Focused RA which indicated that exposure to constituents in seep water or surface water of the river should not pose an unacceptable risk to human health and that ecological receptor populations should not experience adverse health effects from exposure to Site-related constituents.

The vapor intrusion pathway was also not considered at the time of remedy selection. A full evaluation of the vapor intrusion pathway has not yet been completed at or downgradient of the Site. A preliminary investigation of vapor intrusion at the MWW property has been conducted by the MWW and has shown a potential for vapor intrusion. At the time of this FYR, the PRP was in the process of conducting a vapor intrusion investigation at the MWW property to fully evaluate the vapor intrusion pathway. MPCA, MWW, and BAE anticipate further discussion of vapor intrusion results upon receipt of a finalized report from the investigation. Potential vapor intrusion at the Site property and the Anoka County Park are not anticipated due to the absence of potential receptors in those locations.

QUESTION C: Has any other information come to light that could call into question the protectiveness of the remedy?

Question C Summary

Yes. Information has come to light since the selection of the remedy that may affect the protectiveness of the remedy including property redevelopment, increased groundwater use in the vicinity of the Site, and reconstruction of the riverbank.

The Naval Industrial Reserve Ordnance Plant (NIROP) Superfund site and BAE RCRA facility, both located immediately north of the FMC Site, have been redeveloped for commercial and light industrial purposes. The redevelopment was executed in phases and began on the southern half of the property, immediately north of and adjacent to the FMC Site in 2014. The Navy (the PRP at the NIROP site), EPA, and MPCA were involved with the redevelopment of the property in order to assure that the redevelopment is conducted in a manner protective of human health and the environment.
No redevelopment of the FMC Site is anticipated at the time of this FYR. Given the proximity of the Site to the redevelopment, however, potential vapor intrusion exposure pathways may need to be evaluated along the north property boundary of the FMC Site. ICs which are in place or in progress are anticipated to provide protectiveness for groundwater and soil exposure risks.

The City of Fridley (the City) has indicated its intent to increase use of Fridley Municipal Well 13 located approximately one-half mile north of the Site. Historically this well has been utilized to supply water during emergency or high water-demand periods. The City provided formal notification to MPCA of its intent to evaluate bringing Well 13 into regular use in a letter dated October 13, 2012. The letter also acknowledged the MPCA and MDH requirement for notification when the well is put into operation. In 2014 and 2017, the City, in consultation with the MDH, conducted a pumping test to evaluate potential effects that operation of this well would have on groundwater at contaminated sites in

[2] As noted earlier, surface water criteria were not identified as ARARs in the ROD; only MCLs were identified as ARARs.

the southwest Fridley area, including the FMC Site. Both tests were stopped prior to completion due to increasing lead concentrations that exceed the discharge permit limit (one part per billion). MDH indicated that additional VOC aquifer testing will not be considered until the lead contamination issue has been resolved. Although influence at the FMC Site is expected to be minimal, additional information is necessary to evaluate whether long-term use of Fridley Municipal Well 13 will affect groundwater at the FMC Site.

Investigations conducted during this review period determined that either further actions may be needed to clean up Site soil to UU/UE or ICs may be needed to assure that soil remains protective in the long term.

VI. ISSUES/RECOMMENDATIONS

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the Five-Year Review:
None

Issues and Recommendations Identified in the Five-Year Review:

OU(s): OU1	**Issue Category:** Remedy Performance			
	Issue: Capture zone analysis indicates groundwater plume is not adequately captured.			
	Recommendation: Evaluate and expand extraction well network to increase capture zone and monitoring well network to demonstrate capture.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA/State	9/30/2020

OU(s): OU1	**Issue Category:** Monitoring			
	Issue: A full evaluation of potential vapor intrusion has not been completed.			
	Recommendation: Evaluate potential vapor intrusion pathways which could be affected by Site contaminants.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
Unknown	Yes	PRP	EPA/State	9/30/2020

OU(s): OU1 and Soil	**Issue Category:** Institutional Controls
	Issue: Need to evaluate existing ICs, and to develop and implement long-term stewardship procedures.

	Recommendation: Develop an ICIAP to evaluate the effectiveness of the existing ICs, the need for any additional ICs, and to ensure that long-term stewardship procedures are developed and implemented.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA/State	9/30/2021

OU(s): OU1	**Issue Category:** Changed Site Conditions			
	Issue: Three additional potential source areas were found that could be contributing to groundwater contamination.			
	Recommendation: Evaluate options to address the source areas and implement a plan to address the areas.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA/State	9/30/2021

OU(s): OU1	**Issue Category:** Remedy Performance			
	Issue: Contaminant concentrations which exceed surface water standards are being discharged to the Mississippi River at the seeps.			
	Recommendation: Further evaluate remedial options including system enhancement and other technologies in order to achieve appropriate surface water standards.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA/State	9/30/2021

OU(s): soil	**Issue Category:** Changed Site Conditions			
	Issue: On-Site soil contamination levels do not support UU/UE.			
	Recommendation: Evaluate risk and options (i.e., removal of soil, ICs, etc.) to ensure protectiveness in the long term and implement those options.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA/State	9/30/2021

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)		
Operable Unit:	*Protectiveness Determination:*	*Planned Addendum Completion Date:*
OU1	Protectiveness Deferred	

	9/30/2020
Protectiveness Statement: A protectiveness determination of the remedy at OU1 cannot be made until further information is obtained. Further information will be obtained to determine whether the vapor intrusion pathway is complete and whether vapor intrusion poses an unacceptable risk. It is expected that these actions will take approximately twelve months to complete at which time a protectiveness determination will be made.	

Protectiveness Statement(s)	
Operable Unit: Soil	*Protectiveness Determination:* Short-term Protective
Protectiveness Statement: Soil removal actions were conducted prior to implementation of the ROD and decision documents for the Site. EPA and MPCA have found those soil removal actions to be currently protective of human health and the environment. However, in order for the remedy to be protective in the long term, the following actions need to be taken to ensure protectiveness: either additional actions need to be implemented to clean up the soil to levels that allow for UU/UE or ICs will need to be selected and implemented.	

Sitewide Protectiveness Statement	
Protectiveness Determination: Protectiveness Deferred	*Planned Addendum Completion Date:* 9/30/2020
Protectiveness Statement: A protectiveness determination of the Sitewide remedy cannot be made until further information is obtained. Further information will be obtained to determine whether the vapor intrusion pathway is complete and whether vapor intrusion poses an unacceptable risk. It is expected that these actions will take approximately twelve months to complete at which time a protectiveness determination will be made.	

VIII. NEXT REVIEW

The next FYR report for the FMC Corporation Superfund Site is required within five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

Reference List

Arcadis US, Inc, 2015. ERD Pilot Study, Tracer Test and Source Investigation Report. FMC Corporation Site, Fridley, MN. November 2015.

Arcadis US, Inc, 2015. Groundwater Remediation System 2013 Annual Monitoring Report. FMC Corporation Site, Fridley, MN. January 2015.

Arcadis US, Inc, 2016. Groundwater Remediation System 2014 Annual Monitoring Report. FMC Corporation Site, Fridley, MN. February 2016.

Arcadis US, Inc, 2016. Groundwater Remediation System 2015 Annual Monitoring Report. FMC Corporation Site, Fridley, MN. June 2016.

Arcadis US, Inc, 2018. 2016 Site Investigation Report. FMC Corporation Site, Fridley, MN. January 2018.

Arcadis US, Inc, 2018. Focused Risk Assessment Report. FMC Corporation Site, Fridley, MN. August 2018.

Arcadis US, Inc, 2018. Groundwater Remediation System 2016 Annual Monitoring Report. FMC Corporation Site, Fridley, MN. March 2018.

Arcadis US, Inc, 2018. Work Plan for Vapor Intrusion Sampling at the Fridley Filter Plant. FMC Corporation Site, Fridley, MN. September 13, 2018.

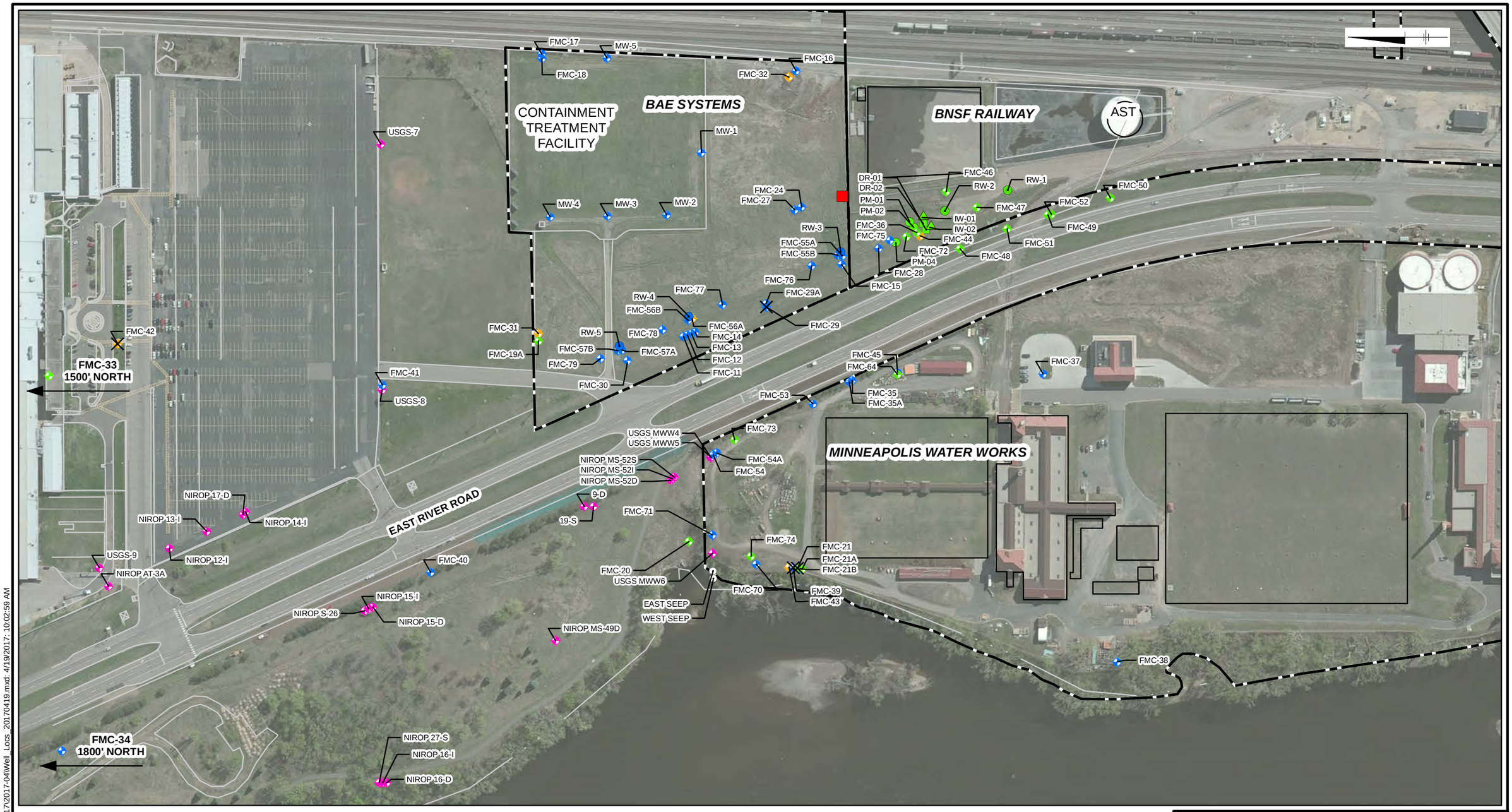
Barr Engineering Co, 2015. 2014-2015 Vapor Intrusion Investigation Report. Water Treatment and Distribution Services Division – Fridley Facility. City of Minneapolis Public Works Department. September 2015.

APPENDIX B – SITE CHRONOLOGY

Site Chronology

Event	Date
Former FMC employee informed the Minnesota Pollution Control Agency (MPCA) of the disposal of industrial and hazardous waste from the 1940s through 1969 on the FMC site	November 1980
FMC, at the request of the MPCA, initiated an investigation of the FMC site	December 1980
Administrative Order and Interim Response Order by Consent (Consent Order)	June 8, 1983
FMC site placed on the National Priorities List (NPL)	September 8, 1983
MPCA executed an FMC site Enforcement Decision Document under the Minnesota Environmental Liability and Response Act (MERLA) that documented the MPCA's Selection of a Remedial Action (RA) for the contaminated groundwater at the site	October 16, 1986
FMC and the MPCA signed a Response Order by Consent under MERLA for the implementation of the RA	October 28, 1986
FMC site Record of Decision (ROD) is signed, which documented EPA's selection of the RA for the contaminated groundwater at the site	September 30, 1987
Initiation of groundwater extraction from the extraction wells on the FMC site	December 7, 1987
Completion of the First Five-Year Review (FYR) Report	September 30, 1992
Completion of the Second FYR Report	March 30, 1999
Extraction Well Capture Zone Analysis	June 2003 and June 2004
Completion of the Third FYR Report	March 17, 2004
Quality Assurance Project Plan for the site is updated	March 2004
Vertical Aquifer Profiling was conducted at the site to further understand site geologic conditions	August 2004 and October 2005
Monitoring Well Network modified, eliminating long screened wells.	October 2005
Seep assessment and dye tracer study performed	August 2007
Completion of the Fourth FYR Report	September 30, 2009
Supplemental Investigation Report	May 2012
Initiation of the enhanced reductive dechlorination (ERD) Pilot Study	September 2012
On-site treatment of groundwater by air stripping begins	May 2013
Explanation of Significant Differences (ESD) issued	September 2013
Completion of the Fifth FYR Report	September 29, 2014
ERD pilot test concluded	March 2015
ERD Pilot Study, Tracer Test and Source Investigation Report	November 2015
Focused Risk Assessment Report	May 2016
Supplemental Site investigation performed	October – November 2016
Supplemental Site Investigation Report	January 2018
Focused Risk Assessment Report, Revised	August 18, 2018

APPENDIX C – FIGURES



LEGEND:

- ABANDONED WELL
- UPPER ALLUVIUM WELL
- LOWER ALLUVIUM WELL
- BEDROCK WELL
- OTHER WELL (INSUFFICIENT INFORMATION AVAILABLE)
- UPPER ALLUVIUM INJECTION WELL
- UPPER ALLUVIUM DOSE RESPONSE WELL
- UPPER ALLUVIUM PERFORMANCE MONITORING WELL
- UPPER ALLUVIUM RECOVERY WELL
- LOWER ALLUVIUM RECOVERY WELL
- SEEP
- AIR STRIPPER
- PROPERTY BOUNDARY
- STRUCTURE

0 200 400 Feet

GRAPHIC SCALE

NOTES:

AERIAL IMAGE: ESRI WORLD IMAGERY

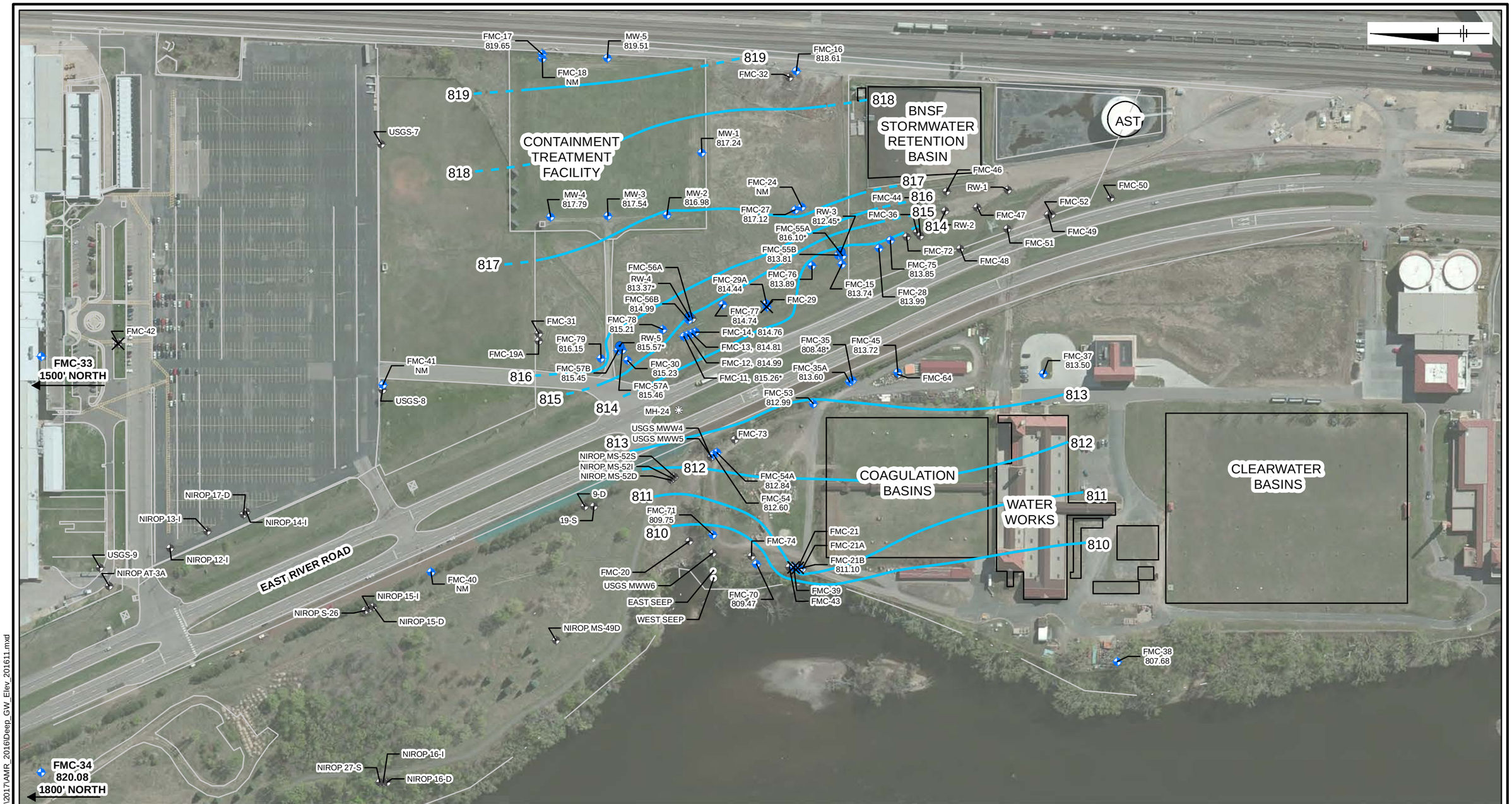
FMC CORPORATION SITE
FRIDLEY, MINNESOTA

SITE LAYOUT

ARCADIS

FIGURE 1

CITY: MPLS DIV/GROUP: 40 DB: MG
BAE-FRIDLEY, MN (MN000553)
Z:\GISProjects_ENV\BAE_Fridley\ArcMap\2017\2017-04\Well_Locs_20170419.mxd: 4/19/2017: 10:02:59 AM



LEGEND:

- ABANDONED WELL
- LOWER ALLUVIUM WELL
- LOWER ALLUVIUM RECOVERY WELL
- WELL NOT SCREENED IN LOWER ALLUVIUM**
- MANHOLE
- SEEP
- CURRENT AND/OR PREVIOUS STRUCTURE
- GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED) (FEET ABOVE MEAN SEA LEVEL)

0 200 400 Feet

GRAPHIC SCALE

NOTES:

1. AERIAL IMAGE: ESRI WORLD IMAGERY
2. RW-3, RW-4, AND RW-5 ARE PUMPING EXTRACTION WELLS
3. * WATER LEVEL NOT USED TO GENERATE CONTOURS
4. **INCLUDES WELLS WITH INSUFFICIENT INFORMATION
5. NM - NOT MEASURED

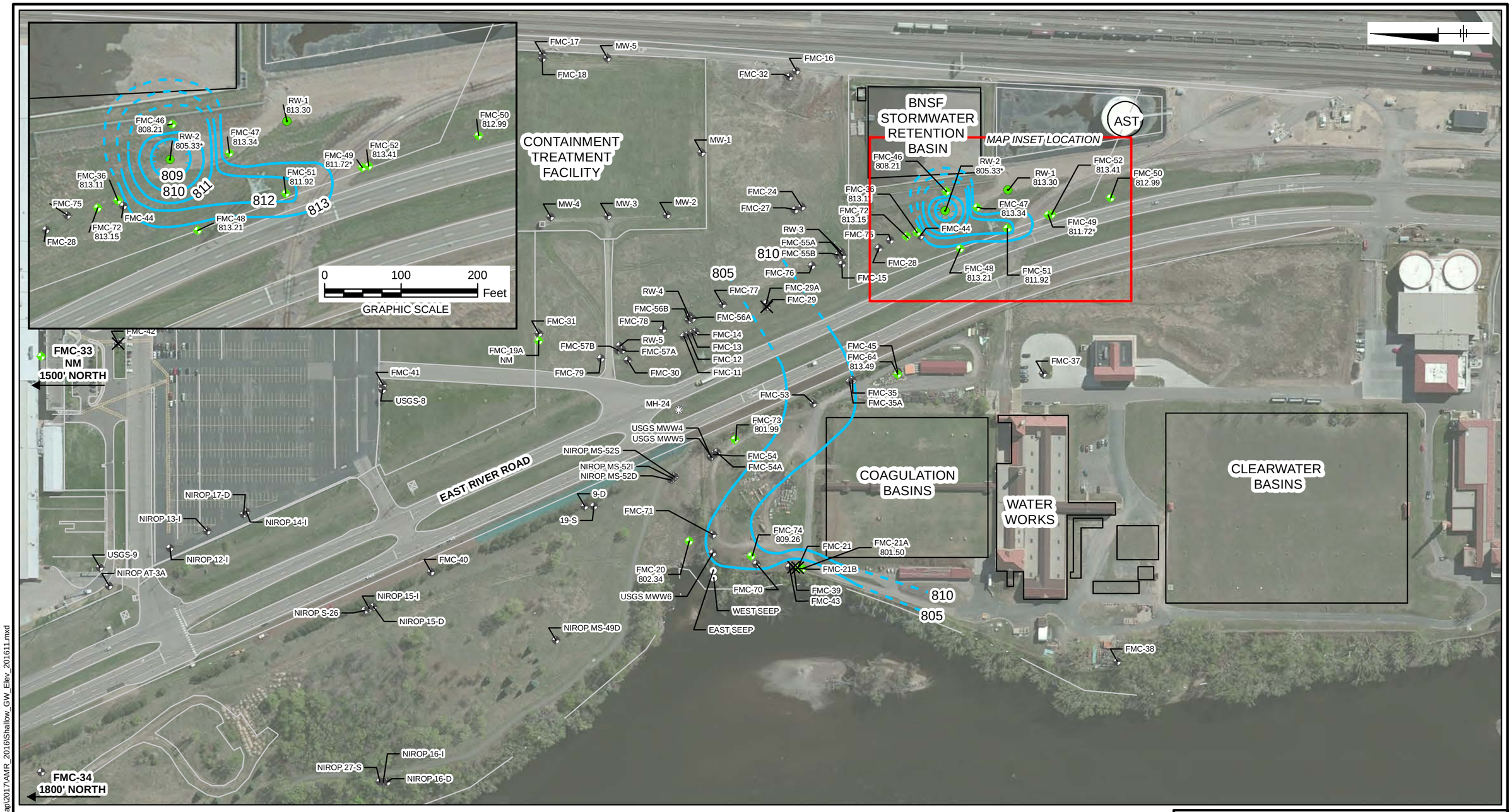
FMC CORPORATION SITE
FRIDLEY, MINNESOTA

GROUNDWATER ELEVATION CONTOUR MAP LOWER ALLUVIUM - NOVEMBER 2016

ARCADIS

FIGURE 2

CITY: MPLS DIV/GROUP: 40 DB: MG
BAE-FRIDLEY, MN (MN000553)
Path: Z:\GISProjects_ENV\BAE_Fridley\ArcMap\2017\AMR_2016\Deep_GW_Elev_201611.mxd



LEGEND:

- ABANDONED WELL
- UPPER ALLUVIUM WELL
- UPPER ALLUVIUM RECOVERY WELL
- WELL NOT SCREENED IN UPPER ALLUVIUM**
- MANHOLE
- SEEP
- CURRENT AND/OR PREVIOUS STRUCTURE
- GROUNDWATER ELEVATION CONTOUR (DASHED WHERE INFERRED) (FEET ABOVE MEAN SEA LEVEL)
- INFERRED DRAWDOWN DUE TO PUMPING

0 200 400 Feet
GRAPHIC SCALE

NOTES:

1. AERIAL IMAGE: ESRI WORLD IMAGERY
2. * WATER LEVEL NOT USED TO GENERATE CONTOURS
3. **INCLUDES WELLS WITH INSUFFICIENT INFORMATION
4. NM - NOT MEASURED

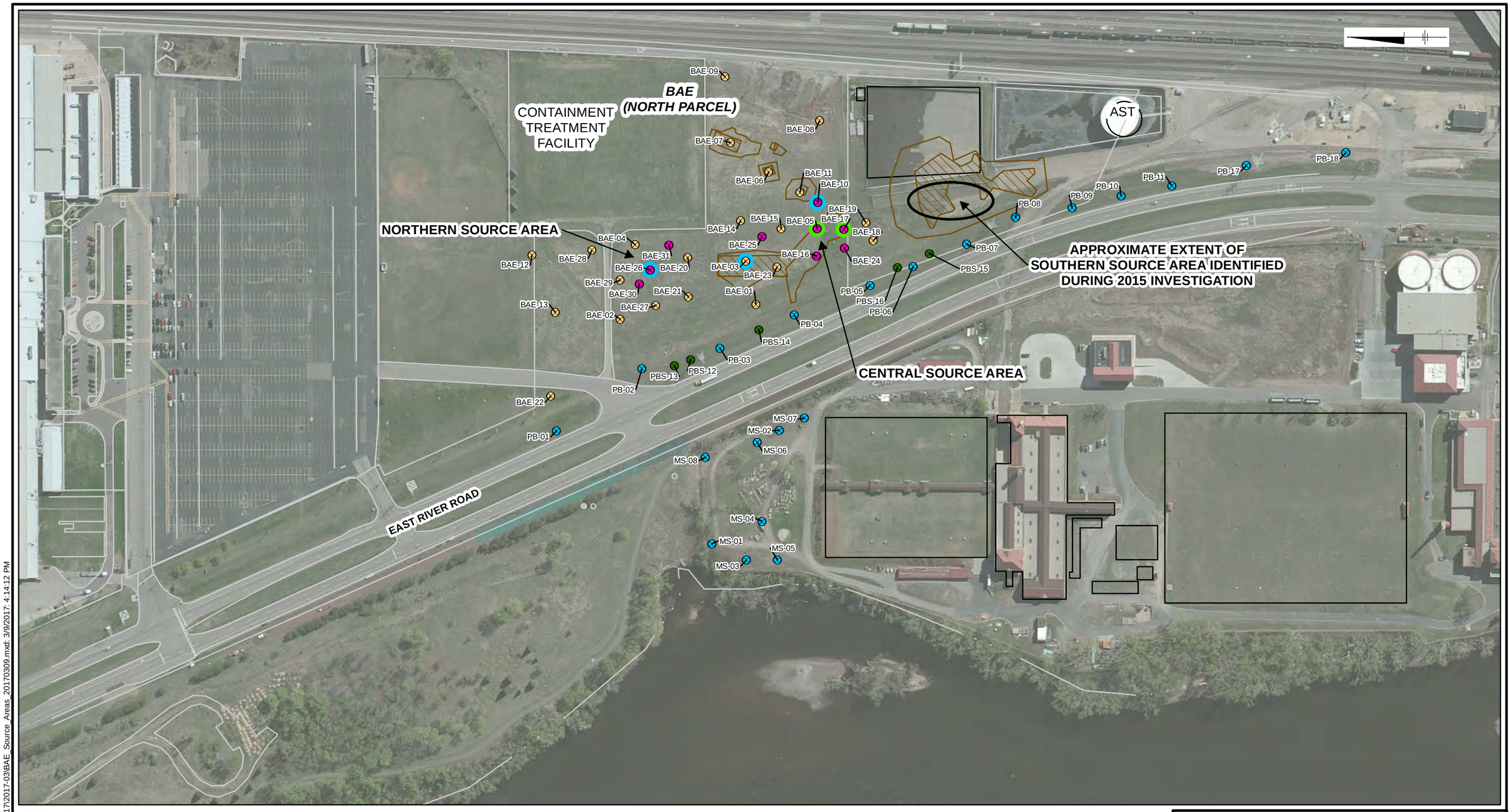
FMC CORPORATION SITE
FRIDLEY, MINNESOTA

GROUNDWATER ELEVATION CONTOUR MAP UPPER ALLUVIUM - NOVEMBER 2016

ARCADIS

FIGURE 3

CITY: MPLS DIV/GROUP: 40 DB: MG
BAE-FRIDLEY, MN (MN000553)
Path: Z:\GISProjects_ENV\BAE_Fridley\ArcMap\2017\AMR_2016\Shallow_GW_Elev_201611.mxd



LEGEND:

- SOIL BORING
- GROUNDWATER BORING
- SOIL AND GROUNDWATER BORING
- BORING LOCATIONS TCE >1 MG/KG
- BORING LOCATIONS NEGATIVE NAPL TEST
- BORING LOCATIONS POSITIVE NAPL TEST
- STRUCTURE
- LIMIT OF SOIL CONTAMINATION (SOILS REMOVED 1983)
- LIMIT OF 1983 EXCAVATED SOILS

MG/KG = MILLIGRAMS PER KILOGRAM
NAPL = NONAQUEOUS PHASE LIQUIDS
TCE = TRICHLOROETHENE

0 200 400 Feet
GRAPHIC SCALE

NOTES:
1. AERIAL IMAGE: ESRI WORLD IMAGERY

FMC CORPORATION SITE
FRIDLEY, MINNESOTA

SOURCE AREAS MAP

ARCADIS

FIGURE 4

APPENDIX D – SPECIAL WELL BORING AND CONSTRUCTION AREA MEMORANDUM

Protecting, maintaining and improving the health of all Minnesotans

M E M O R A N D U M

DATE: September 3, 2015

TO: Licensed and Registered Well Contractors
Advisory Council on Wells and Borings
City of Fridley
City of Columbia Heights
Minneapolis Water Works
Reviva
BAE Systems
Kurt Manufacturing
U.S. Navy
Minnesota Pollution Control Agency
Interested Persons

FROM: Thomas P. Hogan, Director
Environmental Health Division
P.O. Box 64975
St. Paul, Minnesota 55164-0975

PHONE: 651-201-4675

SUBJECT: Notice of Designation of Special Well and Boring Construction Area in Southwestern Fridley and Southwestern Columbia Heights, Anoka County, Minnesota

Minnesota Department of Health (MDH) is designating a Special Well and Boring Construction Area (SWBCA), for portions of southwestern Fridley and southwestern Columbia Heights, Anoka County, as shown in the attached map (Figure 1). The SWBCA designation becomes effective on October 1, 2015, and will remain in effect until further notice.

AUTHORITY

Minnesota Statutes, section 103I.101, subdivision 5, paragraph 7, grants the commissioner of health the authority to establish standards for the construction, maintenance, sealing, and water quality monitoring of wells in areas of known or suspected contamination. Minnesota Rules, part 4725.3650, details the requirements for construction, repair, and sealing of wells within a designated SWBCA, including plan review and approval, water quality monitoring, and other measures necessary to protect public health, prevent the spread of contamination and degradation of groundwater.

HISTORY

The southwest portion of Fridley, Minnesota, contains several Federal and State Superfund sites and one Resource Conservation and Recovery Act site:

- Naval Industrial Reserve Ordnance Plant (NIROP) site.
- FMC Corporation -Fridley site.
- BAE Systems RCRA site.
- Kurt Manufacturing site.
- Dealers Manufacturing (now known as Reviva).

The sites have been under investigation or have implemented remediation systems since the 1980s.

Minnesota Pollution Control Agency (MPCA) has requested the establishment of a SWBCA due to the presence of chlorinated solvents and their breakdown products in the groundwater.

HYDROGEOLOGY

The geology of the site consists of glacial and alluvial deposits of silts and clays interbedded with sand and gravel ranging up to 130 feet in thickness near the Mississippi River. These deposits overlie the basal St. Peter sandstone or the Shakopee member of the Prairie du Chien Group where the St. Peter has been eroded. The Jordan sandstone and older Paleozoic formations underlie the Prairie du Chien Group. Groundwater flow in the glacial and alluvial deposits is complex, but in general flows from the northeast to the southwest toward the Mississippi River, with vertical downward gradients in the eastern portion of the area and upward gradients near the Mississippi River. Groundwater flow in the bedrock is predominately to the southwest.

GROUNDWATER CONTAMINATION

Groundwater in proximity to the southwest Fridley sites has been impacted by a variety of chlorinated ethenes and their degradation products. The contaminants of primary concern at these sites are 1,1,2-trichloroethylene (TCE) and tetrachloroethylene (PCE). Breakdown or degradation products include dichloroethene (DCE) and vinyl chloride (VC). Concentrations of up to 19,600 micrograms per liter (µg/L) of TCE and 961 µg/L of PCE have been detected. A number of investigations have documented extensive contamination in the glacio-fluvial terrace and alluvial deposits east of the Mississippi River and in the underlying bedrock formations, particularly the Prairie du Chien Group (dolomite and sandstone) and Jordan Sandstone.

PUBLIC HEALTH CONCERNS

The primary contaminant of concern within the SWBCA is TCE. Exposure to high levels of TCE in drinking water can damage the liver, kidneys, immune system, and nervous system. Exposure to low levels of TCE over a long period of time has been linked to an increased risk of several types of cancer (kidney, liver, and Non-Hodgkin Lymphoma). TCE may also harm a developing fetus if the pregnant mother is exposed in the first trimester. MDH Health Based Value (HBV) for TCE in drinking water is 0.4 µg/L. The Maximum Contaminant Level (MCL) established by the United States Environmental Protection Agency (USEPA) is 5 µg/L for TCE. The MCL standard applies to water delivered by community and nontransient, noncommunity public-water supplies. Other contaminants of concern include PCE and vinyl chloride. Exposure to PCE has been linked to some types of cancer and to kidney and nervous system damage. MDH Health Risk Limit (HRL) and USEPA MCL for PCE in drinking water is 5 µg/L. Exposure to vinyl chloride has been linked to liver and circulatory system cancers. MDH HRL for vinyl chloride in drinking water is 0.2 µg/L and USEPA MCL is 2 µg/L.

BOUNDARIES OF THE SPECIAL WELL AND BORING CONSTRUCTION AREA

The designated SWBCA is bounded on the west by the Mississippi River, on the south by the Anoka-Hennepin County line (37th Avenue Northeast), on the east by University Avenue, and on the north by Interstate 694. The SWBCA includes: that part of the south half (S1/2) of Section 22 lying south of Interstate 694; that part of the west half of the southwest quarter (W1/2, SW1/4) of Section 23 lying south of Interstate 694; the west half of the northwest quarter (W1/2, NW1/4) and the west half of the southwest quarter (W1/2, SW1/4) of Section 26; Section 27; Section 34; and the west half of the northwest quarter (W1/2, NW1/4) and the west half of the southwest quarter (W1/2, SW1/4) of Section 35; all in Township 30 North, Range 24 West, Anoka County.

REQUIREMENTS OF THE SWBCA

1. All wells and borings regulated by MDH are subject to the requirements of the SWBCA. Wells include water-supply wells used for domestic, public, irrigation, commercial/industrial, cooling/heating, or remedial purposes; monitoring wells; and dewatering wells. Borings include environmental bore holes, elevator borings, and bored geothermal heat exchangers. Notifications and permit applications, and their respective fees, must be submitted to MDH.
2. Construction of a new well or boring, or modification of the depth of an existing well or boring, may not occur until a plan has been reviewed and approved in writing by MDH. In addition to the normally required notification or permit application, with fee, the plan must include the following information: street address; well or boring depth; casing type(s), diameter(s), and depth(s) for each casing; construction methods, including grout materials and grouting methods; anticipated pumping rate; and use.
3. As a condition of the well or boring construction plan approval, the well or boring owner must agree to pay for a volatile organic chemical (VOC) analysis, to be performed by MDH Public Health Laboratory. MDH will review the analytical results and determine if the well can be completed, if the well must be reconstructed in another manner, or if the well must be permanently sealed. Testing requirements may be waived depending on the location, depth, and use of the well or boring.
4. Special construction, location, use, and monitoring may be required for a well or boring in order to protect the public health and groundwater quality and to prevent contaminant migration. These requirements will be based on available knowledge of groundwater contaminant movement near the well or boring location and the proposed use and pumping rate of the well. MDH may require the requestor to provide detailed hydrogeologic pumping model data, or perform pumping tests to show that pumping will not adversely impact existing remediation systems or the contamination plume.
5. Construction of a community public water-supply well must not take place unless, and until, the well site and well plans and specifications have been reviewed and approved by MDH in accordance with Minnesota Rules, part 4725.5850. MDH may approve completion of a public water-supply well within the designated SWBCA if the system owner/operator can demonstrate that the water delivered to the distribution system meets MCLs established by the USEPA or other health guidelines referenced by MDH, either through treatment, blending with other sources, monitoring, or other mechanisms.
6. A water-supply well may be allowed, provided that MDH, with assistance from the MPCA and other agencies as needed, determine that the well will not interfere with remediation efforts, cause further spread of contamination, or result in environmental or human exposures in excess of environmental and public health standards.

7. Borings, including environmental bore holes, elevator borings, and bored geothermal heat exchangers, may be allowed, provided that they are properly constructed and grouted.
8. No well or boring may be permanently sealed until MDH has reviewed and approved the plan for the proposed sealing. In addition to the required notification and fee, the plan must include the following information: street address; original well/boring depth; current well/boring depth (if different); casing type(s), diameters(s), and depth(s); methods of identifying and sealing any open annular spaces; methods for identifying and removing any obstruction(s); grout materials; and placement methods. All wells and borings within the SWBCA must be sealed with neat cement grout or cement sand grout.
9. All other provisions of Minnesota Rules, chapter 4725, are in effect.

PERSONS TO CONTACT

For additional information regarding this SWBCA, please contact Mr. Edward Schneider of MDH Well Management Section at 651-201-4586 or ed.schneider@state.mn.us.

Plans for the construction, modification (including repair), or sealing of wells or borings within the SWBCA must be submitted to:

Mr. Patrick Sarafolean
Minnesota Department of Health
Well Management Section – Metro District
P.O. Box 64975
St. Paul, Minnesota 55164-0975
651-201-3962
patrick.sarafolean@state.mn.us

Notifications/permit applications for either construction or sealing of wells and borings must still be mailed or faxed to MDH Central Office at:

Minnesota Department of Health
Well Management Section
P.O. Box 64502
St. Paul, Minnesota 55164-0502
651-201-4599 (Fax)

For information regarding public health concerns, please contact:

Mr. Daniel Pẽna
Minnesota Department of Health
Site Assessment and Consultation Unit
P.O. Box 64975
St. Paul, Minnesota 55164-0975
651-201-4920
daniel.pena@state.mn.us

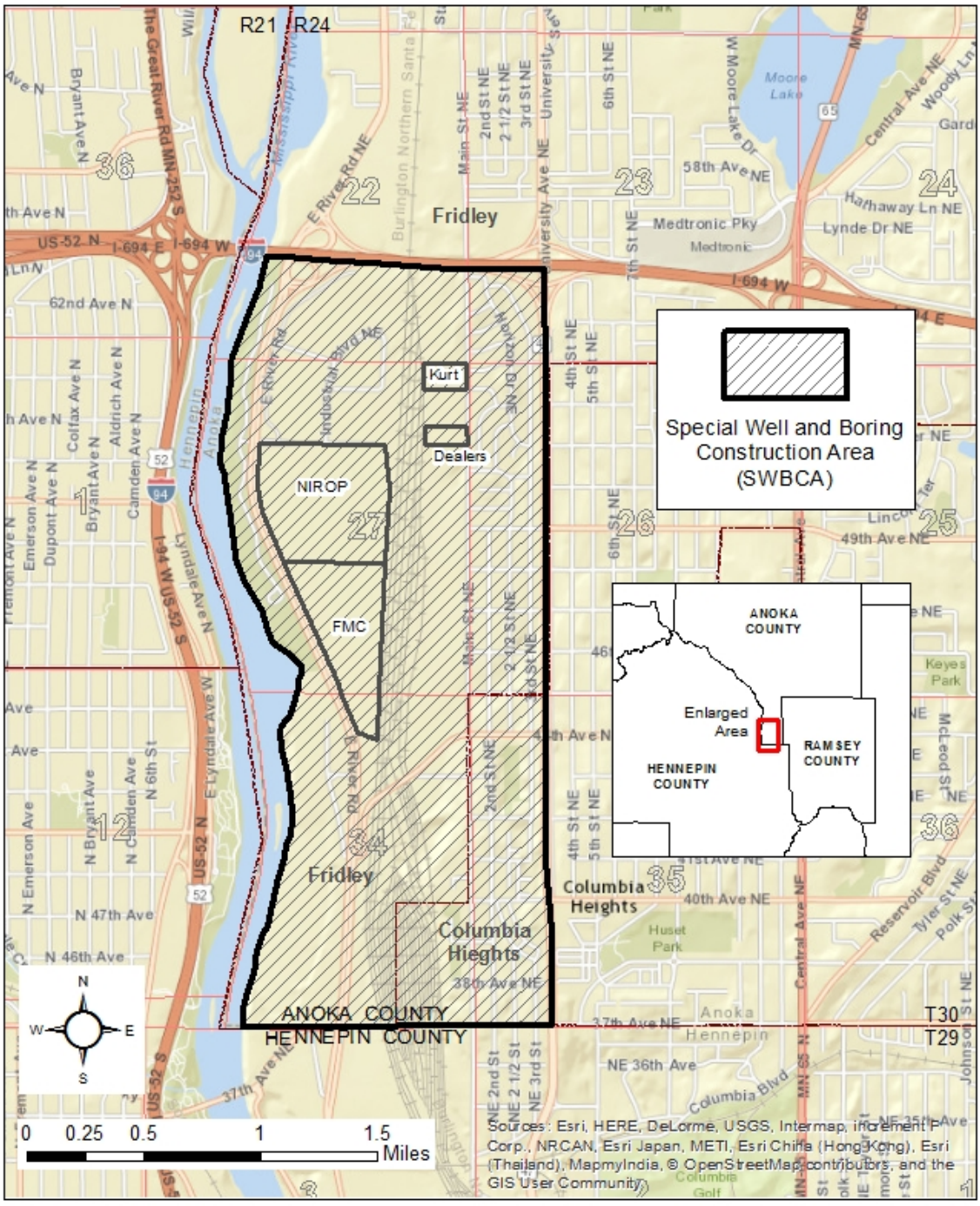
For information regarding groundwater quality and the investigation, monitoring, and remediation of groundwater contamination, please contact:

Mr. Greg Small
Minnesota Pollution Control Agency
Site Remediation and Redevelopment Section
520 Lafayette Road
St. Paul, Minnesota 55155-4194
651-757-2304
gregory.small@state.mn.us

Ms. Shanna Schmitt
Minnesota Pollution Control Agency
Site Remediation and Redevelopment Section
520 Lafayette Road
St. Paul, Minnesota 55155-4194
651-757-2697
shanna.schmitt@state.mn.us

TPH:ECS:fal
Attachment

Figure 1. Special Well and Boring Construction Area
Southwest Fridley and Southwest Columbia Heights, Anoka County



Minnesota Department of Health - Well Management Section
August 28, 2015
SW Fridley Columbia Heights SWBCA.mxd

APPENDIX E – TABLES FROM
2016 ANNUAL MONITORING REPORT

Table E-1
Groundwater VOC Analytical Results from Monitoring Wells and Receptor Points
BAE Systems
FMC Corporation Site
Fridley, Minnesota

Parameter		Trichloroethene	Tetrachloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl chloride	1,1,2,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	Carbon Tetrachloride	Dichloromethane
MDH Health Based Water Guidance		*0.4*	*5*	*50*	*100*	*0.2*	*2*	*9,000*	*100*	*200*	*4*	*3*	*5*
Maximum Contaminant Level		5	5	70	100	2	NS	200	NS	7	5	5	5
FMC-11	11/6/2013	*1.4*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-12	11/7/2013	*1.6*	0.95 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-13	10/26/2006	***8.1***	2.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/26/2006	***8.6***	2.4	ND	ND	ND	ND	1.2	ND	ND	ND	ND	ND
	10/24/2007	***8.0***	2.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2008	***11.4***	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/15/2009	*5.0*	1.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/13/2010	*3.6*	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/17/2011	***8.5***	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/11/2012	***5.3***	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/5/2013	*2.5*	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/28/2014	*3.7*	1.2	0.23 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/28/2015	*3.7*	0.86 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/4/2016	*2.7*	0.94 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-14	10/27/2005	***773***	***375***	2.7	ND	ND	ND	68.5	10.0	1.5	ND	ND	ND
	10/27/2006	***178***	***120***	3.8	ND	ND	ND	4.4	4.3	ND	ND	ND	ND
	10/24/2007	***564***	***145***	5.7	ND	ND	ND	15.9	30.8	ND	ND	ND	ND
	10/24/2008	***1,110***	***807***	5.2	ND	ND	ND	128	15.2	3.7	ND	ND	ND
	10/15/2009	***321***	***443***	2.5	ND	ND	ND	30.1	6.5	ND	ND	ND	ND
	10/13/2010	***456***	***121***	*11.9*	ND	ND	ND	10.0	14.9	ND	ND	ND	ND
	10/19/2011	***233***	***87.6***	2.0	ND	ND	ND	3.8	6.1	ND	ND	ND	ND
	10/11/2012	***301***	***188***	2.8	ND	ND	ND	6.2	8.0	ND	ND	ND	ND
	11/5/2013	***280***	***134***	2.5	ND	ND	ND	4.2	9.2	ND	ND	ND	ND
	10/28/2014	***236***	***94.9***	2.1	ND	ND	ND	4.3	9.9	ND	ND	ND	ND
	10/28/2015	***510***	***129***	2.4 J	ND	ND	ND	6.5	9.6	ND	ND	ND	ND
	11/4/2016	***283***	***38***	5.2	0.59 J	ND	ND	4.2	9.6	ND	ND	ND	ND
FMC-15	10/28/2015	***230***	3	47	1.5 J	ND	ND	ND	7.7	ND	ND	ND	ND
	10/24/2007	***580***	***5.7***	***141***	2.6	*0.72 J*	ND	ND	22.7	ND	ND	ND	ND
	10/24/2008	***293***	3.2	***89.7***	ND	*0.48 J*	ND	ND	13.2	ND	ND	ND	ND
	10/15/2009	***169***	2.7	*68.2*	ND	ND	ND	ND	9.5	ND	ND	ND	ND
	10/13/2010	***492***	*4.3*	***168***	2.6	*0.70*	ND	ND	20.3	1.5	ND	ND	ND
	10/19/2011	***236***	3.5	*49.5*	ND	0.17	ND	ND	7.6	ND	ND	ND	ND
	10/11/2012	***186***	3.0	*55.8*	ND	ND	ND	ND	7.3	ND	ND	ND	ND
	11/5/2013	***324***	3.6	*69.7*	1.3	ND	ND	ND	11.4	1.2	ND	ND	ND
	10/28/2014	***204***	3.4	*47.2*	0.80 J	0.13 J	ND	0.39 J	7.4	0.74 J	ND	ND	ND
	10/28/2015	***230***	3.0	*47.0*	1.5 J	ND	ND	ND	7.7	ND	ND	ND	ND
	11/4/2016	***317***	2.7	*80.7*	1.3 J	ND	ND	0.46 J	24.6	1.2 J	ND	ND	ND
FMC-17	5/30/2006	ND	2.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/24/2006	ND	2.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/27/2007	ND	2.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/22/2007	ND	1.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/29/2008	ND	1.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/21/2008	ND	2.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/22/2009	ND	1.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/13/2009	ND	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/18/2010	ND	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/11/2010	ND	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/25/2011	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/17/2011	ND	1.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/10/2012	ND	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table E-1
Groundwater VOC Analytical Results from Monitoring Wells and Receptor Points
BAE Systems
FMC Corporation Site
Fridley, Minnesota

Parameter		Trichloroethene	Tetrachloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl chloride	1,1,2,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	Carbon Tetrachloride	Dichloromethane
MDH Health Based Water Guidance		*0.4*	*5*	*50*	*100*	*0.2*	*2*	*9,000*	*100*	*200*	*4*	*3*	*5*
Maximum Contaminant Level		5	5	70	100	2	NS	200	NS	7	5	5	5
FMC-17	10/10/2012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/31/2013	0.35 J	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/9/2014	ND	0.72 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2014	0.16 J	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6/30/2016	ND	1.2	ND	ND	ND	ND	ND	ND	ND	0.074 J	ND	ND
	11/2/2016	0.064 J	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-19A	10/13/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/17/2011	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/11/2012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/7/2013	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-20	10/26/2006	*2.4*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/24/2007	*3.6*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/22/2008	*1.2*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/13/2010	***41.4***	1.4	2.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/17/2011	***15.7***	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/10/2012	***14.0***	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/5/2013	***22.0***	ND	4.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/28/2014	***6.5***	0.66 J	0.15 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/27/2015	***24.7***	1	1.6	ND	ND	ND	ND	0.31 J	ND	ND	ND	ND
	11/4/2016	***11.1***	0.65 J	0.46 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-21A	10/26/2006	***101***	1.2	3.1	ND	ND	ND	ND	7.1	ND	ND	ND	ND
	10/23/2007	***54.2***	ND	4.9	ND	ND	ND	ND	6.6	ND	ND	ND	ND
	10/23/2008	***77.9***	ND	3.2	1.8	ND	ND	ND	5.8	ND	ND	ND	ND
	10/14/2009	***62.7***	ND	3.5	1.3	ND	ND	ND	10.1	ND	ND	ND	ND
	10/12/2010	***97.3***	1.2	4.4	ND	ND	ND	ND	15.0	1.2	ND	ND	ND
	10/17/2011	***86.4***	1.6	2.3	ND	ND	ND	ND	8.5	ND	ND	ND	ND
	10/10/2012	***46.0***	2.1	1.8	ND	ND	ND	ND	4.6	ND	ND	ND	ND
	10/29/2013	***42.7***	*4.9*	3.2	1.2	ND	ND	ND	10.9	0.76 J	ND	ND	ND
	10/27/2014	***31***	1.9	1.4	ND	ND	ND	ND	4.6	0.41 J	ND	ND	ND
	10/29/2015	***155***	1.4	4.7	ND	ND	ND	ND	13.9	1.9	ND	ND	ND
	11/3/2016	***64.0***	1.4	6.0	ND	ND	ND	ND	6.0	0.30 J	ND	ND	ND
FMC-21B	10/26/2006	***155***	ND	4.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2007	***178***	ND	4.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2008	***125***	ND	4.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2008	***117***	ND	4.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/14/2009	***160***	ND	*6.2*	ND	ND	ND	ND	1.6	ND	ND	ND	ND
	10/12/2010	***155***	ND	5.7	ND	ND	ND	ND	1.6	ND	ND	ND	ND
	10/17/2011	***55.5***	ND	1.7	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/10/2012	***79.9***	ND	4.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/29/2013	***63.2***	ND	3.3	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/27/2014	***49***	ND	2.9	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/29/2015	***31***	ND	2.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/3/2016	***33.5***	ND	2.3	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-27	11/7/2013	ND	ND	2.2	ND	*0.46 J*	ND	ND	0.42 J	ND	ND	ND	ND
FMC-28	10/27/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/24/2007	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2008	*1.0*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/15/2009	*1.2*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/15/2009	*1.2*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/13/2010	*1.2*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table E-1
Groundwater VOC Analytical Results from Monitoring Wells and Receptor Points
BAE Systems
FMC Corporation Site
Fridley, Minnesota

Parameter		Trichloroethene	Tetrachloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl chloride	1,1,2,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	Carbon Tetrachloride	Dichloromethane
MDH Health Based Water Guidance		*0.4*	*5*	*50*	*100*	*0.2*	*2*	*9,000*	*100*	*200*	*4*	*3*	*5*
Maximum Contaminant Level		5	5	70	100	2	NS	200	NS	7	5	5	5
FM-28	10/19/2011	***8.6***	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/11/2012	*1.1*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/28/2014	*1.8*	0.46 J	ND	ND	ND	ND	ND	0.34 J	ND	ND	ND	ND
	10/29/2015	*1.8*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/5/2016	1.4	0.32 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-29A	10/15/2012	*3.5*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/5/2013	*3.1*	ND	1.4	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/28/2014	*3.5*	ND	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/30/2015	*3.3*	ND	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/5/2016	2.5	ND	0.56 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-30	10/26/2006	***24.9***	2.7	1.9	ND	ND	ND	ND	1.1	ND	ND	ND	ND
	10/26/2006	***25.4***	2.5	2.1	ND	ND	ND	ND	1.1	ND	ND	ND	ND
	10/24/2007	***22.0***	2.7	1.7	ND	ND	ND	ND	1.2	ND	ND	ND	ND
	10/24/2007	***21.2***	2.6	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/24/2008	***17.3***	2.5	1.4	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/24/2008	***16.9***	2.2	1.4	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/15/2009	***13.6***	2.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/13/2010	***13.3***	1.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/17/2011	***10.0***	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/11/2012	***34.9***	3.7	ND	ND	ND	ND	ND	2.3	ND	ND	ND	ND
	10/30/2013	***38.5***	*4.4*	0.48 J	ND	ND	ND	ND	2.8	ND	ND	ND	ND
	10/24/2014	***7.1***	1.1	0.34 J	ND	ND	ND	ND	0.17 J	ND	ND	ND	ND
	10/28/2015	***25.7***	3	0.49 J	ND	ND	ND	ND	1.1	ND	ND	ND	ND
	11/4/2016	***29.4***	6.7	1.2	ND	ND	ND	0.41 J	2.1	ND	ND	ND	ND
FMC-31	11/7/2013	*2.0*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-32	11/7/2013	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-35	10/26/2006	ND	ND	3.9	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2007	*4.2*	ND	*9.3*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/22/2008	ND	ND	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/13/2009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/12/2010	ND	ND	1.4	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/18/2011	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/11/2012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/29/2015	ND	ND	0.64 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-35A	10/26/2006	***11.9***	1.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2007	***10.5***	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/22/2008	***5.4***	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/13/2009	***6.1***	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/12/2010	***11.6***	1.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/18/2011	*5.0*	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/11/2012	*3.6*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/30/2013	*4.0*	0.99 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/27/2014	*3.6*	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/29/2015	*4.8*	1.1	< 1.0	ND	ND	ND	ND	0.47 J	ND	ND	ND	ND
	11/4/2016	6.3	1.1	0.14 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-36	10/27/2006	***1,410***	***59.1***	***265***	ND	***12.2***	ND	65.2	41.5	ND	ND	ND	ND
	10/24/2007	***4,520***	***122***	***586***	8.2	***8.4***	ND	**522**	37.0	**10.6**	*3.8*	ND	ND
	10/24/2008	***9,410***	***236***	***926***	12.7	***104***	ND	**1,230**	*110*	**42.4**	***10.0***	ND	ND
	10/15/2009	***1,470***	***55.3***	***143***	ND	***4.5***	ND	126	19.1	ND	ND	ND	ND

Table E-1
Groundwater VOC Analytical Results from Monitoring Wells and Receptor Points
BAE Systems
FMC Corporation Site
Fridley, Minnesota

Parameter		Trichloroethene	Tetrachloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl chloride	1,1,2,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	Carbon Tetrachloride	Dichloromethane
MDH Health Based Water Guidance		*0.4*	*5*	*50*	*100*	*0.2*	*2*	*9,000*	*100*	*200*	*4*	*3*	*5*
Maximum Contaminant Level		5	5	70	100	2	NS	200	NS	7	5	5	5
FMC-36	10/14/2010	***6,560***	***94.8***	***786***	ND	***7.2***	ND	**757**	44.8	**17.5**	ND	ND	ND
	10/19/2011	***19,600***	***528***	***1,400***	22.2	***5.6***	ND	**2,230**	*203*	**56.5**	***18.1***	ND	ND
	10/15/2012	***1,910***	***102***	***228***	ND	ND	ND	**242**	ND	ND	ND	ND	ND
	11/6/2013	***4,380***	***111***	***404***	ND	ND	ND	**584**	ND	ND	ND	ND	ND
	2/24/2014	***5,860***	***151***	***682***	ND	***28.8***	ND	**936**	36.4	ND	ND	ND	ND
	4/29/2014	***6,430***	***178***	***525***	ND	ND	ND	**1,060**	45	ND	ND	ND	ND
	8/14/2014	***8,570***	***209***	***551***	ND	ND	ND	**1,110**	ND	ND	ND	ND	ND
	10/28/2014	***4,840***	***162***	***307***	ND	ND	ND	**613**	27.7	**11.6 J**	ND	ND	ND
	10/30/2015	***10,300***	***292***	***1,560***	ND	ND	ND	**919**	*114*	ND	ND	ND	ND
	11/6/2016	***4360***	***179***	***796***	ND	ND	ND	**489**	*35.4 J*	ND	ND	ND	ND
FMC-37	10/25/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2007	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/22/2008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/13/2009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/12/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/18/2011	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/10/2012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/28/2013	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/24/2014	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/28/2015	ND	< 1.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/3/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-38	10/25/2006	*3.3*	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2007	*3.0*	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/22/2008	*3.6*	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/13/2009	*3.2*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/12/2010	*3.0*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/17/2011	*4.1*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/10/2012	*2.9*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/28/2013	*3.1*	0.37 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/24/2014	*4.4*	0.65 J	0.17 J	ND	ND	ND	ND	0.25 J	0.24 J	ND	ND	ND
	10/28/2015	*4.5*	0.54 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/3/2016	*3.3*	ND	0.36 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-41	5/30/2014	***5.2***	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-43	10/29/2013	*0.91*	ND	3.2	0.35 J	ND	ND	ND	ND	ND	ND	ND	ND
FMC-44	11/7/2013	*3.5*	0.49 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-45	10/26/2006	***14.3***	1.2	*6.4*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2007	***18.5***	1.5	*7.6*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/22/2008	***12.5***	1.0	*7.0*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/14/2009	***13.1***	ND	5.9	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/13/2010	***12.2***	ND	*6.6*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/13/2010	***11.9***	ND	*6.8*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/17/2011	***7.5***	ND	5.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/11/2012	***12.2***	ND	*7.2*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/30/2013	***11.6***	0.40 J	*7.0*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/27/2014	***6.8***	0.54 J	*7.0*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/28/2015	***6.1***	ND	*5.5*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/4/2016	***3.2***	ND	8.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-46	10/19/2011	***7.0***	ND	*56.9*	ND	***82.8***	ND	ND	4.9	ND	ND	ND	ND
	10/15/2012	***7.8***	ND	*10.8*	ND	***9.2***	ND	ND	ND	ND	ND	ND	ND

Table E-1
Groundwater VOC Analytical Results from Monitoring Wells and Receptor Points
BAE Systems
FMC Corporation Site
Fridley, Minnesota

Parameter		Trichloroethene	Tetrachloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl chloride	1,1,2,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	Carbon Tetrachloride	Dichloromethane
MDH Health Based Water Guidance		*0.4*	*5*	*50*	*100*	*0.2*	*2*	*9,000*	*100*	*200*	*4*	*3*	*5*
Maximum Contaminant Level		5	5	70	100	2	NS	200	NS	7	5	5	5
FMC-46	11/6/2013	*2.6*	ND	*7.4*	4.2	***3.0***	ND	ND	3.9	ND	ND	ND	ND
	10/28/2014	*4.1*	0.18 J	5.4	2.4	*1.5*	ND	ND	2.1	ND	ND	ND	ND
	10/30/2015	*5.0*	ND	11.3	5.0	***5.9***	ND	ND	2.4	ND	ND	ND	ND
	11/6/2016	*0.7*	ND	9.2	4.7	***8.3***	ND	ND	2.1	ND	ND	ND	ND
FMC-47	10/19/2011	***61.6***	2.9	*16.7*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/15/2012	***74.1***	4.0	*28.0*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/8/2013	***155***	***5.9***	***95.1***	1.2	ND	ND	1.5	0.79 J	ND	ND	ND	ND
	10/28/2014	***79.4***	2.8	*55.9*	0.30 J	*0.64*	ND	0.51 J	2.1	ND	ND	ND	ND
	11/6/2016	***21.1***	0.90 J	*8.1*	ND	*ND*	ND	0.23 J	ND	ND	ND	ND	ND
FMC-48	10/27/2006	*4.7*	ND	2.4	ND	ND	ND	ND	1.3	ND	ND	ND	ND
	10/25/2007	***12.6***	ND	*13.5*	ND	ND	ND	ND	2.2	ND	ND	ND	ND
	10/24/2008	***23.0***	ND	*10.3*	ND	ND	ND	ND	1.7	ND	ND	ND	ND
	10/15/2009	***21.5***	ND	*13.7*	ND	ND	ND	ND	1.7	ND	ND	ND	ND
	10/14/2010	***15.1***	ND	*21.4*	ND	ND	ND	1.0	1.5	ND	ND	ND	ND
	10/19/2011	***24.3***	ND	*11.5*	ND	ND	ND	ND	1.7	ND	ND	ND	ND
	10/15/2012	***20.6***	ND	*6.7*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/8/2013	***30.8***	0.42 J	*20.0*	0.30 J	ND	ND	4.2	2.0	ND	ND	0.72 J	ND
	10/28/2014	***197***	0.91 J	***120***	1.1	ND	ND	7.6	7.5	0.47 J	0.20 J	ND	ND
	10/29/2015	***320***	3	***187***	2.7	ND	ND	17.6	9.7	ND	ND	ND	ND
	11/5/2016	***40.4***	1.9	***18.9***	0.49 J	ND	ND	0.71 J	1.4	ND	ND	ND	ND
FMC-49	11/8/2013	***36.2***	0.58 J	*8.6*	ND	ND	ND	ND	0.70 J	ND	ND	ND	ND
FMC-50	10/14/2010	***31.7***	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/19/2011	***30.5***	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/15/2012	***19.7***	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/8/2013	***33.9***	1.9	3.1	ND	ND	ND	1.4	ND	ND	ND	ND	ND
	10/28/2014	***1,300***	***53.4***	***261***	2.1	*0.27 J*	ND	159	15.9	5.5	*1.1*	ND	ND
	10/29/2015	***459***	***17.9***	36.1	ND	ND	ND	55	1.7 J	ND	ND	ND	ND
	11/5/2016	***33.0***	***1.5***	1.4	ND	ND	ND	2.5	ND	ND	ND	ND	ND
FMC-51	10/27/2006	***25.0***	2.2	3.8	ND	***2.5***	ND	1.5	ND	ND	ND	ND	ND
	10/14/2010	***142***	2.6	*10.6*	ND	***2.1***	ND	ND	1.9	ND	ND	ND	ND
	10/19/2011	***40.0***	1.2	3.8	ND	*0.50*	ND	ND	ND	ND	ND	ND	ND
	10/11/2012	***29.3***	1.6	3.1	ND	*0.59*	ND	ND	ND	ND	ND	ND	ND
	11/8/2013	***48.2***	0.80 J	*17.2*	ND	*0.42*	ND	1.8	0.77 J	ND	ND	ND	ND
	10/28/2014	***387***	***10.5***	*69.5*	0.36 J	***4.2***	ND	5	7.1	1.7	0.62 J	ND	ND
	10/27/2015	***1,070***	***25.9***	***228***	ND	***6.0 J***	ND	12.2	21	5.6 J	ND	ND	ND
	11/5/2016	***471***	***19.9***	***300***	1.1 J	***10.3***	ND	3.0 J	19.3	2.4 J	ND	ND	ND
FMC-52	10/27/2006	*4.8*	ND	*13.7*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/25/2007	***23.5***	ND	*25.9*	ND	ND	ND	ND	1.2	ND	ND	ND	ND
	10/24/2008	***26.0***	ND	*46.1*	ND	ND	ND	ND	1.7	ND	ND	ND	ND
	10/15/2009	***13.9***	ND	*35.2*	ND	ND	ND	ND	1.5	ND	ND	ND	ND
	10/14/2010	***183***	3.5	*44.8*	3.8	ND	ND	ND	3.4	ND	ND	ND	ND
	10/19/2011	***71.3***	ND	*31.2*	ND	ND	ND	ND	1.7	ND	ND	ND	ND
	10/15/2012	***143***	ND	*61.7*	2.0	ND	ND	ND	3.0	ND	ND	ND	ND
	11/8/2013	***1,400***	***23.7***	***214***	ND	***5.1 J***	ND	172	13.1 J	ND	ND	ND	ND
	10/28/2014	***614***	***28.6***	***642***	1.4	***4.9***	ND	1.1	94.2	6.9	*4.1*	ND	ND
	10/27/2015	***743***	***28.2***	***611***	ND	***8.9 J***	ND	7.1 J	*103*	5.0 J	ND	ND	ND
	11/5/2016	***4.8***	***0.78 J***	***124***	ND	***3.4***	ND	ND	*30.4*	0.45 J	2.5	ND	ND
FMC-53	10/26/2006	***116***	ND	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2007	***73.8***	ND	*10.9*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2008	***104***	ND	*24.5*	1.0	ND	ND	ND	1.0	ND	ND	ND	ND

Table E-1
Groundwater VOC Analytical Results from Monitoring Wells and Receptor Points
BAE Systems
FMC Corporation Site
Fridley, Minnesota

Parameter		Trichloroethene	Tetrachloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl chloride	1,1,2,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	Carbon Tetrachloride	Dichloromethane
MDH Health Based Water Guidance		*0.4*	*5*	*50*	*100*	*0.2*	*2*	*9,000*	*100*	*200*	*4*	*3*	*5*
Maximum Contaminant Level		5	5	70	100	2	NS	200	NS	7	5	5	5
FMC-53	10/14/2009	***94.5***	ND	*17.8*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/12/2010	***100***	ND	*18.1*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/17/2011	***67.4***	ND	*12.8*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/10/2012	***62.1***	ND	*7.6*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/29/2013	***42.8***	ND	*7.6*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/27/2014	***14***	ND	*15.3*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/28/2015	***26.6***	ND	16.5	0.38 J	ND	ND	ND	0.34 J	ND	ND	ND	ND
	11/4/2016	***19.7***	ND	16.0	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-54	10/26/2006	***218***	***72.4***	5.0	1.1	ND	ND	1.4	6.4	1.3	ND	ND	ND
	10/23/2007	***544***	***304***	*11.1*	ND	ND	ND	ND	14.6	2.3	ND	ND	ND
	10/23/2008	***194***	***113***	4.8	ND	ND	ND	ND	5.0	ND	ND	ND	***9.9***
	10/14/2009	***176***	***79.3***	*6.4*	ND	ND	ND	ND	5.6	ND	ND	ND	ND
	10/13/2010	***166***	***60.3***	*7.3*	ND	ND	ND	ND	4.9	1.0	ND	ND	ND
	10/17/2011	***178***	***64.9***	*8.0*	ND	ND	ND	ND	5.6	ND	ND	ND	ND
	10/10/2012	***227***	***105***	*9.4*	1.3	ND	ND	ND	6.5	1.3	ND	ND	ND
FMC-54A	10/26/2006	***180***	***176***	2.8	ND	ND	ND	6.4	6.2	ND	ND	ND	ND
	10/23/2007	***94.2***	***139***	2.2	ND	ND	ND	2.2	4.0	ND	ND	ND	ND
	10/23/2007	***96.8***	***145***	1.8	ND	ND	ND	1.9	3.2	ND	ND	ND	ND
	10/23/2008	***98.2***	***156***	1.8	ND	ND	ND	1.3	3.1	ND	ND	ND	ND
	10/14/2009	***76.3***	***91.0***	2.2	ND	ND	ND	1.1	3.0	ND	ND	ND	ND
	10/13/2010	***83.0***	***87.2***	1.8	ND	ND	ND	1.2	2.0	ND	ND	ND	ND
	10/17/2011	***58.2***	***97.9***	2.2	ND	ND	ND	1.5	1.6	ND	ND	ND	ND
	10/10/2012	***64.5***	***67.5***	4.6	ND	ND	ND	ND	2.4	ND	ND	ND	ND
	10/29/2013	***69.7***	***82.4***	2.5	ND	ND	ND	0.75 J	4.0	0.35 J	ND	ND	ND
	10/27/2014	***68.3***	***104***	4.2	ND	ND	ND	0.66 J	2.2	ND	ND	ND	ND
	10/29/2015	***60.1***	***45.2***	5.8	ND	ND	ND	0.72 J	1.7	ND	ND	ND	ND
	11/4/2016	***57.3***	***80.4***	1.6	ND	ND	ND	0.36 J	0.96 J	ND	ND	ND	ND
FMC-55A	11/7/2013	*1.1*	ND	ND	ND	ND	ND	ND	0.42 J	ND	ND	ND	ND
FMC-55B	10/15/2012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/4/2013	*0.92*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/28/2014	*1.4*	0.58 J	ND	ND	ND	ND	ND	0.43 J	ND	ND	ND	ND
	10/30/2015	*1.6*	< 1.0	ND	ND	ND	ND	ND	0.40 J	ND	ND	ND	ND
	11/5/2016	*1.5*	0.33 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-56A	11/7/2013	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-56B	10/15/2012	ND	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/4/2013	*0.68*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/24/2014	*0.76*	0.91 J	ND	ND	ND	ND	ND	0.23 J	ND	ND	ND	ND
	10/30/2015	0.66 J	0.85 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/5/2016	2.0	0.85 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-57A	11/7/2013	ND	ND	*10.6*	ND	ND	ND	ND	3.0	ND	ND	ND	ND
FMC-57B	10/15/2012	***6.2***	*5.0*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/4/2013	***6.5***	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/24/2014	***6.3***	0.80 J	0.38 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/30/2015	***6.3***	0.82 J	0.49 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/5/2016	***3.7***	1.2	0.72 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-64	10/26/2006	***62.1***	3.0	*14.7*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2007	***67.0***	3.1	*8.9*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/22/2008	***52.0***	2.7	*17.7*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/14/2009	***49.2***	1.9	*6.9*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/13/2010	***63.4***	3.5	3.9	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table E-1
Groundwater VOC Analytical Results from Monitoring Wells and Receptor Points
BAE Systems
FMC Corporation Site
Fridley, Minnesota

Parameter		Trichloroethene	Tetrachloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl chloride	1,1,2,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	Carbon Tetrachloride	Dichloromethane
MDH Health Based Water Guidance		*0.4*	*5*	*50*	*100*	*0.2*	*2*	*9,000*	*100*	*200*	*4*	*3*	*5*
Maximum Contaminant Level		5	5	70	100	2	NS	200	NS	7	5	5	5
FMC-64	10/18/2011	***51.1***	2.6	5.7	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/11/2012	***47.6***	2.4	5.8	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/30/2013	***38.2***	0.57 J	*11.2*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/27/2014	***41.7***	2.6	5.5	ND	ND	ND	ND	0.54 J	ND	ND	ND	ND
	10/29/2015	***45.3***	2.6	2.9	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/4/2016	***55.7***	1.9	1.7	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-70	10/26/2006	***104***	ND	2.1	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2007	***94.7***	ND	1.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2008	***85.4***	ND	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/14/2009	***106***	ND	*7.8*	ND	ND	ND	ND	1.3	ND	ND	ND	ND
	10/12/2010	***147***	ND	*7.5*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/18/2011	***120***	ND	3.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/11/2012	***50.4***	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/29/2013	***48.3***	ND	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/27/2014	***52.7***	ND	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/29/2015	***34.5***	ND	0.99 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/3/2016	***34.6***	ND	1.4	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-71	10/26/2006	***47.9***	***35.7***	1.5	ND	ND	ND	1.8	1.6	ND	ND	ND	ND
	10/23/2007	***77.0***	***75.7***	1.7	ND	ND	ND	6.0	2.7	ND	ND	ND	ND
	10/22/2008	***61.4***	***135***	ND	ND	ND	ND	1.4	1.5	ND	ND	ND	ND
	10/14/2009	***32.8***	***61.3***	1.2	ND	ND	ND	1.2	1.0	ND	ND	ND	ND
	10/12/2010	***28.4***	***40.4***	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/18/2011	***107***	***90.7***	1.9	ND	ND	ND	2.5	1.3	ND	ND	ND	ND
	10/11/2012	***19.3***	***17.1***	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/29/2013	***19.3***	***12.8***	1.5	ND	ND	ND	0.62 J	0.83 J	ND	ND	ND	ND
	10/27/2014	***19.4***	***16.1***	0.66 J	ND	ND	ND	0.47 J	ND	ND	ND	ND	ND
	10/29/2015	***17***	***7.8***	1.6	ND	ND	ND	ND	0.38 J	ND	ND	ND	ND
	11/4/2016	***14.9***	***7.5***	0.91 J	ND	ND	ND	0.39 J	ND	ND	ND	ND	ND
FMC-72	10/12/2012	***8,050***	***230***	***718***	5.9	*0.56*	ND	**1,300**	42.4	**21.0**	***9.9***	ND	ND
	11/5/2013	***44,200***	***1,170***	***1,630***	16.3	***4.0***	ND	**7,170**	*163*	**89.9**	***34.8***	ND	ND
	2/24/2014	***68,000***	***1,510***	***2,790***	ND	ND	ND	***10,300***	*211*	**127**	ND	ND	ND
	4/29/2014	***60,100***	***1,130***	***2,550***	ND	ND	ND	***9,100***	ND	ND	ND	ND	ND
	8/14/2014	***15,300***	***424***	***768***	ND	ND	ND	**2,580**	ND	ND	ND	ND	ND
	10/28/2014	***48,600***	***1,080***	***1,800***	12.5 J	***5.0 J***	ND	**5,780**	*106*	**70.7**	ND	ND	ND
	10/30/2015	***19,600***	***496 J***	***5,430***	***179***	***2.7***	ND	**3,120**	87.5	**48.7**	***12.2***	ND	ND
	11/6/2016	***43,700***	***1,260***	***1,730***	***ND***	***ND***	ND	**6770**	ND	**ND**	***ND***	ND	ND
FMC-73	10/11/2012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/29/2013	*1.1*	0.73 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/27/2014	*0.79*	2.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/29/2015	*0.41 J*	0.53 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/4/2016	*0.44*	0.59 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-74	10/11/2012	***525***	***367***	3.4	ND	ND	ND	ND	10.5	1.4	ND	ND	ND
	5/6/2013	***531***	***242***	3.8	ND	ND	ND	ND	11.0	1.3	ND	ND	ND
	10/29/2013	***749***	***323***	*6.4*	ND	ND	ND	ND	25.4	2.1 J	ND	ND	ND
	10/27/2014	***720***	***575***	5.7	ND	ND	ND	ND	16.2	ND	ND	ND	ND
	10/29/2015	***341***	***383***	2.8 J	ND	ND	ND	ND	7.9	ND	ND	ND	ND
	11/3/2016	***322***	***242***	3.3	0.43 J	ND	ND	ND	8.7	0.55 J	ND	ND	ND
FMC-75	10/12/2012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/5/2013	***15.7***	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table E-1
Groundwater VOC Analytical Results from Monitoring Wells and Receptor Points
BAE Systems
FMC Corporation Site
Fridley, Minnesota

Parameter		Trichloroethene	Tetrachloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl chloride	1,1,2,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	Carbon Tetrachloride	Dichloromethane
MDH Health Based Water Guidance		*0.4*	*5*	*50*	*100*	*0.2*	*2*	*9,000*	*100*	*200*	*4*	*3*	*5*
Maximum Contaminant Level		5	5	70	100	2	NS	200	NS	7	5	5	5
FMC-75	10/28/2014	0.10 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/30/2015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/6/2016	0.073 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
FMC-76	10/12/2012	***97.0***	ND	***75.7***	ND	*1.6*	ND	ND	5.9	ND	ND	ND	ND
	10/31/2013	***201***	ND	***130***	0.72 J	***3.4***	ND	ND	6.0	1.2	ND	ND	ND
	10/28/2014	***140***	ND	***90.3***	0.77 J	***2.4***	ND	ND	4.3	0.65 J	ND	ND	ND
	10/29/2015	***319***	ND	***223***	5.4	***7.4***	ND	ND	23.6	1.7 J	ND	ND	ND
	11/6/2016	***83.5***	ND	***91.6***	1.1	***4.4***	ND	ND	2.7	0.48 J	ND	ND	ND
FMC-77	10/12/2012	***20.8***	ND	1.9	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/31/2013	***17.3***	ND	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/28/2014	***11***	0.42 J	0.20 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/29/2015	***27***	ND	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/6/2016	***1130***	1.3	35.1	1.7	ND	ND	ND	1.1	0.48 J	ND	ND	ND
FMC-78	10/12/2012	***640***	***435***	5.0	ND	ND	ND	10.4	15.2	ND	ND	ND	ND
	10/31/2013	***548***	***163***	5.5	0.42 J	ND	ND	23.7	32.1	0.47 J	ND	*4.0*	ND
	10/28/2014	***640***	***182***	4.2	0.32 J	ND	ND	18.5	17.6	0.33 J	ND	ND	ND
	10/29/2015	***739***	***138***	ND	ND	ND	ND	ND	6.6 J	ND	ND	ND	ND
	11/6/2016	***699***	***151***	5.8	ND	ND	ND	14.4	17.2	ND	ND	ND	ND
FMC-79	6/18/2012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/12/2012	***31.2***	ND	5.5	ND	ND	ND	ND	1.2	ND	ND	ND	ND
	10/31/2013	***27.6***	ND	4.7	ND	ND	ND	ND	1.3	ND	ND	ND	ND
	10/24/2014	***31.1***	ND	4.7	ND	ND	ND	ND	1.1	0.28 J	ND	ND	ND
	10/29/2015	***35.1***	ND	4.8	ND	ND	ND	ND	1	ND	ND	ND	ND
	11/6/2016	***24.9***	ND	5	ND	ND	ND	ND	1	ND	ND	ND	ND
MW-1	5/31/2006	***14.5***	ND	5	ND	1.7	ND	ND	18.9	ND	ND	ND	ND
	10/24/2006	ND	ND	ND	ND	0.20 J	ND	ND	2.4	ND	ND	ND	ND
	4/27/2007	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/22/2007	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/29/2008	*2.3*	ND	1.6	ND	0.26	ND	ND	ND	ND	ND	ND	ND
	10/21/2008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/22/2009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/13/2009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/18/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/11/2010	***5.3***	ND	3.2	ND	ND	ND	ND	4.6	ND	ND	ND	ND
	5/25/2011	*1.1*	ND	1.1	ND	ND	ND	ND	9.3	ND	ND	ND	ND
	10/17/2011	*3*	ND	1.4	ND	0.25	ND	ND	9.8	ND	ND	ND	ND
	5/10/2012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/10/2012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/31/2013	*0.51*	ND	0.39 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/9/2014	0.32 J	ND	0.46 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2014	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6/29/2015	*0.65*	ND	0.58 J	ND	ND	ND	ND	0.53 J	ND	ND	ND	ND
	10/27/2015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6/30/2016	0.58	ND	0.60 J	ND	ND	ND	ND	1.1	ND	0.20 J	ND	ND
	11/2/2016	7.8	ND	4.5	ND	0.25	ND	ND	12.2	0.44 J	ND	ND	ND
MW-2	5/30/2006	*3.2*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/24/2006	*2.9*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/27/2007	*2.6*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/22/2007	*4.5*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/29/2008	*3.4*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table E-1
Groundwater VOC Analytical Results from Monitoring Wells and Receptor Points
BAE Systems
FMC Corporation Site
Fridley, Minnesota

Parameter		Trichloroethene	Tetrachloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl chloride	1,1,2,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	Carbon Tetrachloride	Dichloromethane
MDH Health Based Water Guidance		*0.4*	*5*	*50*	*100*	*0.2*	*2*	*9,000*	*100*	*200*	*4*	*3*	*5*
Maximum Contaminant Level		5	5	70	100	2	NS	200	NS	7	5	5	5
MW-2	10/21/2008	*2.3*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/22/2009	*1.7*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/13/2009	*1.9*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/18/2010	*2.4*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/11/2010	*3.8*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/25/2011	*1.7*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/17/2011	*1.2*	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/10/2012	*1.3*	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/10/2012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/10/2012	*1*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/31/2013	*1.1*	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/9/2014	*1.2*	0.88 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2014	*1.1*	1.3	*ND*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6/29/2015	*0.81*	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/27/2015	*0.58*	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/1/2016	*0.78*	1.2	ND	ND	ND	ND	ND	ND	ND	0.11 J	ND	ND
	11/2/2016	*0.77*	1.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
MW-3	5/30/2006	***303***	***52.1***	6.1	ND	ND	ND	9.3	10.9	ND	ND	ND	ND
	10/25/2006	***93.0***	***16***	27	ND	ND	ND	1.4	3.9	ND	ND	ND	ND
	4/27/2007	***219.0***	***35.9***	15	ND	ND	ND	4.8	8.3	ND	ND	ND	ND
	10/22/2007	***196***	***21.3***	25.3	ND	ND	ND	3.3	5.7	ND	ND	ND	ND
	10/22/2007	***208***	***21.8***	25.7	ND	ND	ND	3.7	5.5	ND	ND	ND	ND
	5/29/2008	***257***	***39.7***	9.7	ND	ND	ND	4.4	8.3	ND	ND	ND	ND
	10/21/2008	***47.7***	***8.4***	17.7	ND	ND	ND	ND	1.5	ND	ND	ND	ND
	5/22/2009	***200***	***26.7***	15.5	ND	ND	ND	3.8	7.4	ND	ND	ND	ND
	10/13/2009	***11.9***	1	11.9	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/13/2009	***12.4***	1.2	12	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/18/2010	***172***	***19.7***	56.9	ND	ND	ND	5.1	9.3	ND	ND	ND	ND
	10/11/2010	***197***	***25.5***	31.2	ND	ND	ND	7.1	10.7	ND	ND	ND	ND
	5/25/2011	***258***	***40.1***	5.2	ND	ND	ND	9.8	8.6	ND	ND	ND	ND
	10/17/2011	***265***	***26.2***	23.6	ND	ND	ND	8.7	11.4	ND	ND	ND	ND
	5/10/2012	***45.7***	***2.6***	34.4	ND	ND	ND	ND	3.8	ND	ND	ND	ND
	10/10/2012	***136***	***6.8***	***71.6***	ND	ND	ND	1.2	7	ND	ND	ND	ND
	10/31/2013	***73***	***10.6***	27.1	ND	ND	ND	0.89 J	2.1	ND	ND	ND	ND
	5/9/2014	***170***	***30.5***	8.7	ND	ND	ND	4.9	5.1	ND	ND	ND	ND
	10/23/2014	***172***	***22.5***	30.7	ND	ND	ND	5.2	6.7	ND	ND	ND	ND
	6/29/2015	***152***	***24.9***	16.6	0.24 J	ND	ND	3.6	5.1	0.30 J	ND	ND	ND
	10/27/2015	***123***	***22.3***	28.9	ND	ND	ND	2.5	3.6	ND	ND	ND	ND
	6/30/2016	***159***	***31.0***	11.5	ND	ND	ND	7.8	6.1	0.28 J	0.12 J	ND	ND
	11/2/2016	***138***	***30.9***	3.3	ND	ND	ND	6.9	4.2	ND	ND	ND	ND
MW-4	5/30/2006	***10.4***	1.6	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/25/2006	***8.8***	1.4	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/27/2007	***9.8***	1.5	1.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/22/2007	***10***	1.4	1.3	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/29/2008	***11***	1.4	1.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/21/2008	***9.2***	1.7	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/22/2009	***9.1***	1.3	1.1	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/22/2009	***8.1***	1.4	1	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/13/2009	***8.1***	1.5	1	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/18/2010	***8***	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table E-1
Groundwater VOC Analytical Results from Monitoring Wells and Receptor Points
BAE Systems
FMC Corporation Site
Fridley, Minnesota

Parameter		Trichloroethene	Tetrachloroethene	cis-1,2-Dichloroethene	trans-1,2-Dichloroethene	Vinyl chloride	1,1,2,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethene	1,2-Dichloroethane	Carbon Tetrachloride	Dichloromethane
MDH Health Based Water Guidance		*0.4*	*5*	*50*	*100*	*0.2*	*2*	*9,000*	*100*	*200*	*4*	*3*	*5*
Maximum Contaminant Level		5	5	70	100	2	NS	200	NS	7	5	5	5
MW-4	10/11/2010	***8.5***	1.6	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/25/2011	***8.5***	1.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/17/2011	***6***	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/10/2012	***6.9***	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/10/2012	***7.2***	1.7	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/10/2012	***6.5***	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/31/2013	***7.7***	1.4	0.84 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/9/2014	***6.3***	1.1	0.50 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2014	***7.8***	1.4	0.69 J	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6/29/2015	***6.6***	1.5	0.51 J	ND	ND	ND	0.32 J	ND	ND	ND	ND	ND
	10/27/2015	***5.1***	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6/30/2016	***6.8***	1.7	0.57 J	ND	ND	ND	0.28 J	ND	ND	ND	ND	ND
	11/2/2016	***5.8***	1.8	0.60 J	ND	ND	ND	0.23 J	ND	ND	ND	ND	ND
MW-5	5/30/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/24/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	4/27/2007	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/22/2007	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/29/2008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/21/2008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/22/2009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/13/2009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/18/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/11/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/25/2011	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/17/2011	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/10/2012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/10/2012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/31/2013	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/9/2014	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/23/2014	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6/29/2015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/27/2015	ND	ND	*ND*	ND	ND	ND	ND	ND	ND	ND	ND	ND
	6/30/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/2/2016	ND	ND	*ND*	ND	ND	ND	ND	ND	ND	ND	ND	ND
MWW	10/26/2006	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/26/2007	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	10/24/2008	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/15/2009	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/14/2010	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/19/2011	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/15/2012	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/15/2013	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/29/2014	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	10/30/2015	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/22/2016	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table E-2
TCE Constituent Mass Removal
BAE Systems
FMC Corporation Site
Fridley, Minnesota

ARCADIS Design & Consultancy for natural and built assets

Year-Quarter	TCE Concentration (mg/L)				Cumulative Volume Extracted (millions of gallons)				Yearly Mass of TCE Removed Per Well (lbs)				Yearly Total Mass of TCE Extracted [a] (lbs)
	RW2	RW3	RW4	RW5	RW2	RW3	RW4	RW5	RW2	RW3	RW4	RW5	Total
1988-1	20.90	0.35	0.71	1.45	4.50	5.61	4.38	4.37	-	-	-	-	-
1988-2	23.30	0.20	0.74	1.20	6.37	9.90	7.39	6.63	-	-	-	-	-
1988-3	24.00	0.19	0.82	0.50	8.17	13.62	10.33	9.25	-	-	-	-	-
1988-4	8.30	0.10	---	0.63	10.21	17.97	14.16	12.56	1,648	33	86	104	1,871
1989-1	32.00	0.25	0.49	---	12.13	20.88	17.41	15.38	-	-	-	-	-
1989-2	23.00	0.20	---	0.56	13.52	24.66	19.76	18.17	-	-	-	-	-
1989-3	49.00	0.17	0.32	---	15.17	28.79	23.19	22.27	-	-	-	-	-
1989-4	44.00	0.18	---	0.91	16.10	33.30	26.61	24.93	1,795	25	37	72	1,930
1990-1	23.00	0.07	0.16	---	16.74	38.01	31.41	28.63	-	-	-	-	-
1990-2	91.00	0.21	---	0.51	17.69	41.93	35.45	31.56	-	-	-	-	-
1990-3	28.00	0.23	0.26	---	19.68	45.89	39.51	35.25	-	-	-	-	-
1990-4	30.00	0.14	---	0.28	20.85	50.01	43.79	37.87	1,597	22	32	53	1,703
1991-1	27.00	0.16	0.29	---	22.31	54.29	47.22	40.57	-	-	-	-	-
1991-2	44.00	0.20	---	0.22	23.87	59.07	50.63	43.47	-	-	-	-	-
1991-3	31.00	0.24	0.38	---	25.43	62.77	54.25	45.54	-	-	-	-	-
1991-4	40.00	0.26	---	0.74	27.17	67.80	57.61	48.07	1,883	32	40	35	1,990
1992-1	30.00	0.24	0.38	---	28.16	71.24	59.20	50.62	-	-	-	-	-
1992-2	26.00	0.19	---	0.62	29.96	75.09	61.46	53.35	-	-	-	-	-
1992-3	20.00	0.19	0.85	---	31.70	79.06	64.65	56.91	-	-	-	-	-
1992-4	14.00	0.17	---	0.83	34.70	83.33	68.01	60.90	1,278	25	58	78	1,440
1993-1	12.00	0.14	0.51	---	36.57	87.83	70.26	64.40	-	-	-	-	-
1993-2	16.00	0.17	---	1.00	38.62	91.73	72.90	67.68	-	-	-	-	-
1993-3	16.00	0.22	0.60	---	41.04	95.84	75.43	70.80	-	-	-	-	-
1993-4	20.00	0.32	---	0.70	43.19	99.76	78.21	74.33	1,142	29	50	97	1,317
1994-1	6.90	0.23	0.70	---	45.78	104.29	81.16	77.70	-	-	-	-	-
1994-2	7.40	0.23	---	0.77	47.83	108.64	83.71	80.45	-	-	-	-	-
1994-3	4.00	0.07	0.29	---	49.94	111.70	86.50	83.40	-	-	-	-	-
1994-4	2.60	0.05	---	0.41	51.75	114.90	86.93	89.13	385	20	36	72	514
1995-1	6.10	0.13	0.73	---	54.20	118.88	92.35	89.40	-	-	-	-	-
1995-2	5.10	0.12	---	0.21	56.17	123.20	95.17	92.31	-	-	-	-	-
1995-3	6.40	0.09	0.34	---	57.77	127.63	97.78	95.36	-	-	-	-	-
1995-4	6.80	0.09	---	0.62	60.29	131.96	101.04	99.16	437	15	62	36	549
1996-1	5.70	0.14	0.29	---	61.94	136.10	104.02	102.17	-	-	-	-	-
1996-2	4.20	0.11	---	0.41	64.61	139.85	106.94	104.91	-	-	-	-	-
1996-3	4.10	0.08	0.36	---	66.39	143.78	109.67	107.20	-	-	-	-	-
1996-4	4.60	0.07	---	0.33	68.40	148.28	113.18	110.07	310	13	33	37	394
1997-1	6.10	0.16	0.31	---	70.48	151.64	115.70	112.20	-	-	-	-	-
1997-2	9.10	0.20	---	0.32	72.39	155.30	118.50	114.40	-	-	-	-	-
1997-3	14.00	0.13	0.39	---	73.78	158.79	122.00	116.90	-	-	-	-	-
1997-4	9.90	0.11	---	0.32	74.82	162.20	125.30	119.60	499	17	35	26	577
1998-1	5.00	0.11	0.25	---	76.73	165.37	128.15	122.27	-	-	-	-	-
1998-2	7.80	0.14	---	0.32	78.55	169.60	129.98	124.51	-	-	-	-	-
1998-3	4.30	0.11	0.27	---	81.02	171.63	132.26	127.31	-	-	-	-	-
1998-4	2.80	0.08	---	0.18	83.50	175.96	135.23	130.30	344	13	21	23	401
1999-1	3.50	0.07	0.23	---	85.74	180.38	137.88	132.91	-	-	-	-	-
1999-2	2.10	0.06	---	0.18	89.97	184.92	139.80	135.78	-	-	-	-	-
1999-3	3.80	0.09	0.20	---	91.65	189.03	141.99	138.20	-	-	-	-	-
1999-4	3.80	0.06	---	0.22	93.68	192.64	144.24	140.41	257	10	15	16	298
2000-1	1.80	0.07	0.11	---	96.47	196.77	146.46	142.96	-	-	-	-	-
2000-2	2.10	0.08	---	0.19	98.63	200.71	148.51	146.81	-	-	-	-	-

Notes and Abbreviations on Page 3.

Table E-2
TCE Constituent Mass Removal
BAE Systems
FMC Corporation Site
Fridley, Minnesota

ARCADIS Design & Consultancy for natural and built assets

Year-Quarter	TCE Concentration (mg/L)				Cumulative Volume Extracted (millions of gallons)				Yearly Mass of TCE Removed Per Well (lbs)				Yearly Total Mass of TCE Extracted [a] (lbs)
	RW2	RW3	RW4	RW5	RW2	RW3	RW4	RW5	RW2	RW3	RW4	RW5	Total
2000-3	1.80	0.06	0.21	---	101.17	203.86	150.66	149.53	-	-	-	-	-
2000-4	2.10	0.08	---	0.13	104.42	208.96	153.31	153.14	175	10	13	18	215
2001-1	3.10	0.08	0.17	---	106.51	213.08	155.31	156.15	-	-	-	-	-
2001-2	2.90	0.07	---	0.15	108.82	215.49	157.14	158.33	-	-	-	-	-
2001-3	4.70	0.08	0.11	---	110.62	217.43	158.67	159.64	-	-	-	-	-
2001-4	4.90	0.08	---	0.20	113.18	219.98	160.64	161.94	285	7	15	12	319
2002-1	4.50	0.49	0.98	---	115.15	221.98	162.82	164.68	-	-	-	-	-
2002-2	6.80	0.08	---	0.11	116.81	225.16	165.31	168.18	-	-	-	-	-
2002-3	4.70	0.07	0.19	---	119.44	228.99	168.27	171.94	-	-	-	-	-
2002-4	3.90	0.06	---	0.11	121.72	234.18	172.09	175.72	345	15	43	14	417
2003-1	2.60	0.04	0.34	---	123.82	238.80	175.88	179.00	-	-	-	-	-
2003-2	4.43	0.04	---	0.10	126.44	244.09	180.70	182.33	-	-	-	-	-
2003-3	3.80	0.06	0.23	---	131.13	249.51	185.48	185.71	-	-	-	-	-
2003-4	5.00	0.03	---	0.06	134.06	254.36	190.32	188.43	413	7	40	9	470
2004-1	3.70	0.04	0.22	---	135.79	259.59	196.39	191.36	-	-	-	-	-
2004-2	3.20	0.04	---	0.05	137.62	264.30	202.65	193.99	-	-	-	-	-
2004-3	9.80	0.08	0.17	---	140.49	268.87	206.49	196.15	-	-	-	-	-
2004-4	3.62	0.05	---	0.05	142.00	274.10	212.46	198.50	382	8	36	4	430
2005-1	2.73	0.04	0.19	---	143.48	278.50	217.90	200.87	-	-	-	-	-
2005-2	1.74	0.04	---	0.04	144.79	282.01	223.01	203.01	-	-	-	-	-
2005-3	1.91	0.03	0.18	---	146.42	286.79	227.30	204.77	-	-	-	-	-
2005-4	2.79	0.07	---	0.05	149.76	290.26	231.80	206.46	156	6	30	3	196
2006-1	2.89	0.06	0.20	---	152.20	294.40	236.70	208.70	-	-	-	-	-
2006-2	3.71	0.07	---	0.05	154.40	298.60	241.50	211.10	-	-	-	-	-
2006-3	3.52	0.07	0.18	---	158.10	302.60	245.40	213.50	-	-	-	-	-
2006-4	3.02	0.06	---	0.05	160.90	306.60	250.50	216.20	306	8	28	4	346
2007-1	1.74	0.04	0.15	---	162.50	309.80	254.40	218.60	-	-	-	-	-
2007-2	2.40	0.05	---	0.04	165.10	313.10	257.70	220.80	-	-	-	-	-
2007-3	2.49	0.10	0.17	---	167.30	317.20	263.00	222.00	-	-	-	-	-
2007-4	4.38	0.08	0.19	---	170.10	321.50	266.80	224.70	223	9	23	3	258
2008-1	2.43	0.05	---	0.03	171.34	325.00	270.49	227.08	-	-	-	-	-
2008-2	4.46	0.07	0.20	---	173.11	328.82	275.53	229.11	-	-	-	-	-
2008-3	2.65	0.06	---	0.03	175.00	332.80	280.86	231.11	-	-	-	-	-
2008-4	2.93	0.05	0.17	---	176.34	335.89	284.98	232.86	165	7	28	2	202
2009-1	1.96	0.04	---	0.02	177.80	338.80	289.20	234.40	-	-	-	-	-
2009-2	1.28	0.03	0.15	---	179.10	342.30	294.30	236.80	-	-	-	-	-
2009-3	1.51	0.13	---	0.03	180.60	346.10	298.80	241.50	-	-	-	-	-
2009-4	1.74	0.04	0.11	0.02	182.10	350.20	303.30	245.70	78	7	22	3	110
2010-1	1.76	0.05	0.09	0.02	183.80	353.90	307.90	249.60	-	-	-	-	-
2010-2	2.85	0.09	0.10	0.02	186.10	357.40	312.80	253.00	-	-	-	-	-
2010-3	2.20	0.06	0.12	0.02	187.80	360.90	317.80	257.20	-	-	-	-	-
2010-4	1.26	0.07	0.16	0.03	189.50	363.70	322.00	261.20	129	7	18	3	157
2011-1	0.93	0.13	0.12	0.02	191.29	365.53	324.51	264.68	-	-	-	-	-
2011-2	3.21	0.09	0.24	0.03	194.44	367.94	332.07	268.22	-	-	-	-	-
2011-3	5.53	0.08	0.19	0.03	196.42	373.16	339.97	271.93	-	-	-	-	-
2011-4	3.23	0.04	0.20	0.02	199.21	380.42	346.60	275.14	265	10	41	3	319
2012-1	1.50	0.03	0.25	0.02	202.04	385.03	351.36	277.94	-	-	-	-	-
2012-2	1.44	0.05	0.15	0.02	203.73	389.78	356.16	280.62	-	-	-	-	-
2012-3	2.62	0.05	0.14	0.02	204.18	394.75	362.28	284.01	-	-	-	-	-
2012-4	1.73	0.04	0.10	0.02	204.18	398.93	367.22	286.77	66	6	27	2	101

Notes and Abbreviations on Page 3.

Table E-2
TCE Constituent Mass Removal
BAE Systems
FMC Corporation Site
Fridley, Minnesota

Year-Quarter	TCE Concentration (mg/L)				Cumulative Volume Extracted (millions of gallons)				Yearly Mass of TCE Removed Per Well (lbs)				Yearly Total Mass of TCE Extracted [a] (lbs)
	RW2	RW3	RW4	RW5	RW2	RW3	RW4	RW5	RW2	RW3	RW4	RW5	Total
2013-1	0.55	0.04	0.16	0.01	204.18	402.31	372.27	289.04	-	-	-	-	-
2013-2	0.13	0.07	0.14	0.02	204.18	404.76	375.96	291.30	-	-	-	-	-
2013-3	2.22	0.07	0.09	0.02	204.18	408.53	381.40	295.52	-	-	-	-	-
2013-4	1.01	0.06	0.14	0.02	204.18	411.58	385.71	298.89	0	6	21	2	28
2014-1	0.49	0.05	0.19	0.02	204.18	412.97	387.19	300.18	-	-	-	-	-
2014-2	---	0.06	0.07	0.02	204.18	417.25	391.50	304.26	-	-	-	-	-
2014-3	---	0.05	0.17	0.02	204.18	422.23	394.96	308.08	-	-	-	-	-
2014-4	0.31	0.05	0.20	0.02	204.18	432.49	403.86	316.09	0	9	24	3	36
2015-1	---	0.03	0.18	0.02	204.18	441.57	411.61	322.55	-	-	-	-	-
2015-2	---	0.03	0.10	0.02	204.18	446.87	416.49	326.25	-	-	-	-	-
2015-3	4.42	0.04	0.09	0.02	204.76	454.63	422.82	329.80	-	-	-	-	-
2015-4	2.30	0.05	0.10	0.02	206.13	460.82	427.24	332.28	48	9	24	3	83
2016-1	1.25	0.15	0.22	0.01	207.33	465.59	430.29	334.46	-	-	-	-	-
2016-2	1.86	0.05	0.11	0.01	209.31	470.49	432.52	336.38	-	-	-	-	-
2016-3	2.71	0.07	0.12	0.01	211.52	474.60	435.94	336.67	-	-	-	-	-
2016-4	1.97	0.047	0.087	0.016	213.12	479.22	438.75	338.09	119	12	13	1	145
									Total TCE Mass Removed:				16,800

Footnotes:
a. For an example calculation, refer to Appendix B.

Acronyms and Abbreviations:
--- = measurement not available
- = calculation completed only on a yearly basis
lbs = pounds
mg/L = milligrams per liter
NS = not sample
TCE = Trichloroethene

Table E-3
Groundwater VOC Analytical Results from the Seeps
BAE Systems
FMC Corporation Site
Fridley, Minnesota

Well ID	VOCs (µg/L)	TCE	PCE	cis-1,2-DCE	trans-1,2-DCE	VC	1,1,1-TCA	1,1,2,2-PCA	1,1-DCA	1,1-DCE	1,2-DCA	CT	MC
	CAS No.	79-01-6	127-18-4	156-59-2	156-60-5	75-01-4	71-55-6	79-34-5	75-34-3	75-35-4	107-06-2	56-23-5	75-09-2
	Health Risk Limit	*0.4*	*5*	50	40	0.2	9000	2	100	200	**1**	1	5
	Maximum Contaminant Level	**5.0**	**5.0**	70	100	2.0	200			7.0	**5**	5.0	5.0
	Sample Date												
EAST SEEP	9/28/2006	***210***	***64.2***	7.1	ND	ND	6.9	ND	6.2	1.2	ND	ND	ND
EAST SEEP	10/26/2006	***194***	***54.4***	11.5	ND	ND	6.1	ND	5.5	1.2	ND	ND	ND
EAST SEEP	6/27/2007	***96.8***	***39.7***	7.3	ND	ND	2.5	ND	2.6	ND	ND	ND	ND
EAST SEEP	9/11/2007	***173***	***82.1***	7.6	ND	ND	6.3	ND	4.4	ND	ND	ND	ND
EAST SEEP	11/19/2007	***180***	***60.7***	13.9	ND	ND	20	ND	4.6	1.3	ND	ND	ND
EAST SEEP	8/15/2008	***100***	***38.0***	5.0	ND	ND	2.4	ND	2.8	ND	ND	ND	ND
EAST SEEP	10/24/2008	***123***	***57.6***	5.0	ND	ND	5.0	ND	2.8	ND	ND	ND	ND
EAST SEEP	6/17/2009	***26.1***	***7.2***	1.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
EAST SEEP	9/16/2009	***147***	***83.4***	12.5	ND	ND	2.7	ND	3.8	ND	ND	ND	ND
EAST SEEP	6/15/2010	***45.2***	***28.3***	10.1	ND	ND	ND	ND	1.3	ND	ND	ND	ND
EAST SEEP	8/31/2011	***17.3***	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
EAST SEEP	10/19/2011	***86.3***	***45.7***	2.6	ND	ND	ND	ND	1.6	ND	ND	ND	ND
EAST SEEP	3/28/2012	***76.5***	***54.6***	3.0	ND	ND	1.6	ND	2.4	ND	ND	ND	ND
EAST SEEP	9/20/2012	***112***	***89.2***	1.6	ND	ND	1.7	ND	3.0	ND	ND	ND	ND
EAST SEEP	11/14/2012	***67.4***	***60.5***	1.0	ND	ND	1.0	ND	1.7	ND	ND	ND	ND
EAST SEEP	9/5/2013	***46.0***	***34.2***	ND	ND	ND	ND	ND	1.4	ND	ND	ND	ND
EAST SEEP	12/27/2013	***130***	***154***	6.6	ND	ND	1.8	ND	3.6	ND	ND	ND	ND
EAST SEEP	10/29/2014	***56.4***	ND	2.4	ND	ND	56.9	0.50 J	1.2	ND	ND	ND	ND
EAST SEEP	7/21/2015	***79.3***	***97.6***	5.3	ND	ND	0.86 J	ND	1.6	ND	ND	ND	ND
EAST SEEP	6/15/2016	***50.1***	***66.1***	16.7	ND	ND	0.47 J	ND	1.6	ND	ND	ND	ND
EAST SEEP	11/17/2016	***37.1***	***60.1***	20.0	ND	ND	0.49 J	ND	1.1	ND	ND	ND	ND
WEST SEEP	9/28/2006	*2.1*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WEST SEEP	10/26/2006	*4.4*	1.0	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WEST SEEP	6/27/2007	***15.3***	2.5	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WEST SEEP	9/11/2007	*3.1*	1.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WEST SEEP	11/19/2007	***34.8***	***6.5***	ND	ND	ND	ND	ND	1.6	ND	ND	ND	ND
WEST SEEP	8/15/2008	***26.9***	***5.8***	1.1	ND	ND	ND	ND	1.3	ND	ND	ND	ND
WEST SEEP	10/24/2008	***33.5***	***9.0***	1.2	ND	ND	ND	ND	1.1	ND	ND	ND	ND
WEST SEEP	6/17/2009	*4.3*	1.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WEST SEEP	9/16/2009	***10.1***	2.4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WEST SEEP	6/15/2010	*3.8*	1.2	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WEST SEEP	8/31/2011	***20.6***	4.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WEST SEEP	10/19/2011	***14.6***	3.8	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WEST SEEP	3/28/2012	*1.7*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WEST SEEP	9/20/2012	*2.2*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WEST SEEP	11/14/2012	*1.7*	0.77 J	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WEST SEEP	9/5/2013	*1.0*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WEST SEEP	12/27/2013	*1.8*	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
WEST SEEP	10/29/2014	*1.4*	ND	ND	ND	ND	0.89 J	ND	ND	ND	ND	ND	ND
WEST SEEP	7/21/2015	***9.9***	***6.5***	0.35 J	ND	ND	ND	ND	0.36 J	ND	ND	ND	ND
WEST SEEP	6/15/2016	***15.5***	***11.3***	0.43 J	ND	ND	ND	ND	0.69 J	ND	0.11 J	ND	ND
WEST SEEP	11/17/2016	*3.3*	1.2	1.3	ND	ND	ND	ND	0.41 J	ND	ND	ND	ND

Acronyms and Abbreviations:

Italic = *r*esult exceeds Minnesota Department of Health Risk Level Water Criteria
BOLD = result exceeds Federal Maximum Contaminant Level.
CT = Carbon Tetrachloride
MC = Methylene Chloride
NA = not available or not analyzed
ND = not detected
NS = no standard
1,1-DCA = 1,1-Dichloroethane
1,1-DCE = 1,1-Dichloroethene
1,2-DCA = 1,2-Dichloroethane
1,1,1-TCA = 1,1,1-Trichloroethane
1,1,2,2-PCA = 1,1,2,2-Tetrachloroethane
cis-1,2-DCE = cis-1,2-Dichloroethene
PCE = Tetrachloroethene
TCE = Trichloroethene
TCL = Target Compound List
tran-1,2-DCE = trans-1,2-Dichloroethene
VC = Vinyl Chloride
VOCs = Volatile Organic Compounds
µg/L = micrograms per liter

APPENDIX F – SITE INSPECTION CHECKLIST

Site Inspection Checklist

I. SITE INFORMATION	
Site name: FMC Corporation Superfund Site	**Date of inspection: 3/13/19**
Location and Region: Fridley, MN, Region 5	**EPA ID: MND006481543**
Agency, office, or company leading the five-year review: EPA	**Weather/temperature:** 38ºF, Rain
Remedy Includes: (Check all that apply) ☐ Landfill cover/containment ☐ Access controls ☒ Institutional controls ☒ Groundwater pump and treatment ☐ Surface water collection and treatment ☐ Other_____ _____	☐ Monitored natural attenuation ☒ Groundwater containment ☐ Vertical barrier walls
Attachments: ☒ Inspection team roster below ☐ Site map attached	

Attendees:
Sheila Desai, U.S. EPA
Shanna Schmitt, MPCA
Andrew Fiskness, Wood
Joe Renier, Wood
Tim Ruda, BAE
Ryan Oesterreich, Arcadis
Sarah Massuch, BAE (joined at end of inspection)

II. INTERVIEWS (Check all that apply)

1. **O&M site manager** Tim Ruda (Name) Env. Engineer (Title) 3/13/19 (Date)
   Interviewed ☒at site ☐at office ☐by phone Phone no. _____
   Problems, suggestions; ☐Report attached _____

2. **O&M staff** _____ (Name) _____ (Title) _____ (Date)
   Interviewed: ☐at site ☐at office ☐by phone Phone no. _____
   Problems, suggestions; ☐Report attached _____

3. **Local regulatory authorities and response agencies** (i.e., State and Tribal offices, emergency response office, police department, office of public health or environmental health, zoning office, recorder of deeds, or other city and county offices, etc.) Fill in all that apply.

   Agency City of Minneapolis – Minneapolis Water Works
   Contact Chad Donnelly (Name) Engineer (Title) 3/13/19 (Date) _____ (Phone no.)
   Problems; suggestions; ☒Report attached See comments in Appendix H of Five Year Review

   Agency _____
   Contact _____ (Name) _____ (Title) _____ (Date) _____ (Phone no.)
   Problems; suggestions; ☐Report attached _____

   Agency _____
   Contact _____ (Name) _____ (Title) _____ (Date) _____ (Phone no.)
   Problems; suggestions; ☐Report attached _____

   Agency _____
   Contact _____ (Name) _____ (Title) _____ (Date) _____ (Phone no.)
   Problems; suggestions; ☐Report attached _____

4. **Other interviews** (optional) ☐ Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. O&M Documents

☒ O&M manual ☒ Readily available ☒ Up to date ☐ N/A
☒ As-built drawings ☒ Readily available ☒ Up to date ☐ N/A
☐ Maintenance logs ☐ Readily available ☐ Up to date ☒ N/A
Remarks Electronic files. Maintenance logs based on review electronic data received and maintenance as needed

2. Site-Specific Health and Safety Plan ☒ Readily available ☐ Up to date ☐ N/A
☐ Contingency plan/emergency response plan ☒ Readily available ☐ Up to date ☐ N/A
Remarks

3. O&M and OSHA Training Records ☒ Readily available ☐ Up to date ☐ N/A
Remarks

4. Permits and Service Agreements

☐ Air discharge permit ☐ Readily available ☐ Up to date ☒ N/A
☒ Effluent discharge ☒ Readily available ☒ Up to date ☐ N/A
☒ Waste disposal, POTW ☒ Readily available ☒ Up to date ☐ N/A
☒ Other permits: Water Appropriations Permit ☐ Readily available ☐ Up to date ☐ N/A
Remarks VOCs reported under the BAE facility permit -> Minor source

5. Gas Generation Records ☐ Readily available ☐ Up to date ☒ N/A
Remarks

6. Settlement Monument Records ☐ Readily available ☐ Up to date ☒ N/A
Remarks

7. Groundwater Monitoring Records ☒ Readily available ☒ Up to date ☐ N/A
Remarks

8. Leachate Extraction Records ☐ Readily available ☐ Up to date ☒ N/A
Remarks

9. Discharge Compliance Records

☒ Air ☒ Readily available ☒Up to date ☐ N/A
☒ Water (effluent) ☒ Readily available ☒ Up to date ☐ N/A
Remarks

10. Daily Access/Security Logs ☐ Readily available ☐ Up to date ☒ N/A
Remarks

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house ☐ Contractor for State
☒ PRP in-house ☒ Contractor for PRP
☐ Federal Facility in-house ☐ Contractor for Federal Facility
☐ Other_____
_____

2. **O&M Cost Records**

☒Readily available ☒ Up to date
☐ Funding mechanism/agreement in place
Original O&M cost estimate_____ ☐Breakdown attached

Total annual cost by year for review period if available

From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost
From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost
From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost
From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost
From_____ To_____ _____ ☐ Breakdown attached
Date Date Total cost

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: _____
_____
_____
_____
_____
_____

V. ACCESS AND INSTITUTIONAL CONTROLS ☐ Applicable ☐ N/A

A. Fencing

1. **Fencing damaged** ☐ Location shown on site map ☐ Gates secured ☒ N/A
   Remarks_____
   _____

B. Other Access Restrictions

1. **Signs and other security measures** ☐ Location shown on site map ☒ N/A
   Remarks_____
   _____

C. Institutional Controls (ICs)

1. **Implementation and enforcement**
   Site conditions imply ICs not properly implemented ☐ Yes ☐ No ☒ N/A
   Site conditions imply ICs not being fully enforced ☐ Yes ☐ No ☒ N/A

   Type of monitoring (*e.g.*, self-reporting, drive by) _____
   Frequency _____
   Responsible party/agency _____
   Contact _____ _____ _____ _____
   Name Title Date Phone no.

   Reporting is up-to-date ☐ Yes ☐ No ☒ N/A
   Reports are verified by the lead agency ☐ Yes ☐ No ☒ N/A

   Specific requirements in deed or decision documents have been met ☐ Yes ☐ No ☒ N/A
   Violations have been reported ☐ Yes ☐ No ☒ N/A
   Other problems or suggestions: ☐ Report attached
   _____
   _____
   _____
   _____

2. **Adequacy** ☐ ICs are adequate ☐ ICs are inadequate ☐ N/A
   Remarks____ Additional ICs may be needed and will be evaluated_____
   _____
   _____

D. General

1. **Vandalism/trespassing** ☐ Location shown on site map ☒ No vandalism evident
   Remarks_____
   _____

2. **Land use changes on site** ☒ N/A
   Remarks_____
   _____

3. **Land use changes off site** ☒ N/A
   Remarks_____
   _____

VI. GENERAL SITE CONDITIONS

A. Roads ☐ Applicable ☒ N/A

1. **Roads damaged** ☐ Location shown on site map ☐ Roads adequate ☐ N/A
   Remarks_____
   _____

B. Other Site Conditions

Remarks _____
_____
_____
_____
_____
_____

VII. LANDFILL COVERS ☐ Applicable ☒ N/A

A. Landfill Surface

1. **Settlement** (Low spots) ☐ Location shown on site map ☐ Settlement not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

2. **Cracks** ☐ Location shown on site map ☐ Cracking not evident
   Lengths_____ Widths_____ Depths_____
   Remarks_____
   _____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

4. **Holes** ☐ Location shown on site map ☐ Holes not evident
   Areal extent_____ Depth_____
   Remarks_____
   _____

5. **Vegetative Cover** ☐ Grass ☐ Cover properly established ☐ No signs of stress
   ☐ Trees/Shrubs (indicate size and locations on a diagram)
   Remarks_____
   _____

6. **Alternative Cover (armored rock, concrete, etc.)** ☐ N/A
   Remarks_____
   _____

7. **Bulges** ☐ Location shown on site map ☐ Bulges not evident
   Areal extent_____ Height_____
   Remarks_____
   _____

8. **Wet Areas/Water Damage** ☐ Wet areas/water damage not evident
☐ Wet areas ☐ Location shown on site map Areal extent_____
☐ Ponding ☐ Location shown on site map Areal extent_____
☐ Seeps ☐ Location shown on site map Areal extent_____
☐ Soft subgrade ☐ Location shown on site map Areal extent_____
Remarks_____
_____

9. **Slope Instability** ☐ Slides ☐ Location shown on site map ☐ No evidence of slope instability
Areal extent_____
Remarks_____
_____

B. Benches ☐ Applicable ☐ N/A
(Horizontally constructed mounds of earth placed across a steep landfill side slope to interrupt the slope in order to slow down the velocity of surface runoff and intercept and convey the runoff to a lined channel.)

1. **Flows Bypass Bench** ☐ Location shown on site map ☐ N/A or okay
Remarks_____
_____

2. **Bench Breached** ☐ Location shown on site map ☐ N/A or okay
Remarks_____
_____

3. **Bench Overtopped** ☐ Location shown on site map ☐ N/A or okay
Remarks_____
_____

C. Letdown Channels ☐ Applicable ☐ N/A
(Channel lined with erosion control mats, riprap, grout bags, or gabions that descend down the steep side slope of the cover and will allow the runoff water collected by the benches to move off of the landfill cover without creating erosion gullies.)

1. **Settlement** ☐ Location shown on site map ☐ No evidence of settlement
Areal extent_____ Depth_____
Remarks_____
_____

2. **Material Degradation** ☐ Location shown on site map ☐ No evidence of degradation
Material type_____ Areal extent_____
Remarks_____
_____

3. **Erosion** ☐ Location shown on site map ☐ No evidence of erosion
Areal extent_____ Depth_____
Remarks_____
_____

4. **Undercutting** ☐ Location shown on site map ☐ No evidence of undercutting
Areal extent_____ Depth_____
Remarks_____
_____

5. **Obstructions** Type_____ ☐ No obstructions
☐ Location shown on site map Areal extent_____
Size_____
Remarks_____
_____

6. **Excessive Vegetative Growth** Type_____
☐ No evidence of excessive growth
☐ Vegetation in channels does not obstruct flow
☐ Location shown on site map Areal extent_____
Remarks_____
_____

D. Cover Penetrations ☐ Applicable ☐ N/A

1. **Gas Vents** ☐ Active ☐ Passive
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____
_____

2. **Gas Monitoring Probes**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____
_____

3. **Monitoring Wells** (within surface area of landfill)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____
_____

4. **Leachate Extraction Wells**
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ Evidence of leakage at penetration ☐ Needs Maintenance ☐ N/A
Remarks_____
_____

5. **Settlement Monuments** ☐ Located ☐ Routinely surveyed ☐ N/A
Remarks_____
_____

E. Gas Collection and Treatment ☐ Applicable ☐ N/A

1. **Gas Treatment Facilities**
☐ Flaring ☐ Thermal destruction ☐ Collection for reuse
☐ Good condition ☐ Needs Maintenance
Remarks_____
_____

2. **Gas Collection Wells, Manifolds and Piping**
☐ Good condition ☐ Needs Maintenance
Remarks_____
_____

3. **Gas Monitoring Facilities** (*e.g.*, gas monitoring of adjacent homes or buildings)
☐ Good condition ☐ Needs Maintenance ☐ N/A
Remarks_____
_____

F. Cover Drainage Layer ☐ Applicable ☐ N/A

1. **Outlet Pipes Inspected** ☐ Functioning ☐ N/A
Remarks_____
_____

2. **Outlet Rock Inspected** ☐ Functioning ☐ N/A
Remarks_____
_____

G. Detention/Sedimentation Ponds ☐ Applicable ☐ N/A

1. **Siltation** Areal extent_____ Depth_____ ☐ N/A
☐ Siltation not evident
Remarks_____
_____

2. **Erosion** Areal extent_____ Depth_____
☐ Erosion not evident
Remarks_____
_____

3. **Outlet Works** ☐ Functioning ☐ N/A
Remarks_____
_____

4. **Dam** ☐ Functioning ☐ N/A
Remarks_____
_____

H. Retaining Walls ☐ Applicable ☐ N/A

1. **Deformations** ☐ Location shown on site map ☐ Deformation not evident
Horizontal displacement_____ Vertical displacement_____
Rotational displacement_____
Remarks_____
_____

2. **Degradation** ☐ Location shown on site map ☐ Degradation not evident
Remarks_____
_____

I. Perimeter Ditches/Off-Site Discharge ☐ Applicable ☐ N/A

1. **Siltation** ☐ Location shown on site map ☐ Siltation not evident
Areal extent_____ Depth_____
Remarks_____
_____

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A
☐ Vegetation does not impede flow
Areal extent_____ Type_____
Remarks_____
_____

3. **Erosion** ☐ Location shown on site map ☐ Erosion not evident
Areal extent_____ Depth_____
Remarks_____
_____

4. **Discharge Structure** ☐ Functioning ☐ N/A
Remarks_____
_____

VIII. VERTICAL BARRIER WALLS ☐ Applicable ☒ N/A

1. **Settlement** ☐ Location shown on site map ☐ Settlement not evident
Areal extent_____ Depth_____
Remarks_____
_____

2. **Performance Monitoring** Type of monitoring_____
☐ Performance not monitored
Frequency_____ ☐ Evidence of breaching
Head differential_____
Remarks_____
_____

IX. GROUNDWATER/SURFACE WATER REMEDIES ☒ Applicable ☐ N/A

A. Groundwater Extraction Wells, Pumps, and Pipelines ☐ Applicable ☐ N/A

1. **Pumps, Wellhead Plumbing, and Electrical**
☒ Good condition ☒ All required wells properly operating ☐ Needs Maintenance ☐ N/A
Remarks Regular maintenance soon, re-calibration on flow meters_____
_____
_____

2. **Extraction System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☒ Good condition ☐ Needs Maintenance
Remarks_____
_____

3. **Spare Parts and Equipment**
☒ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks_____
_____

B. Surface Water Collection Structures, Pumps, and Pipelines ☐ Applicable ☒ N/A

1. **Collection Structures, Pumps, and Electrical**
☐ Good condition ☐ Needs Maintenance
Remarks_____
_____

2. **Surface Water Collection System Pipelines, Valves, Valve Boxes, and Other Appurtenances**
☐ Good condition ☐ Needs Maintenance
Remarks_____
_____

3. **Spare Parts and Equipment**
☐ Readily available ☐ Good condition ☐ Requires upgrade ☐ Needs to be provided
Remarks_____
_____

C. Treatment System ☒ Applicable ☐ N/A

1. **Treatment Train** (Check components that apply)
☐ Metals removal ☐ Oil/water separation ☐ Bioremediation
☒ Air stripping ☐ Carbon adsorbers
☒ Filters filters are changed based on need
☐ Additive (*e.g.*, chelation agent, flocculent)_____
☐ Others_____
☒ Good condition ☐ Needs Maintenance
☒ Sampling ports properly marked and functional
☒ Sampling/maintenance log displayed and up to date
☒ Equipment properly identified
☒ Quantity of groundwater treated annually 55-60 million gallons
☐ Quantity of surface water treated annually_____
Remarks_____
_____

2. **Electrical Enclosures and Panels** (properly rated and functional)
☐ N/A ☒ Good condition ☐ Needs Maintenance
Remarks_____
_____

3. **Tanks, Vaults, Storage Vessels**
☐ N/A ☒ Good condition ☐ Proper secondary containment ☐ Needs Maintenance
Remarks_____
_____

4. **Discharge Structure and Appurtenances**
☐ N/A ☒ Good condition ☐ Needs Maintenance
Remarks_____
_____

5. **Treatment Building(s)**
☐ N/A ☒ Good condition (esp. roof and doorways) ☐ Needs repair
☐ Chemicals and equipment properly stored
Remarks_____
_____

6. **Monitoring Wells** (pump and treatment remedy)
☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☒ Good condition
☒ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks_____
_____

D. Monitoring Data

1. Monitoring Data
☒ Is routinely submitted on time ☐ Is of acceptable quality

2. Monitoring data suggests:
☐ Groundwater plume is effectively contained ☒ Contaminant concentrations are declining

E. Monitored Natural Attenuation

1. **Monitoring Wells** (natural attenuation remedy)
☐ Properly secured/locked ☐ Functioning ☐ Routinely sampled ☐ Good condition
☐ All required wells located ☐ Needs Maintenance ☐ N/A
Remarks_____
_____

X. OTHER REMEDIES

If there are remedies applied at the site which are not covered above, attach an inspection sheet describing the physical nature and condition of any facility associated with the remedy. An example would be soil vapor extraction.

XI. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.).
4 more extraction wells to be installed – lower alluvium, Increase treatment system from 200 gpm to 400 gpm, Remediate North soils in 2019, 2020 – RW-6 well treatment expansion – South Source Area, Central Source area – evaluating a longer term solution (possible in-situ) – looking at possible options in 2019_
_____
_____
_____

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy.
_____
_____
_____
_____
_____
_____
_____
_____
_____

C. Early Indicators of Potential Remedy Problems

Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs that suggest that the protectiveness of the remedy may be compromised in the future.

Vapor Intrusion Investigation started this week and will include 2 seasons

D. Opportunities for Optimization

Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy.

APPENDIX G – SITE INSPECTION PHOTO LOG

FMC Corporation Fifth Five Year Review Site Inspection Photo Log
March 13, 2019

Photo 1: RW-3 Outside View

Photo 2: RW-3 inside view

Photo 3: RW-4

Photo 4: Treatment System Trailer, North side

Photo 5: Treatment System Trailer, South Side

Photo 6: Air Gap

Photo 7: Mixing tank near treatment trailer

Photo 8: Air Stripper

Photo 9: Blower for air stripper

Photo 10: General view of inside treatment system trailer

Photo 11: FMC-77

APPENDIX H – MINNEAPOLIS WATER WORKS COMMENT LETTER

Minneapolis
City of Lakes

Public Works – Water Treatment & Distribution Services
4300 Marshall Street NE
Minneapolis, MN 55112
TEL 612.661.4975
www.minneapolismn.gov

April 30, 2019

Shelia Desai
Remedial Project Manager
U.S. Environmental Protection Agency Region 5
77 West Jackson Blvd.
Chicago, Illinois 60604

Shanna Schmitt, PG
Geologist/Project Manager
Minnesota Pollution Control Agency (MPCA)
520 Lafayette Road
St. Paul, MN 55155

Re: Five Year Review - FMC Corporation Superfund Site

Sheila and Shanna-

In accordance with the provisions of the Comprehensive Environmental Response and Liability Act, the City of Minneapolis' Division of Water Treatment & Distribution Services is submitting this correspondence for your review as you begin to prepare the Five-Year Review report (Report) for the above-referenced superfund site. The items below summarize the points of discussion presented by City staff at our March 13, 2019 interview. These issues are those that we find to be most concerning and of critical importance to the assessment of regulatory compliance with the Record of Decision (ROD) and grading performance of the remedial measures for the past cycle.

- Expansion of the monitoring well network in the upper alluvial formation: the existing well network is inadequate to fully delineate the plume.

- Update the environmental monitoring program to measure dissolved concentrations of the contaminants of concern (COC) – beneath the City's Fridley water treatment campus – to further assess potential vapor intrusion. An update to the Site Conceptual Model should be completed following these investigations.

- Capture Zone Analysis (CZA): Results reveal an inadequate capture zone of the groundwater plume to that prescribed in the ROD. The groundwater data suggests that the concentration of the COCs is not maintained as prescribed at the site boundary.
    - 2009 Report revealed a 50% capture zone
    - 2014 report revealed a 40% capture zone
    - 2018 Limited CZA completed. Partial captured modeled
    - River seeps and constituent concentrations observed at these locations.

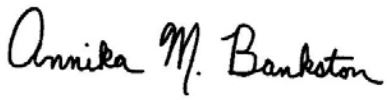
- Vapor Intrusion
    - A Protectiveness Determination statement has not been made, nor does it appear that such a statement will be made with this Report due to the lack of effort by the responsible party to act on previously-suggested well network changes and off-site investigations.
    - A ROD amendment (Explanation of Significant Differences) appears justified to recognize vapor intrusion.

These issues are essentially a recount of the findings and deficiencies that were made record of with the past two 5-year review reports. The same findings are also made record of in the annual reports, yet very little action is observed as being taken by the responsible party in response.

In summary, the City is deeply concerned about the continued threat of down-gradient contamination due to the observed off-site migration of the COCs originating from this superfund site. The potential impacts to water treatment plant infrastructure, as well as the health and welfare of the people who work and visit the treatment plant on a daily basis is a real concern for City staff. It is the opinion of City staff that a more aggressive approach be taken by the responsible party and/or or new strategies be evaluated and implemented to remediate the known sources areas and better control source zone migration.

The City of Minneapolis appreciates the efforts of the US EPA and the MPCA on this important project and we thank you for the opportunity to meet with you, and this opportunity to voice our concerns. We look forward to reviewing the report.

Regards,



Annika M. Bankston,
Superintendent, Water Plant Operations & Maintenance
Minneapolis Division of Water Treatment & Distribution Services

Copy: Glen Gerads, Director
Minneapolis Division of Water Treatment & Distribution Services