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BUILDING A BETTER WORLD

TECHNICAL MEMORANDUM

Date: July 30, 2012 **Reference:** 10500630.010101

To: Ms. Diana Engeman, United States Environmental Protection Agency

From: Kevin G. Armstrong, C.P.G.

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30284039
Superfund

Subject: Detailed Analysis of Hydraulic Containment Remedial Strategy
Peoples Natural Gas, Dubuque, Iowa Former Manufactured Gas Plant Site
Civil Action C92-1048

This Technical Memorandum is an Addendum to the April 9, 2009 Technical Memorandum (hereinafter referred to as Addendum), which provided a detailed analysis and comparison of remedial action alternatives for the Peoples Natural Gas (PNG), Dubuque, Iowa Former Manufactured Gas Plant Site (Site), presents a detailed analysis of the hydraulic containment remedial strategy for the Site. The alternate remedial strategy was previously evaluated in the Amendment to the May 2006 Technical Impracticability (TI) Evaluation Report (Amended TI Evaluation Report), submitted to the United States Environmental Protection Agency (USEPA) May 15, 2012. On December 1, 2006, MidAmerican Energy Company (MidAmerican) submitted a petition to the USEPA to modify the groundwater component of the remedial action by waiving compliance with performance standards for groundwater on a portion of the Site, identified as the TI Zone. In the Amended TI Evaluation Report, MidAmerican proposed a technically practicable alternative remedial strategy that is protective of human health and the environment. The alternative remedial strategy incorporates access restrictions, previous soil removal actions and site geology, hydraulic containment of the downgradient silty sand aquifer plume, and monitored natural attenuation (MNA) to achieve the Site groundwater chemical-specific Applicable or Relevant, and Appropriate Requirements (ARARs)/remediation goals outside the proposed TI Zone. The proposed TI Zone is shown in Figure 1.

The alternative remedial strategy presented in this Addendum is assessed according to the nine evaluation criteria developed by the USEPA to address Comprehensive Environmental Response, Compensation Liability Act of 1980 (CERCLA) requirements:

1. Overall Protection of Human Health and the Environment
2. Compliance with (ARARs)
3. Long-Term Effectiveness and Permanence
4. Reduction of Toxicity, Mobility, or Volume through Treatment

5. Short-Term Effectiveness
6. Implementability
7. Cost
8. State Acceptance
9. Community Acceptance

Criteria 1 and 2 are referred to as threshold criteria. Criteria 3 through 7 are referred to as the primary balancing criteria. Criteria 8 and 9 are referred to as modifying criteria. The first seven of the nine criteria are assessed in this Addendum. The remaining two criteria, State Acceptance and Community Acceptance, will be evaluated following regulatory review of the Addendum and public comment on the Proposed Plan.

A summary of the comparative analysis of remedial alternatives for groundwater is provided in Table 1. In addition to the hydraulic control remedial alternative (Alternative 5), Table 1 includes a summary of the four alternative remedial strategies evaluated in the April 9, 2009 Technical Memorandum.

1.0 DESCRIPTION OF ALTERNATIVE REMEDIAL STRATEGY

1.1 Exposure Control

As stated in the September 16, 1991 Record of Decision (ROD) (USEPA, 1991), institutional controls are required to impose groundwater and land used restrictions at the Site. In addition, access to the Site must be controlled with site fencing (USEPA, 1991). In 2005, the Iowa state legislature passed the Uniform Environmental Covenants Act (UECA), which has been certified under Iowa Code Title XI, Chapter 445I and provides a legally enforceable means to restrict land use or access under a real estate instrument. The USEPA intends to implement a uniform environmental covenant to limit exposure to residual soil contamination, address the potential for future vapor intrusion, and prohibit installation of drinking water wells in the plume (USEPA, 2010). The Iowa Administrative Code (IAC) provides the Iowa Department of Natural Resources (IDNR) with existing authority to prohibit private and public water well installation in the vicinity of contamination at 567 IAC 38.12 and 567 IAC 3.3(7), respectively. MidAmerican will formally notify the IDNR Water Supply Section, the City of Dubuque (City) Water Department, and the Dubuque County Health Department of the area of contamination for consideration when reviewing new water well permit applications. A Memorandum for Record of Property Restriction and an Iowa Real Estate Transfer - Groundwater Hazard Statement were recorded with the County Recorder, Dubuque County, Iowa on May 14, 1991 for both the Site, owned by the City, and the Highway Corridor, owned by the Iowa Department of Transportation (IDOT). These documents restrict both excavations and disturbances at a depth of 6 feet or below, and installation of water supply or private wells. The Site is listed in the IDNR registry of abandoned or uncontrolled disposal sites. The City-owned portion of the Site is currently fenced, and the IDOT portion is covered by U.S. Highway 61.

1.2 Source Control

Several excavations conducted over the course of remedial activities removed approximately 45 percent of the original source contamination from the Site (MWH, 2006). However, dense nonaqueous phase liquid (DNAPL) remains beneath and east of the City maintenance garage, along the 30-inch diameter sanitary sewer force main, and in the Highway Corridor area. Since much of this material is inaccessible, further excavation would not eliminate source material from the Site.

As discussed in the May 2006 TI Evaluation Report, the majority of residual source material remaining at the Site will likely be contained by the site geology (MWH, 2006). If the DNAPL remaining east of the City maintenance garage were to migrate over time, site data suggests the lower confining unit (LCU) would limit downward migration of contaminants to the alluvial aquifer. Further lateral migration of DNAPL would likely be contained due to the slope of the LCU as the elevation climbs on the east side of Kerper Boulevard. The degree of both vertical and horizontal migration will be limited by the extent of DNAPL retention as residual material.

DNAPL detected in the Drain Sump is assumed to be accumulating from the lateral drainpipe installed under U.S. Highway 61. The impacted area is inaccessible due to the presence of the highway; however, the LCU appears to be present in the impacted area. No potential receptors have been identified near this portion of the Site.

Currently, site wells are gauged semiannually for the presence of DNAPL. Semiannual gauging for free product would be continued to monitor the potential for DNAPL migration under the alternative remedial strategy.

1.3 Dissolved Plume Control

A hydraulic containment system consisting of extraction wells would be installed between Kerper Boulevard and the levee, to prevent downgradient plume migration. Analysis of data collected during November 2011 pilot testing indicates hydraulic control can be maintained by operation of three groundwater extraction wells, without installation of a cutoff wall. Groundwater sampling conducted during the pilot test confirmed the viability of direct discharge of extracted groundwater for treatment at the City's Water and Resource Recovery Center (WRRC) through the sanitary sewer system under a Publically Owned Treatment Works (POTW) Industrial Wastewater Discharge Permit (Discharge Permit).

1.4 MNA

MNA would monitor plume stability through groundwater sampling and analysis to detect changes in groundwater concentrations or plume migration. Natural attenuation reduces contaminant concentrations in groundwater and limits migration via natural processes such as biodegradation, chemical transformation, sorption, dispersion, diffusion, and volatilization. Biodegradation is the primary mechanism that reduces contaminant mass. Low permeability

and adsorptive clayey soil can be the primary physical attenuation mechanisms, which limit migration rates and greatly increase the time available for on-site biodegradation.

As discussed in Section 5.6 of the TI Evaluation Report, groundwater conditions at the PNG site appear conducive to microbial activity, and initial geochemical data suggest various microbial processes are occurring (MWH, 2006). Continued groundwater monitoring would be required to confirm contaminant migration is not occurring, concentrations are stable, and concentrations will eventually decrease. The majority of contamination remains in the upper fill layer and the silty sand aquifer, with the underlying low permeability UCU and LCU providing a mechanism for physical attenuation at the site.

2.0 DETAILED ANAYSIS OF GROUNDWATER ALTERNATIVE 5 – ACCESS RESTRICTIONS WITH HYDRAULIC CONTAINMENT AND MONITORED NATURAL ATTENUATION

2.1 Overall Protection of Human Health and the Environment

This alternate remedial strategy would be protective of human health and the environment. Physical features such as fencing enclosing the City-owned portion of the Site, the absence of existing drinking water wells in the plume area, and the presence of U.S. Highway 61 restrict access to residual soil and groundwater contamination. The combination of the uniform environmental covenant, IDNR's existing authority to prohibit private and public water well installation in the vicinity of contamination, the Memorandum For Record of Property Restriction, and the Iowa Real Estate Transfer - Groundwater Hazard Statement will further limit site excavation and associated exposure to residual soil contamination, address the potential for future vapor intrusion, and prohibit installation of drinking water wells in the plume.

Site geology will likely contain residual source material remaining at the site, and the hydraulic containment system would prevent off-site plume migration to the nearby Mississippi River. Limits included in the POTW Discharge Permit are expected to restrict WRRC employee exposure to dissolved compounds and allow sufficient treatment through the WRRC.

Natural attenuation processes may reduce groundwater concentrations over time for some compounds.

2.2 Compliance with ARARs

The alternate remedial strategy would not achieve compliance with chemical-specific ARARs/remediation goals, given the significant amount of contaminant mass remaining as DNAPL and adsorbed material. Waiver of chemical-specific ARARs has been requested within the proposed TI Zone. Given sufficient time, ARARs/remediation goals for biodegradable volatile organic compounds (VOCs) are likely to be achieved at the edges of the plume. However, polycyclic aromatic hydrocarbons (PAHs) are less amenable to biodegradation, and DNAPL and adsorbed material will continue to serve as a source of dissolved compounds.

2.3 Long-Term Effectiveness and Permanence

The alternate remedial strategy would provide long-term effectiveness, and the overall exposure risk remaining at the Site would be low. Site geology will likely contain residual source material remaining at the site, and the presence of U.S. Highway 61 permanently restricts access to residual soil and groundwater contamination in the Highway Corridor. Exposure to soil and groundwater is highly unlikely, given the uniform environmental covenant, IDNR's existing authority to prohibit private and public water well installation in the vicinity of contamination, the Memorandum for Record of Property Restriction, and the Iowa Real Estate Transfer - Groundwater Hazard Statement. Because a uniform environmental covenant is a legally binding document, approved by the IDNR and standardized in Iowa Code, long-term effectiveness and reliability is expected. Existing rules provide the IDNR with authority to prohibit water well installation; this regulation is anticipated to be effective because the rule is codified, increasing anticipated permanence.

Operation of the hydraulic containment system would provide long-term control of the downgradient dissolved plume, reducing potential for off-site migration to the Mississippi River. A sequestering agent would be employed for in-well water treatment to reduce operational and maintenance issues similar to the scaling and biofouling issues encountered during operation of the previous groundwater extraction and treatment system. Discharge to the WRRC would be regulated by a POTW Discharge Permit, which is expected to minimize the exposure risk to WRRC employees and allow sufficient treatment through the WRRC. Routine maintenance would be required to ensure continued operation of the containment system; and routine groundwater monitoring would be required to assess the progress of natural attenuation and identify trends that may affect the effectiveness of the alternate remedial strategy. Because installation of nearby water wells will be restricted by institutional controls, the current direction of groundwater flow is not expected to change.

The alternate remedial strategy would require ongoing five-year reviews to confirm its long-term effectiveness.

2.4 Reduction in Toxicity, Mobility, or Volume through Treatment

The alternate remedial strategy would not significantly reduce the toxicity, mobility, or volume of site contaminants, since no treatment processes are included. A relatively small mass of dissolved compounds would be extracted by the hydraulic containment system, with subsequent treatment through the WRRC. In addition, natural attenuation processes would gradually reduce contaminant concentrations.

2.5 Short-Term Effectiveness

There would be no additional risks posed to the community, site workers, or the environment as a result of the exposure and source control portions of the alternate remedial strategy. Monitored natural attenuation would pose minimal risk to the community or environment from monitoring; a slight risk of field and laboratory worker exposure to contaminants would be

present while sampling and analyzing impacted groundwater. Simple precautions taken when collecting groundwater samples would provide adequate protection.

Workers would be exposed to typical mechanical equipment risks during installation of the hydraulic containment system. Extraction wells would be installed to the east of the Site in unimpacted soil, and excavation activities associated with conveyance pipe installation would primarily be conducted in areas and to depths previously excavated, minimizing exposure of site workers to contaminated soil and groundwater. Risks to site workers would be addressed by adherence to a site-specific Health and Safety Plan that would determine the necessary levels of personal protective equipment needed for each activity. Impact to the surrounding community would be minimal. Air monitoring in the work space and at the site perimeter during construction would determine when site actions were posing a risk to workers and the community.

Installation and startup of the hydraulic containment system would be expected to take a month or less, with hydraulic control expected shortly after operation begins.

2.6 Implementability

A Memorandum for Record of Property Restriction and an Iowa Real Estate Transfer - Groundwater Hazard Statement have been implemented to restrict excavations and disturbances at a depth of 6 feet or below, and installation of water supply or private wells. The USEPA intends to implement a uniform environmental covenant to limit exposure to residual soil contamination, address the potential for future vapor intrusion, and prohibit installation of drinking water wells in the plume (USEPA, 2010). In addition, existing regulations will restrict future water well installation in the impacted groundwater plume; MidAmerican will formally notify the IDNR Water Supply Section, the City Water Department, and the Dubuque County Health Department of the area of contamination for consideration when reviewing new water well permit applications. New well permits would be reviewed as a part of the USEPA five-year review process to verify no drinking water wells have been placed within the impacted area. Implementation of institutional controls would require coordination with the City Water Department, the Dubuque County Health Department, and the IDNR Water Supply Section, with no foreseeable difficulty.

The hydraulic containment system is technically feasible to install and implement; would use available technologies, equipment, and services; and could be installed over a period of less than one month. The containment system would use an extraction well previously installed for the November 2011 pilot test; therefore, installation of two additional extraction wells would be required. The hydraulic containment system could be reliably monitored by routine monitoring of flow rates and water quality. There would be minimal risk of direct groundwater exposure resulting from system failure. Although the City has provided preliminary verbal approval for discharge to the WRRC, implementation of the hydraulic containment system would require coordination with the WRRC to obtain a POTW Industrial Wastewater Discharge Permit. Additionally, construction and operation of the system would require City permits for excavation and use of the Right of Way.

2.7 Cost

The present value cost of the alternate remedial strategy is estimated to be $1,221,000, including hydraulic containment system installation; and system operation, system monitoring, and MNA for 30 years.

REFERENCES

MWH, 2006. *Technical Impracticability Evaluation Report, Peoples Natural Gas Site*. May 2006.

MWH, 2012. *Amendment to the May 2006 Technical Impracticability Evaluation Report, Former Peoples Natural Gas Site*. May 2012.

USEPA, 1991. *Record of Decision: Peoples Natural Gas Coal Gasification Site, Dubuque, Iowa*. September 1991.

USEPA, 2010. *Third Five-Year Review Report for Peoples Natural Gas, Dubuque, Iowa*. July 2010.

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Attachments:

Table 1 Summary of Detailed Analysis of Remedial Alternatives for Groundwater
Figure 1 Proposed Technical Impracticability Zone

TABLE 1

SUMMARY OF DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES FOR GROUNDWATER
MIDAMERICAN ENERGY COMPANY
PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

Criteria	Alternative 1 Access Restrictions and Additional Excavation	Alternative 2 Access Restrictions and In-Situ Solidification	Alternative 3 Access Restrictions and In-Situ Thermal Treatment	Alternative 4 Access Restrictions and Monitored Natural Attenuation	Alternative 5 Access Restrictions, Hydraulic Containment System, and Monitored Natural Attenuation
OVERALL PROTECTIVENESS					
Groundwater Ingestion for Existing Users	High because no existing users to protect.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Groundwater Ingestion for Future Users	High because access restrictions prohibit use of groundwater.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Environmental Protection	Moderate. DNAPL and groundwater plume contained by site geology. Low to moderate if the LCU is damaged.	Moderate. DNAPL and groundwater plume contained by site geology. Low to moderate if the LCU is damaged and/or created area of low permeability changes flow paths.	Same as Alternative 1.	Moderate. DNAPL and groundwater plume contained by site geology.	Moderate. DNAPL contained by site geology; downgradient plume migration controlled by hydraulic containment system.
COMPLIANCE WITH ARARs					
Chemical-Specific	ARARs for accessible soil could be achieved. ARARs for groundwater would take in excess of a thousand years.	Same as Alternative 1.	Same as Alternative 1.	ARARs not likely achieved in a reasonable time frame. Natural attenuation processes will reduce the overall contaminant mass over time.	Same as Alternative 4.
Action-Specific	None identified.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Location-Specific	None identified.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Other	None identified.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
LONG-TERM EFFECTIVENESS					
Magnitude of Residual Risk	The low potential for future use of groundwater near the site remains. Restrictions on accessing contaminated groundwater will remove exposure risk.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Adequacy and Reliability of Control	Multiple layers of protection: existing IDNR rules and Environmental Covenants. Contaminant mass removed through excavation.	Multiple layers of protection: existing IDNR rules and Environmental Covenants. Contaminant mass immobilized by in-situ solidification.	Multiple layers of protection: existing IDNR rules and Environmental Covenants. Contaminant mass volatilized and/or mobilized for extraction by in-situ thermal treatment.	Multiple layers of protection: existing IDNR rules and Environmental Covenants. MNA increases reliability of predicting future plume concentrations, assessment of plume size and applicability of access restrictions.	Multiple layers of protection: existing IDNR rules and Environmental Covenants. MNA increases reliability of predicting future plume concentrations, assessment of plume size, and applicability of access restrictions. Hydraulic containment system reduces potential for off-site migration of groundwater plume.
Need for 5-Year Review	Review required to ensure adequate protection of human health and environment.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
REDUCTION IN TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT					
Treatment Process and Materials Treated	Excavation of accessible soil contaminant mass.	Solidification of accessible soil and groundwater contaminant mass.	Extraction and volatilization of accessible contaminant mass.	None.	Extracted groundwater would be treated at the WRRC by screening, grit removal, primary treatment, secondary treatment by the oxygen activated sludge process, final clarification, and ultraviolet disinfection.
Amount of Hazardous Materials Destroyed or Treated	65% of the total remaining contaminant mass will be removed. 206,230 pounds of contaminant mass remains. DNAPL will remain and mobilization is possible.	65% of the total remaining contaminant mass will be immobilized but not destroyed. 206,230 pounds of contaminant mass remains mobile. DNAPL will remain and mobilization is possible.	59% of the total remaining contaminant mass will be removed. 252,620 pounds of contaminant mass remains. DNAPL will remain and mobilization is possible.	None.	A relatively small mass of dissolved compounds would be extracted by the hydraulic containment system, with subsequent treatment at the WRRC. In addition, natural attenuation processes would gradually reduce contaminant concentrations.

TABLE 1 (CONTINUED)

SUMMARY OF DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES FOR GROUNDWATER
MIDAMERICAN ENERGY COMPANY
PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

Criteria	Alternative 1 Access Restrictions and Additional Excavation	Alternative 2 Access Restrictions and In-Situ Solidification	Alternative 3 Access Restrictions and In-Situ Thermal Treatment	Alternative 4 Access Restrictions and Monitored Natural Attenuation	Alternative 5 Access Restrictions, Hydraulic Containment System, and Monitored Natural Attenuation
REDUCTION IN TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT (CONTINUED)					
Degrees of Expected Reduction	Untreated source material would remain in the inaccessible area beneath the City of Dubuque (City) maintenance garage, along the 30-inch sanitary sewer force main, and within the Highway Corridor area, leaving an ongoing source for groundwater contamination.	None.	Temperatures are limited to 212°F. Approximately 41% of the estimated 614,290 pounds of contaminant mass remaining at the site is present under U.S. Highway 61 or remains east of the City maintenance garage as residual DNAPL or adsorbed material.	None.	Although some contaminant mass will be removed by the hydraulic containment system, the overall reduction is expected to be small.
Degree to which Treatment is Reversible	Mass removal is irreversible but may mobilize DNAPL. DNAPL will remain as an ongoing source for groundwater contamination.	Immobilization is irreversible. Low permeability may encourage mobilization of DNAPL. DNAPL will remain as an ongoing source for groundwater contamination.	Thermal treatment of contaminant mass is irreversible. The DNAPL may be mobilized. DNAPL will remain as an ongoing source for groundwater contamination.	None.	The small amount of contaminant mass removed by the hydraulic containment system is irreversible. However, continued downgradient migration would be expected if the system were to be shut off.
Type/Quantity of Residuals	206,230 pounds of untreated source material would remain in the inaccessible area beneath the City maintenance garage, along the 30-inch sanitary sewer force main, and within the Highway Corridor area,	Same as Alternative 1.	225,620 pounds of untreated source material would remain present under U.S. Highway 61, remains east of the City maintenance garage as residual DNAPL or adsorbed material and either inaccessible to in-situ thermal treatment and/or not susceptible to treatment due to the temperature limitation of 212°F.	Current conditions persist with natural degradation.	Current conditions persist with natural degradation.
Statutory Preference for Treatment	Does not satisfy for inaccessible areas of the site. Alternative 2 would satisfy the preference by reducing the contaminant mass in the accessible soil by 66% of the total site contaminant mass.	Does not satisfy for inaccessible areas of the site. Alternative 3 would satisfy the preference by irreversibly reducing contaminant mobility in accessible soil and groundwater by 66% of the total site contaminant mass.	Does not satisfy for inaccessible areas of the site. Alternative 4 would satisfy the preference by destroying and reducing the contaminant mass in accessible soil by 59% of the total site contaminant mass.	Does not satisfy.	Satisfies preference for treatment for the small amount of contaminant mass removed by the hydraulic containment system. Does not satisfy for remainder of site contaminants.
SHORT-TERM EFFECTIVENESS					
Protection of Community During Remedial Actions	Minor, controllable exposure risks from excavated soil and vapor migration.	Minor, controllable exposure risks from soil cuttings and vapor migration.	Minor, controllable exposure risks from soil cuttings, extracted groundwater, and vapor migration.	Risk to community by remedy is not increased.	Minor, controllable risks during construction outside of the fenced portion of the site. Minor, controllable exposure risks from extracted groundwater.
Protection of Workers During Remedial Actions	Risks controlled through use of PPE and Standard Operating Procedures.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative1.	Same as Alternative1.
Environmental Impacts	LCU may be damaged allowing DNAPL to migrate into the alluvial aquifer. Excavation may facilitate DNAPL migration.	LCU may be damaged allowing DNAPL to migrate into the alluvial aquifer. Low permeability area may alter groundwater flow direction locally.	LCU may be damaged allowing DNAPL to migrate into the alluvial aquifer. Heated soil may facilitate DNAPL migration.	No short-term environmental impact.	LCU may be damaged during well installation allowing DNAPL to migrate into the alluvial aquifer. Groundwater extraction may induce DNAPL migration by increasing hydraulic gradient.
Time until RAOs Achieved	As soon as restrictions are in place.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
IMPLEMENTABILITY					
Ability to Construct and Operate the Technology	Difficult. Equipment and process is common but there is a large volume of overburden to remove and excavators must protect LCU.	Difficult. Equipment and process is specialized. The treatment process is relatively complex.	Difficult. Equipment and process is uncommon for FMGP sites. The treatment process is relatively complex.	Easy. Monitoring wells already installed and groundwater sampling previously conducted at the site.	Moderate. Monitoring wells already installed and groundwater sampling previously conducted at the site. Hydraulic containment system equipment and process is common.
Ability to Construct and Operate the Technology	Difficult. Equipment and process is common but there is a large volume of overburden to remove and excavators must protect LCU.	Difficult. Equipment and process is specialized. The treatment process is relatively complex.	Difficult. Equipment and process is uncommon for FMGP sites. The treatment process is relatively complex.	Easy. Monitoring wells already installed and groundwater sampling previously conducted at the site.	Moderate. Monitoring wells already installed and groundwater sampling previously conducted at the site. Hydraulic containment system equipment and process is common.

TABLE 1 (CONTINUED)

SUMMARY OF DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES FOR GROUNDWATER
MIDAMERICAN ENERGY COMPANY
PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

Criteria	Alternative 1 Access Restrictions and Additional Excavation	Alternative 2 Access Restrictions and In-Situ Solidification	Alternative 3 Access Restrictions and In-Situ Thermal Treatment	Alternative 4 Access Restrictions and Monitored Natural Attenuation	Alternative 5 Access Restrictions, Hydraulic Containment System, and Monitored Natural Attenuation
IMPLEMENTABILITY (CONTINUED)					
Reliability	High. Multiple layers of protection and appropriate authorities notified. Excavation equipment is reliable.	Moderate. Multiple layers of protection and appropriate authorities notified. Equipment reliable.	Moderate. Multiple layers of protection and appropriate authorities notified. Equipment is reliable, but untested at an FMGP site.	High. Multiple layers of protection and appropriate authorities notified. Monitoring ensures current plume conditions are known.	High. Multiple layers of protection and appropriate authorities notified. Operation of hydraulic containment system is mature technology. Poor water quality will require ongoing maintenance to control scaling and biofouling of system. Monitoring provides current data on plume conditions.
Ease of Undertaking Additional Remedial Action if Necessary	Difficult - access to the remaining contamination limited by the LCU, maintenance garage and highway corridor.	Difficult - solidified areas of the site not easily penetrated. Access to the remaining contamination limited by the LCU, maintenance garage, and highway corridor.	Possible, but restricted by conveyance piping and well layout during implementation. Access to the remaining contamination limited by the LCU, maintenance garage, and highway corridor.	High.	High.
Ability to Monitor Effectiveness	New well permits could easily be verified to be outside of known area of contamination. Groundwater monitoring used to ensure impacted areas are addressed.	New well permits could easily be verified to be outside of known area of contamination. Groundwater monitoring used to ensure impacted areas are addressed.	New well permits could easily be verified to be outside of known area of contamination. Groundwater monitoring used to ensure impacted areas are addressed.	New well permits could easily be verified to be outside of known area of contamination. MNA increases predictability of future concentrations.	New well permits could easily be verified to be outside of known area of contamination. MNA increases predictability of future concentrations. Effectiveness of the hydraulic containment system monitored by groundwater extraction rates.
Ability to Obtain Approvals from other Agencies	High.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.	Same as Alternative 1.
Coordination with other Agencies	Required coordination with City, Dubuque County, and IDNR for implementation of access restrictions plus excavation permits.	Same as Alternative 1 plus groundwater discharge permits and building permits.	Same as Alternative 2 plus air discharge permits.	Required coordination with City, Dubuque County, and IDNR for implementation of access restrictions.	Required coordination with City, Dubuque County, and IDNR for implementation of access restrictions; and the WRRC for POTW Industrial Wastewater Discharge Permit.
Availability of Off-Site Treatment/Disposal	Required coordination for off-site treatment/disposal of impacted soil.	Not applicable.	Same as Alternative 1.	Not applicable.	Treatment available at WRRC.
Availability of Necessary Equipment/Specialists	Readily available.	Potential for low availability as it is not a common technology.	Potential for low availability as there is only one licensed contractor.	Same as Alternative 1.	Same as Alternative 1.
Availability of Prospective Technologies	Commonly utilized.	Available technology, but will require bench-scale testing.	Same as Alternative1, but not specifically for FMGP contaminants; pilot scale testing may be required.	Same as Alternative 1.	Same as Alternative 1.
COST					
Capital, Operation & Maintenance, Present Worth Cost	$2,523,000.	$3,840,000.	$3,545,000.	$622,000.	$1,221,000.

Notes:

% = Percent.
ºF = Degrees Fahrenheit.
ARAR = Applicable or Relevant and Appropriate Requirements.
City = City of Dubuque.
DNAPL = Dense nonaqueous phase liquid.
FMGP = Former Manufactured Gas Plant.
IDNR = Iowa Department of Natural Resources.
LCU = Lower Confining Unit.
MNA = Monitored natural attenuation.
POTW = Publically-Owned Treatment Works.
PPE = Personal protective equipment.
RAOs = Remedial action objectives.
U.S. = United States.
WRRC = Water and Resource Recovery Center.

US EPA ARCHIVE DOCUMENT

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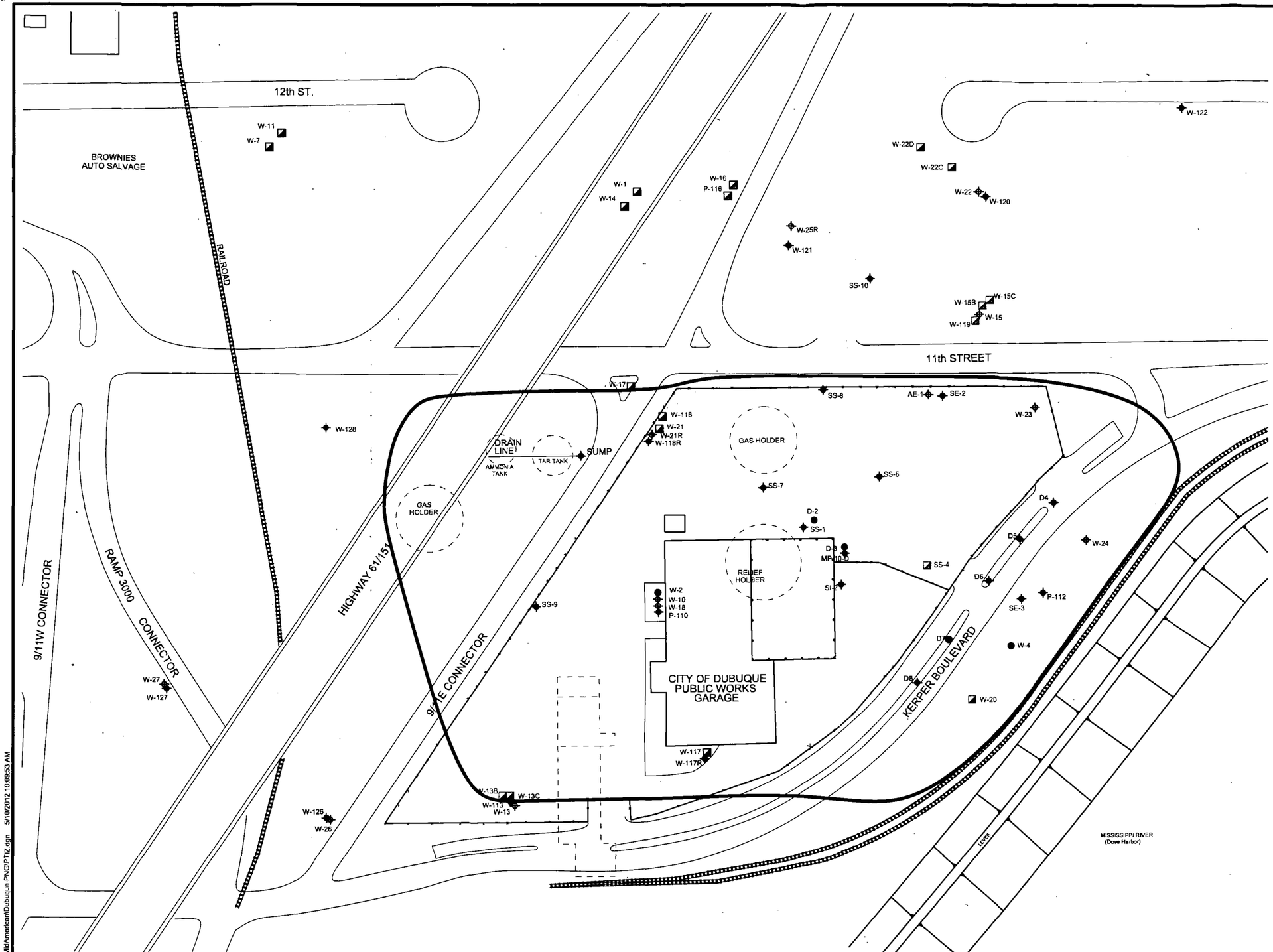

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SCALE IN FEET

MANAGING OFFICE: DES MOINES, IOWA

PROJECT: MIDAMERICAN ENERGY COMPANY
PEOPLES NATURAL GAS SITE
DUBUQUE, IOWA

TITLE: **PROPOSED TECHNICAL IMPRACTICABILITY ZONE**

MWH

FIGURE: 1