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Feasibility Study Report

Elmira Water Street Manufactured Gas Plant Site
City of Elmira, New York

NYSDEC Site #808025
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Table of Contents

Table of Contents (cont.)

Tables

Figures

Appendices

Engineer's Certification

In accordance with NYSDEC DER-10 Section 1.5 (b) 2,

I, Daniel R. Kopcow, certify that I am currently a NYS Registered Professional Engineer, and that this Report was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the NYSDEC Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation (DER-10).

11/2/2015

Engineer's Seal | Date
GEI Consultants, Inc., P.C.

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Abbreviations and Acronyms

AOC	Area of Concern
AWQS	Ambient Water Quality Standards, Guidance Values, and Groundwater Effluent Limitations
bgs	Below ground surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene
COC	Constituents of Concern
CY	Cubic yard
DEC Soil Cleanup Guidance	Soil Cleanup Guidance DEC Policy, November 4, 2009
DER	Division of Environmental Remediation
DER-10	NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation, May, 2010
FS	Feasibility Study
GAC	Granular Activated Carbon
GEI	GEI Consultants, Inc., P.C.
GRA	General Response Action
HASP	Health and Safety Plan
IC/ECs	Institutional Controls/Engineering Controls
ISCO	In-Situ Chemical Oxidation
ISS	In-Situ Soil Solidification
LTTD	Low-Temperature Thermal Desorption
MGP	Manufactured Gas Plant
mg/kg	Milligrams per kilogram (equivalent to ppm)
MNA	Monitored Natural Attenuation
NAPL	Non-Aqueous Phase Liquid
NAVD88	North American Vertical Datum 1988
NCP	National Contingency Plan. 40CFR1J Part 300 – National Oil and Hazardous Substances Pollution Contingency Plan
NGVD	National Geodetic Vertical Datum 6 NYCRR Title 6 of the New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
NYSDPW	New York State Department of Public Works
NYSEG	New York State Electric and Gas Corporation
OM&M	Operations, Maintenance and Monitoring
PAH	Polycyclic Aromatic Hydrocarbon
PDI	Pre-Design Investigation
PID	Photo-ionization Detector
POTW	Publicly Owned Treatment Works
PPE	Personal Protective Equipment

Abbreviations and Acronyms (cont.)

ppm	Parts per million (equivalent to mg/kg in soil)
PRAP	Proposed Remedial Action Plan
RAO	Remedial Action Objective
RI	Remedial Investigation
RIR	Remedial Investigation Report
ROD	Record of Decision
SCG	Standards, Criteria, and Guidance
SCO	Soil Cleanup Objective
SMP	Site Management Plan
SVOC	Semi-Volatile Organic Compound
SWRP	Surface Water Elevation Reference Point
TOGS	Technical and Operational Guidance Series
USACE	United States Army Corps of Engineers
UST	Underground Storage Tank
VCO	Voluntary Consent Order
VOC	Volatile Organic Compound

Executive Summary

Introduction and Purpose

This report describes the Feasibility Study (FS) undertaken for a site located between East Water Street and the Chemung River in the City of Elmira, New York. The site is the location of a former manufactured gas plant (MGP) which was constructed by the Elmira Gas Light Company, a predecessor company to NYSEG (New York State Electric and Gas Corporation). The MGP operated for 15 years, from 1852 to 1867. The location of the site is shown in Figure 1.

The FS was conducted pursuant to a Multi-site Order on Consent between NYSEG and the New York State Department of Environmental Conservation (NYSDEC), and the guidance provided in the document entitled "*NYSDEC Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation*" [DER-10]. The FS was based on a series of environmental investigations performed at the site which are described in the Remedial Investigation Report (RIR) of October 2014.

The purpose of this FS was to: 1) identify and comparatively evaluate appropriate remedial alternatives for soil and groundwater, 2) recommend media-specific alternatives that adequately mitigate potential threats to human health and the environment due to the constituents of concern (COC) from former MGP operations, and 3) identify alternatives which are consistent with the remedial objectives for the site and future contemplated site use.

Site Description

The site is located in an urban area in the central business district of the City of Elmira (Figure 2). The address of the site is 510 East Water Street. The site is defined as the former parcel of land where the MGP operations were conducted. This 1-acre area is now centrally located within a larger parcel that is owned by NYSEG. The footprint of the site and the current NYSEG parcel is shown on Figure 3. The site is currently vacant. The ground surface is mostly covered by an asphalt parking lot, with a grass and weed-covered strip present in an area in the southern portion of the site.

As shown on Figure 3, there are perpetual NYSDEC easements in the southern portion of the site. The easement areas were established in 1947 to implement the New York State Department of Public Works (NYSDPW) Elmira Flood Protection Project for the Chemung River. The flood control features in the southern portion of the site, and the adjacent City of Elmira property to the south, consist of a man-made flood control levee which was constructed along the bank of the Chemung River during the period from 1948 to 1949. The levee includes a concrete retaining wall constructed around a sheet pile wall, a sloped embankment constructed of soil and rip rap, and an access road for NYSDEC maintenance of the levee area. A large (82-inch diameter) interceptor sewer pipe is located in the southern area of the site (Figure 4). The pipe conveys storm water from the City of Elmira to an outfall at the river at an off-site location to the east of the site.

Site History

The Elmira Water Street MGP was constructed in 1852. Based on the date of construction and the configuration of the plant, the MGP was constructed and operated as a coal carbonization plant using coal as a feedstock. The plant operated for 15 years until it was shut down in 1867. After plant closure, the Gas Holder at the site continued to be used to store gas manufactured at an off-site location (Madison Avenue MGP). According to property deed information, gas storage continued at the site until 1869.

There were four structures present at the site during the time of gas production. A gas production building (MGP Building) was constructed in the southern portion of the site. A Gas Holder with a below-grade foundation was constructed at a location between the MGP Building and East Water Street. Two outbuildings were shown on the historic maps to the west and northwest of the gas production building. The buildings were not labeled on the historical maps, and their purpose is unknown. The above-ground portions of the buildings were demolished by 1898. Also around 1898, the area to the south of the MGP Building was extensively modified. The shoreline along the Chemung River was widened towards the south, and a flood control embankment was constructed. The site topography was again significantly modified in the 1940's when the interceptor sewer was installed to drain storm water flow for the City of Elmira, and the shoreline area again expanded and built-up to construct the current flood control embankment wall and levee.

The site has an extensive history of industrial and commercial development following closure of the MGP. Other past land use include petroleum sales, auto service and sales, auto painting, a greasing facility, a rag storage facility, and a junk yard. Remedial activities have previously been performed prior to the Remedial Investigation (RI) to remove petroleum underground storage tanks (USTs), and below-grade automotive hydraulic lifts.

Geology and Hydrology

Anthropogenic fill materials are present in most areas of the site. The fill is thickest in the area of the Gas Holder foundation. Anthropogenic fill materials are also present in the southern area of the site, and off site at the shoreline of the Chemung River which has been widened and built-up with rip rap and soil to construct the features of the NYSDEC flood control levee embankment. Underlying the fill is alluvium comprised of silt, sand, and gravel. Within the alluvium, a lacustrine clay layer was observed at several boring locations. The clay layer is not laterally continuous across the site; however, may be continuous in the area of the Gas Holder foundation based on the borings advanced in this area. Bedrock is present at a depth of 82 feet below ground surface (bgs) in the former MGP process area.

There are no surface water features at the site. Surface water that accumulates at the site's parking lot drains into catch basins, with flow then directed into a flood control interceptor drain located in the southern area of the site. The groundwater table in the alluvium is found at depths which ranged from approximately 16 feet bgs at the site, to 6 feet bgs in the off-site area along the river shoreline. The direction of groundwater flow in the alluvium is from north to the south, towards the Chemung River.

Subsurface Structures and Soil Impacts

MGP Features

Based on the historical information reviewed, and on the observations made during the RI, all of the above-grade MGP structures have been removed, and two of the below-grade foundations for the former MGP structures have also been removed. The remains of foundation walls are still present in the area of the MGP Building, and the Gas Holder foundation is still present in the subsurface of the site. The Gas Holder foundation appears to be in good condition.

Surface Soil

Following discussions with the New York State Department of Health (NYSDOH), RI surface soil sample locations were identified on the site to the north of the embankment wall, and on the off-site area consisting of the grass-covered area to the south of the embankment wall. For the samples to the north of the wall, polycyclic aromatic hydrocarbons (PAHs) were identified above the Commercial Use Soil Cleanup Objectives (SCOs), and this area is proposed for soil removal in this FS.

For the samples collected to the south of the embankment wall, concentrations of one PAH compound was identified in very low, estimated concentrations. The concentrations of this PAH compound was approximately equal to or only slightly elevated above the Unrestricted SCO. Remedial action is not proposed in this area based on the low concentrations of PAHs identified, on the low potential for an exposure in this area, and because this area has been demonstrated to be outside of the area of MGP-related impacts.

Subsurface Soil

Coal tar non-aqueous phase liquid (NAPL)-coated or saturated soil was not identified in any of the soil borings advanced in the former gas production area, or in the adjacent areas sampled during the RI. No purifier residuals, such as blue-stained wood chips or soil, or lime-like materials, were identified at any of the RI exploration locations. Visible evidence of MGP-related impacts was limited to hydrocarbon-like staining and hydrocarbon sheen and blebs in fill at the bottom of the subsurface Gas Holder foundation, and sheen in soil in a 7-foot interval below the bottom of the Gas Holder foundation floor. Soil borings advanced in all radial directions from the Gas Holder foundation, and below the impacted interval identified beneath the holder floor, have defined the horizontal and vertical extent of the MGP-impacted fill and soil.

Remedial work has previously been performed at the site to remove petroleum USTs, and hydraulic oil lifts and surrounding soils. Visible evidence of impacts to soil from these former land uses was not identified at the RI test pit, soil boring, or well exploration locations.

Groundwater

No exceedances of the NYSDEC Groundwater Standards or Guidance Values were identified for volatile or semi-volatile organic COC, or total cyanide in any of the groundwater samples collected from the monitoring wells and temporary well points adjacent to the Chemung River. Exceedances of several common metals were identified in groundwater; however, the metal exceedances are attributed to naturally occurring groundwater concentrations.

Sediments

Visible evidence of hydrocarbon impacts was not observed during the probing of sediments in the Chemung River to the south of the site, or downstream at the nearest identified potential depositional area. PAHs were detected in very low-level concentrations in the sediment samples collected in the area adjacent to the site; however, the concentrations detected were similar to, or only slightly elevated above the concentrations of PAHs detected in the upstream samples. Based on the probing of sediments and on the sample analyses, the Chemung River is demonstrated to be outside of the area of identified MGP impacts.

Surface Water

MGP-related COC was not identified in samples collected from the Chemung River.

<u>Human Health Exposure Assessment</u>

A qualitative human health exposure assessment was performed during the RI for the NYSEG property, and the off-site areas characterized by the investigation. With one exception, the potential for an exposure to MGP-related residuals is considered to be very low, or no potentially-complete exposure pathway was identified. For a subsurface utility worker or construction worker who may perform excavation work on the NYSEG parcel in the area of the Gas Holder foundation, the worker may potentially be exposed to impacted fill or soil. The potential for this exposure appears to be very low given the depth of the impacted soil and fill in the foundation (deeper than 15 feet bgs), and the absence of any utilities in this area.

Area of Concern (AOC)

Upon consideration of the results of the RI, and on preliminary discussions with the NYSDEC, remedial action was identified for one AOC on the site. AOC 1 is the area of the Gas Holder foundation which is located in the northwest corner of the MGP former process area (Figure 7). Remedial action is identified to address MGP-impacted fill and soil associated with this feature, and also MGP-impacted soil below the foundation floor. The impacted media associated with AOC 1 is fill and subsurface soil.

General Response Actions (GRAs)

GRAs are categories or approaches to the remedy which may be combined and further defined to create remedial alternatives. To meet the remedial action objectives (RAOs) developed for the site, the following GRAs were identified:

1. **No Action.** This response action is listed for compliance with DER-10 FS guidance, but would not result in meeting the RAOs and is not contemplated for this site.
2. **Institutional Controls and Engineering Controls (IC/ECs) Pertaining to Soil or Groundwater.** These actions, also known as IC/ECs, involve restrictions of legal access to soil or groundwater and engineering controls to limit physical access.
3. **Containment of Soil and Groundwater.** Containment actions involve little or no treatment, but provide physical barriers to exposure, or otherwise remove pathways of exposure. These actions include vertical barriers and surface soil covers or impervious caps.
4. **In-Situ Treatment of Soil and Groundwater.** These actions include on-site reduction in the volume, toxicity, and/or mobility of the COC. Technologies include in-situ solidification (ISS) of impacted soil, in-situ groundwater treatment, active enhancement of natural attenuation of groundwater, and monitored natural attenuation (MNA) of groundwater.
5. **Removal and Off-Site Treatment/Disposal of Soil and NAPL/Groundwater**. These actions include excavation of impacted soil, extraction of NAPL, followed by off-site treatment/disposal of these materials in properly permitted facilities.

Identification and Screening of Technologies

Remediation technologies are the practical means used to address a specific environmental condition. The goal of the identification and screening of technologies was to enable the most effective and applicable technologies to be applied to meet the site-specific conditions and remedial objectives. The individual technologies and approaches were then grouped to form alternatives, with each alternative addressing the site as a whole.

The identification and screening of technologies was conducted in three stages, in accordance with DER-10 guidance. An initial screening process was first used to determine the most applicable technologies for the site. For each of the General Response Actions – No Action, Institutional Controls/Engineering Controls, Containment, In-Situ Treatment, and Removal, one or more technologies and process options were identified, described, and screened with respect to site-specific applicability.

Next, the technologies that were not eliminated from consideration due to site-specific applicability were further refined and evaluated. The evaluation at this stage used the criteria of effectiveness, implementability, and relative cost, in accordance with the DER-10 guidance.

The retained technologies included: in-situ solidification (ISS), subsurface fill and soil excavation with off-site soil treatment and disposal, surface soil removal and re-establishment of a soil cover, and IC/ECs.

Development and Analysis of Alternatives

Five remedial alternatives were identified for detailed analysis based on the land use approaches, RAOs, and GRAs, and the identified applicable technologies. The alternatives include the following:

1. **Alternative 1**
   - No Action (required for comparison purposes by DER-10)

2. **Alternative 2**
   - Isolation of impacted soil (parking lot and soil cover)
   - IC/ECs implemented by a Site Management Plan (SMP) (site and groundwater use restrictions, and an environmental easement)
   - Periodic Certification of IC/ECs in accordance with Part 375-1.8(h)(3)

3. **Alternative 3**
   - Pre-Design Investigation (PDI), including an evaluation of the need to protect NYSDEC Flood Control Easement area features during remediation
   - Protection and/or relocation of utilities along East Water Street or on the site
   - Support of the Gas Holder foundation, if needed
   - Removal of fill/soil to account for ISS swell
   - ISS of fill within the Gas Holder foundation to address soil exceeding 500 parts per million (ppm) for Total PAHs, and ISS of visibly impacted subsurface soil below the Gas Holder foundation floor
   - Re-paving areas disturbed by construction
   - Removal and restoration of soil in the identified area outside of AOC 1, north of the levee wall, to accommodate a 1-foot thickness of soil cover meeting the SCOs specified in 6 NYCRR Part 375-6.7(d) for Commercial Use; and the installation of a demarcation layer

- Monitoring of groundwater for a period of 5 years to assess post-remedial conditions, followed by a re-evaluation of the need for continued monitoring
- IC/ECs implemented by an SMP (site and groundwater use restrictions, and an environmental easement)
- Periodic Certification of IC/ECs in accordance with Part 375-1.8(h)(3)

4. **Alternative 4**

- PDI, including an evaluation of the need to protect NYSDEC Flood Control Easement area features during remediation
- Protection and/or relocation of utilities along East Water Street or on the site
- Installation of excavation support at AOC 1 around the Gas Holder foundation
- Removal of the Gas Holder foundation contents to address soil exceeding 500 ppm for Total PAHs, removal of the Gas Holder foundation, removal of the soils/materials inside the support structure and removal of visibly MGP-impacted soil below the Gas Holder foundation floor to address the potential for future impacts to groundwater
- Backfill of the excavation area with soil meeting NYSDEC criteria
- Re-paving of the excavation area
- Removal and restoration of unpaved site surface soils in the identified area outside of AOC 1 north of the levee wall to accommodate a 1-foot thickness of soil cover meeting the SCOs specified in 6 NYCRR Part 375-6.7(d) for Commercial Use, including the installation of a demarcation layer
- Monitoring of groundwater for a period of 5 years to assess post-remedial conditions, followed by a re-evaluation of the need for continued monitoring
- IC/ECs implemented by an SMP (site and groundwater use restrictions, and an environmental easement)
- Periodic Certification of IC/ECs in accordance with Part 375-1.8(h)(3)

5. **Alternative 5**

- Protection and/or relocation of site utilities
- Removal of soil with COC apparently attributable to the former MGP operations to allow for Unrestricted Use
- Reconstruction of any utilities removed
- IC/ECs implemented by an SMP (including groundwater use restrictions, and an environmental easement agreement)

Comparative Evaluation

Detailed comparative evaluation of the alternatives was then performed using the following eight criteria as defined by DER-10:

1. Overall protection of human health and the environment

2. Conformance with standards, criteria, and guidance (SCGs)
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume of COC through treatment
5. Short-term impacts and effectiveness of controls
6. Implementability
7. Cost effectiveness
8. Land Use

Community Acceptance, which is the ninth criterion, will be evaluated after the public comment period for the FS, in accordance with DER-10.

Alternative 2 would not meet the RAOs for environmental protection and was dropped from further consideration.

The remaining three alternatives all attain the project RAOs. Alternative 3 achieves the RAOs at a lower cost than Alternative 4; however, some level of concern would remain for a potential exposure because the MGP-impacted material would remain at AOC 1 within the solidified mass. Alternative 4 would provide a higher-level of assurance for the prevention of potential exposures and future groundwater impacts because the MGP-impacted material would be removed from AOC 1. Both Alternatives 3 and 4 would be more implementable with less community disruption and short-term risks than Alternative 5. Compared to the cost for Alternatives 3 and 4, the higher cost of Alternative 5 does not offer a commensurably higher value in additional environmental protection, nor does it increase the actual land use options. Alternative 5 would be anticipated to have a much higher resource utilization during implementation.

Estimated Costs for Each Alternative

The costs of each alternative evaluated are summarized as follows:

Alternative 1	$0 million
Alternative 2	$0.5 million
Alternative 3	$1.5 million
Alternative 4	$3.2 million
Alternative 5	$6.4 million

Recommended Remedy

The elements identified in Alternative 4 are recommended for the Elmira Water Street MGP site. Alternative 4 was selected based on the criteria evaluated in the FS, with additional consideration given to the RAOs.

The estimated cost for implementation of Alternative 4 is $3.2 million.

This remedy was selected because:

1. This alternative is readily implementable with moderate short-term impacts.
2. The remedy will allow the future property use for Commercial purposes.
3. This alternative will meet the RAOs developed for the site.
4. This alternative is the most cost effective when compared with the other alternatives because it offers a greater level of protection for both human and ecological receptors based on the removal of the MGP-impacted material from the site.
5. This alternative will allow for a wider-range of potential future land re-use options following remediation, which may be an important issue for NYSEG at this site.

In accordance with DER-31 Green Remediation, this alternative would have a moderate environmental footprint, primarily associated with the initial removal and disposal of impacted soil, water, and debris. During the course of the remedial activities, steps would be taken to mitigate the environmental footprint and provide for sustainable practices, energy usage, and materials. The details of these provisions will be developed in the design phase of the remedy.

The next step is a NYSDEC issuance of a Proposed Remedial Action Plan (PRAP) for public comment and a Record of Decision (ROD). A design for the remedy including detailed drawings and specifications for remedial construction will follow the issuance of the PRAP and ROD.

1. Introduction and Scope

This report describes the Feasibility Study (FS) undertaken for a site located between East Water Street and the Chemung River in the City of Elmira, New York. The site is the location of a former manufactured gas plant (MGP) which was constructed and operated by the Elmira Gas Light Company. This company was a predecessor company to NYSEG (New York State Electric and Gas Corporation). The MGP operated at the site for 15 years from 1852 to 1867. The location of the site is shown on Figure 1.

This FS was conducted pursuant to a Multi-site Order on Consent between NYSEG and the New York State Department of Environmental Conservation (NYSDEC), and the specifications provided in the document entitled "*NYSDEC Division of Environmental Remediation (DER) Technical Guidance for Site Investigation and Remediation*" (DER-10), issued May 2010 [NYSDEC, 2010a].

1.1 Purpose of Report

As requested by the NYSDEC, this FS has been prepared following the completion of the Remedial Investigation Report (RIR) for the site [GEI, 2014]. DER-10 specifies that the FS should be prepared by the party responsible for performing remediation, and the report should be submitted to the NYSDEC DER for approval prior to the implementation of the remedy. The FS develops and evaluates options for remedial action in accordance with CERCLA [40 CFR 300.430(e)] to address the impacted media at the site or area of concern (AOC) that is being addressed by cleanup actions. The purpose of this FS is summarized as follows:

- To identify the goal of the remedial program;
- To describe the nature and extent of the impacted media to be addressed by the developed alternatives;
- To develop remedial action objectives (RAOs) for the site;
- To develop a set of remedial action alternatives;
- To complete an initial screening and detailed analysis of the identified alternatives;
- To implement the specified decision process identified in DER-10, to identify and evaluate appropriate remedial options;
- To develop and provide a detailed description of the recommended site remedy; and
- To demonstrate that the recommended remedy can achieve the cleanup objectives for the site.

1.2 Report Organization

The balance of this document is divided into the following sections, in accordance with NYSDEC's guidance document DER-10 [Section 4.4 (b) 4]:

- **Section 2.0 – Site Description and History**. This section provides a description of the current layout of the site, and the history of the MGP.
- **Section 3.0 – Summary of the Remedial Investigation (RI) and Exposure Assessment**. This section describes the results of the environmental investigation, and describes the potential for current or potential future site users to be exposed to impacted media.
- **Section 4.0 – Remedial Goals and Remedial Action Objectives**. This section introduces the documents that govern the FS evaluation, and presents the requirements which are applied to the MGP site.
- **Section 5.0 – General Response Actions (GRAs) and Volume Estimates**. This section describes the broad categories of remedies under consideration for this site and provides estimates of the volumes of the impacted media.
- **Section 6.0 – Identification and Screening of Technologies**. This section names and describes the principal technologies which might be implemented for the remedy, and screens these technologies for applicability to this specific site.
- **Section 7.0 – Development and Analysis of Alternatives**. In this section, a range of alternatives consisting of several technologies are described, evaluated in accordance with a standard set of criteria, and compared with one another.
- **Section 8.0 – Recommended Remedy**. This section presents the principal elements and sequence of implementation of the remedy.
- **Section 9.0 – References**. This section lists the project references.

Appendices for this report include:

- **Appendix A –** Includes a cost estimate table for each of the identified remedial alternatives.
- **Appendix B –** Includes volume estimates for impacted media identified for the AOC.

2. Site History and Description

This section includes a description of the site, and provides information regarding the history of the site, based on the background information obtained for the RI.

2.1 Site Description

The site is located in an urban area in the central business district of the City of Elmira (Figure 2). The address of the site is 510 East Water Street. The site is defined as the former parcel of land where the MGP operations were conducted (Figure 5). This 1-acre area is now centrally located within a larger (2.4 acre) parcel that is owned by NYSEG. The footprint of the site and the larger NYSEG parcel is shown on Figure 3. The site is currently vacant. The ground surface is mostly covered by an asphalt parking lot, or by grass and weeds. Because the site is a mostly vacant parking lot, public access to the site is unrestricted. According to information provided by the City of Elmira Code Enforcement Department, the site is zoned for Commercial Land Use (City of Elmira – Business G District Intent – Gateway Commercial).

As shown on Figure 3, there are perpetual flood control easements in the southern portion of the site. The easement areas were established in 1947 to implement the New York State Department of Public Works (NYSDPW) Elmira Flood Protection Project for the Chemung River. The easement documents for the site (Parcels 380 and 381), and surrounding areas are included in an appendix of the RIR.

The flood control features at the site, and the adjacent City of Elmira property to the south, consist of a man-made flood control levee which was constructed along the bank of the Chemung River during the period from 1948 to 1949. The levee is comprised of a concrete retaining wall constructed around a sheet pile wall, a sloped embankment constructed of soil and rip rap, and an access road for maintenance of the levee area. The embankment is flat in the area of the concrete wall, and then slopes steeply to the south down to the access road which is approximately 20 feet north of the shoreline of the river (Figure 3). As shown on Figure 4, an 82-inch diameter storm water sewer pipe is located to the north of the levee wall.

Maintenance responsibilities for the flood control levee area on the site and the adjacent City of Elmira parcel began with the NYSDPW, were transferred to the New York State Department of Transportation (NYSDOT), and then transferred recently to the NYSDEC Regional Office in Elmira. The easements are in place “to retain rights to construct, reconstruct, maintain and operate levees, walls, rip rap, work areas, access roads, pole lines, pipe lines, and to clear trees, brush, and debris in the easement areas”. The NYSDEC Regional Office in Elmira required a permit to be in place to perform the RI activities at the site and the adjacent areas of the Chemung River. The United States Army Corps of Engineers (USACE) also reviewed and approved the work described in the permit.

2.1.1 Adjacent Off-Site Parcels

The adjacent off-site parcels are described below.

North

To the north of the site is East Water Street. Across East Water Street are Dewitt Street and two municipal properties. To the east of Dewitt Street are the buildings and grounds of the Chemung County Nursing Facility. To the west of Dewitt Street are the buildings and grounds of the Elmira Housing Authority – Newtown Towers. The closest occupied building to the site (Newtown Towers) is approximately 300 feet to the northwest of the site.

Also to the northwest of the site at the corner of East Water Street and Madison Avenue, is a vacant parcel (Figure 3). This parcel is the former location of a gasoline sales and service station. This parcel is a listed NYSDEC Spill Site. Environmental records identified for this parcel are discussed in the RIR.

South

To the south of the NYSEG parcel is a strip of land along the shoreline of the Chemung River. Based on tax maps obtained from the City of Elmira, the shoreline area is owned by the City. Also located in this parcel are the southern portions of the NYSDEC flood control features.

To the south of the City of Elmira property is the Chemung River. The reach of the river adjacent to the City property is classified as a Class C water body according to New York State's Stream Classification System. The Chemung River is a high-volume, fast-flowing river which has caused heavy flooding in the City of Elmira throughout its recorded history. In June 1972, the flooding caused by Hurricane Agnes destroyed the bridge at Madison Avenue (now the Sly Street Bridge), which is located 150 feet to the west of the site.

East

The area to the east of the site is the eastern portion of the parcel owned by NYSEG (Figure 3). It is currently vacant and is mostly covered by a former auto sales company's parking lot. Further to the east of the NYSEG property is the Melvin Place roadway. This roadway appears to be primarily used to access the maintenance road along the shoreline of the river.

West

The area to the west of the site is the western portion of the parcel owned by NYSEG (Figure 3). It is also currently vacant and is also mostly covered by the former auto sales parking lot. To the west of the NYSEG property is a strip of land adjacent to the Sly Street Bridge. This parcel is owned by the City of Elmira who maintains the landscaping in this area.

Adjacent Off-Site Parcels Zoning

Based on information provided by the City of Elmira Code Enforcement Department, all of the adjacent off-site parcels discussed above are zoned for Gateway Commercial Use.

2.2 Site History and Former Structures

The RIR contains a chronology of the site from the 1852 to 2011, which has been compiled from a number of sources, including records obtained from NYSEG, and the City of Elmira. The historical features of the MGP are shown in blue on Figure 5.

The Elmira Water Street MGP was constructed in 1852 by the Elmira Gas Light Company. Based on the date of construction and the configuration of the plant, the MGP was constructed and operated as a coal carbonization plant using coal as a feedstock. The plant operated for 15 years until it was shut down in 1867. After plant closure, the Gas Holder at the site continued to be used to store gas manufactured at an off-site location (Madison Avenue MGP). According to property deed information, gas storage continued at the site until 1869. It is assumed that the above-grade portion of the Gas Holder was demolished sometime prior to 1898, because the holder is not shown on the Sanborn Map for that year.

2.2.1 Historical Site Features

The historical research identified former site features which may have been potential source areas or AOCs for MGP-related residuals, and as such, those areas were targeted for investigation during the RI. Maps and atlas figures for the features are included in the RIR. The key features of the MGP, shown in blue on Figure 5, are summarized as follows:

- **MGP Building –** The MGP Building was located in the southeast/central area of the site. As shown on Figure 5, the building was subdivided into four areas. It is likely that these areas contained the retorts and purifiers; however, there are no labels on the historic figures.
- **Gas Holder –** The Gas Holder for the MGP was located to the north of the MGP Building. Based on a historical lithograph, the holder appears to have been a single lift, cast iron gas vessel, with a deep water seal masonry tank.
- **MGP Structure A –** A building was shown to the east of the MGP Building on the historical maps. The building was not labeled on the maps, and its purpose is unknown.
- **MGP Structure B –** A structure was present along the northern area of the site along East Water Street during the period of MGP operations. The building was not labeled on the historical maps, and its purpose is unknown.
- **Chemung River –** During the time of MGP operations, the Chemung River was located adjacent to the site.

Additional non-MGP historical features that were identified as potential AOCs were investigated during the RI. These features are discussed in the RIR, and unless otherwise noted in the following sections, are not further addressed in this report.

As shown on Figure 5, the shoreline at the time of MGP operations was significantly different than the current shoreline. From the period of MGP operations until the present, fill has been added to expand the shoreline approximately 50 feet to the south. The shoreline was expanded in two phases to control flooding in the area, culminating in the construction of the modern levee wall and embankment in 1948 to 1949.

2.2.2 Other Property Uses

The site has an extensive history of industrial and commercial development following closure of the MGP. Other past land use includes petroleum sales, auto service and sales, auto painting, a greasing facility, a rag storage facility, and a junk yard. Remedial activities have previously been performed at the site to remove petroleum underground storage tanks (USTs), and below-grade automotive hydraulic lifts. The results of the post-remedial sampling performed in these areas is included in the RIR.

2.3 Physical Setting and Local Land and Water Use

2.3.1 Topography

The ground surface of the site is relatively flat. The ground surface slopes from the concrete levee wall (855 feet NAVD88) towards East Water Street (850 feet NAVD88), with an overall change in elevation of 5 feet.

For the off-site area to the south, from the concrete levee wall towards the Chemung River, the ground surface slopes steeply to the south following the slope of the constructed soil and rip rap flood control embankment. The elevation on the south side of the wall is 852 feet NAVD88, and the elevation of the shoreline of the river is 835 feet NAVD88, with an overall drop of 17 feet. The ground surface contours for the site are included on Figure 3.

2.3.2 Land Use

The site is currently vacant. The ground surface is mostly covered by an asphalt parking lot, with a grass and weed-covered strip adjacent to the flood control levee wall to the south.

2.3.3 Site Zoning

According to information provided by the City of Elmira Code Enforcement Department, the site is zoned for commercial land use (City of Elmira – Business G District Intent – Gateway Commercial). All surrounding parcels are also zoned for Commercial Use.

2.3.4 Utilities and Infrastructure

The utilities at the site and surrounding areas are shown on Figure 4. The utilities include a sanitary sewer line (not currently in use), underground electric lines for light poles (not currently in use), a storm sewer pipe, and the features constructed in the flood control levee area (Figure 4).

2.3.5 Water Supply in the Area

The Elmira Water Board provides drinking water and maintains water mains to deliver approximately 6 million gallons of water every day to the City of Elmira and several adjoining municipalities. Drinking water is obtained from four intake locations in the Chemung River, and from a group of five groundwater extraction wells. The intake points and wells are all located in close proximity to each other in the area immediately to the east of the South Walnut Street Bridge. This area is approximately 1 mile to the west of, and up stream of the site.

2.4 Site Geology

The stratigraphic units at the site are described as follows:

- **Fill – MGP Site** – At the majority of the soil boring locations in and around the MGP process area, a layer of fill containing anthropogenic materials was observed. The fill was thickest (approximately 15 feet thick) in the area of the Gas Holder foundation (Figure 10). The fill material was observed to consist mostly of sand and gravel, mixed with varying amounts of brick fragments, clinkers, ash, and coal.
- **Fill – City of Elmira / NYSDEC Flood Control Easement Area** – As shown on Cross Section A-A' (Figure 10), a layer of fill is present in the NYSDEC Flood Control Easement Area. The fill contains several layers of material with a total thickness of approximately 25 feet. The bottom layer appears to be a soil layer which is assumed to have been imported to the parcel to construct the bulk of the embankment levee wall. A layer of rip rap was added on top of the soil fill, to armor the soil against erosion. A layer of soil was then added to cover the rip rap so that the slope could be vegetated. The pipes, and wall and sheet pile structure for the flood control features have been constructed within this fill material (Figure 10).
- **Alluvium** – Underlying the fill is a thick deposit of alluvium comprised of a heterogeneous mix of silt, sand, and gravel. At the site, one soil boring was advanced down to the bedrock to determine the depth to bedrock and to observe deep soil conditions. The sampling performed at this location indicates that the alluvium is approximately 80 feet thick.
- **Lacustrine Clay** – Inter-bedded within the alluvium are lenses of lacustrine clay. As shown on Cross Section A-A' (Figure 10), the lenses of clay are not laterally continuous within the alluvium across the site; however, the clay may be continuous beneath the Gas Holder foundation as shown by the exploration locations advanced in this area during the

RI. The borings and the clay layer thicknesses in and around the Gas Holder area are summarized as follows: SB1 (5 feet), SB2 (10 feet), SB3 (12 feet), SB5 (4 feet), SB7 (8 feet), SB8 (10 feet), SB10 (15 feet), SB17 (11 feet), MW2 (7 feet), and MW3 (6 feet).

- **Bedrock –** Shale was encountered beneath the alluvium at a depth of 82 feet below ground surface (bgs) in the former process area at SB10.

2.5 Site Hydrogeology

2.5.1 Site Surface Water and Drainage

Surface water in the parking lot area of the site, and in East Water Street, drains into a series of catch basins in these areas. The water then drains into a 60-inch corrugated pipe and then into "Manhole P" located in the footprint of the former Dewitt Street (Figure 4). Note that, as shown on Figure 4, flow was formerly diverted to the Chemung River from "Manhole P". However, the outfall pipe was filled with concrete in 1947 when the flood control project was implemented (Figure 4). Surface water at the site, and in the area-wide setting of the site currently flows within the 82-inch interceptor sewer to the north of the levee wall (Figure 4). The discharge point to the Chemung River is approximately ½ mile to the east of the site. The drainage area for the storm sewer pipes, the storm sewer catch basin, and the 82-inch interceptor sewer pipe were mapped during the RI. The information is shown on Figure 4.

Metal Pipe at Shoreline of River

Note that, as shown on Figure 4, one metal pipe is currently present in the shoreline area of the river. The pipe has an approximate diameter of 36 inches. According to information provided by staff from the NYSDEC Regional Office in Elmira, NY, this pipe is not aligned with the former outfall location, is not the same size as the outfall pipe that was decommissioned in 1947, and is not connected to the storm sewer system in the on-site area. The purpose of the current pipe present at the shoreline in the river area is therefore unknown. It was observed to be dry at the time of the RI sampling.

2.5.2 Groundwater Flow and Gradient

Groundwater elevation data was obtained from the overburden wells, and the temporary well points installed along the access road at the shoreline of the river (Figure 6). Surface water elevation data was obtained at the reference point on the Sly Street Bridge (SWRP1) at the same time as the groundwater elevation data was obtained.

Groundwater Flow Direction

A complete round of depth-to-water measurements was taken during the RI for all the site wells and the temporary well points. The depth to the water table was observed to range from between 6 feet bgs at the flood control access road area, and 16 feet bgs at the site. Based on the measurements obtained from the wells and the measurement obtained for the surface water elevation reference point, the surface of the water table slopes from the north towards the south towards the Chemung River.

3. Summary of the RI and Exposure Assessment

This section summarizes the results of the RI including the human health exposure assessment.

3.1 RI AOC Summary

The AOCs for the RI were identified in the RIR. Information regarding conditions observed at the former MGP features, and the nature and extent of MGP-related residuals associated with the features, is summarized below. The locations of the test pits, soil borings, and monitoring wells are shown on Figure 7.

MGP Building

Based on test pits excavated in and around the footprint of the building (TP4 and TP5), and on the soil boring advanced in this area (SB13, SB15, BH3, and MW7), the remains of foundation walls are still present in the subsurface in this area. These features are constructed from several types of materials including: bricks, concrete, and field stone. Floors for the foundations were not observed. Visible evidence of MGP-related residuals was not observed in any of the test pits or the subsurface soil borings advanced in the footprint of the MGP Building. It appears that the southern portion of the MGP Building foundation was removed in order to construct the flood control features in this area.

Gas Holder

Based on the test pits and soil borings advanced in the footprint of the Gas Holder, the foundation for the holder is still present in the subsurface of the site. The location of the holder foundation is shown on Figure 6. The foundation is constructed of brick, and is 1.4 feet thick. The foundation appears to be in good condition. The diameter of the foundation is 40 feet. Based on information obtained from borings SB4, SB5, and SB7 the bottom of the holder floor is 17.5 feet bgs. The depth of the footers for the foundation is unknown; however, based on information obtained during the excavation of TP3, the footer is deeper than 23 feet bgs. The foundation contains fill material including: silt, glass bottles, wood, metal debris, and brick fragments. Water was observed at 10 feet bgs inside the holder. The elevation of water inside the holder was approximately 7 feet higher than the elevation of the groundwater table outside the holder foundation (16 feet bgs).

No visible evidence of coal tar, or coal tar non-aqueous phase liquid (NAPL) mixed in the soil or fill matrix was observed in the holder foundation; however, hydrocarbon odors, staining, blebs, and sheen were observed in fill and soil at the bottom of the holder foundation (Figure 10). Soil below the holder floor was observed to have odor and hydrocarbon-like sheen in the soil matrix (Figure 10).

MGP Structure A

Boring SB14 was advanced in the footprint of MGP Structure A (Figure 7). Brick fragments were observed in fill to a depth of 6 feet bgs; however, a foundation for this former feature was not observed. Impacted fill or soil was not observed in the footprint of this feature.

MGP Structure B

The boring for MW1 and TP6 were advanced in the footprint of the former MGP Structure B (Figure 7). A foundation for this former feature was not encountered. Impacted fill or soil was not observed in the footprint of this feature.

3.2 Off-Site Areas

RI sampling was performed in three off-site areas to assess whether MGP-related residuals may be present at, or have migrated in the subsurface to these areas. These areas include: the portions of the NYSEG parcel surrounding the MGP site, the City of Elmira Shoreline Area, and the Chemung River.

NYSEG Parcel

Soil borings and wells were installed in the current NYSEG parcel surrounding the MGP site (Figure 7). The GP series of borings were advanced during the investigation performed in 1998. Soil boring SB2, SB11, SB16, and wells MW4, and MW8 were installed in 2013. Visible evidence of MGP-related residuals or other hydrocarbon-like impacts was not observed at any of the boring or well locations.

City of Elmira / NYSDEC Flood Control – Shoreline Area

Soil borings SB18, SB19, SB20, SB21, and SB22 were advanced in the access roadway along the Chemung River (Figure 7). Visible evidence of hydrocarbon-impacts was not observed at the exploration locations in this area. For soil boring SB20, a very slight petroleum-like odor was observed at a depth interval of 10 to 12 feet bgs. Because this area was part of the river during MGP operations, and because petroleum was not used as a feedstock for the MGP, the impact at this location is unlikely to be related to the former MGP operations.

Chemung River

Extensive probing of sediments was performed in the Chemung River in the area adjacent to the site, and also at the nearest identified downstream depositional area. Visible evidence of hydrocarbon impacts was not observed at any of the probing locations. Visible evidence of hydrocarbon impacts was not observed in the vibracore samples collected in the area adjacent to the site.

3.3 Nature and Extent of MGP-Related Impacts

Coal tar or coal tar NAPL mixed in the fill or soil matrix was not identified in the subsurface of the site. Purified residuals such as blue-stained wood chips or lime materials were not identified at any of the exploration locations. Visual evidence of MGP impacts (hydrocarbon staining, blebs and sheen) were limited to fill and soil at the bottom of the Gas Holder foundation, and odor and sheen in soil just below the holder floor. Soil sampling at deeper depths below the holder foundation, and in all directions horizontally from the foundation, have demonstrated that the MGP-related residual impacts do not extend beyond the Gas Holder foundation area.

Surface soil, subsurface soil, groundwater, surface water, and sediments were sampled during the RI. Conclusions for each of these media are summarized below.

3.3.1 Surface Soil

MGP-related residuals were not observed at the ground surface of the investigation area. Most of the surface soil in the northern portion of the site is covered by the asphalt pavement of a parking lot constructed for a former auto sales facility. In the southern portion of the site, and off site along the Chemung River shoreline, what would have been the ground surface and/or the former shoreline of the river is now covered by approximately 25 feet of fill soil and rip rap which appears to have been imported to the shoreline area by the USACE to construct the flood control levee embankment features approximately 85 years after the decommissioning of the MGP.

This FS includes measures to address the surface soil impacts on the site. For the samples collected to the north of the levee embankment wall, polycyclic aromatic hydrocarbons (PAHs) were detected in concentrations greater than the Commercial Use Soil Cleanup Objectives (SCOs). The impacted soil in this area will be addressed by soil removal, the placement of a demarcation layer, and the installation of a soil cover.

The embankment area to the south of NYSDEC flood control levee wall is not considered an AOC needing remediation. Concentrations of one PAH compound (indeno(1,2,3-cd)pyrene) was identified in all the samples in very low, estimated (“J”) concentrations by the laboratory. The concentrations identified were approximately equal to or only slightly greater than the Unrestricted SCO of 0.5 mg/kg. No additional TPAH17 compounds were detected in concentrations greater than the Unrestricted SCOs. Soil in this area is covered by grass, therefore, the potential for a potential receptor to contact the soil is considered to be very low. In addition, because the soil in this area was imported by the USACE to construct the embankment wall approximately 85 years after decommissioning of the MGP, the PAH exceedances identified in this area could not possibly be attributed to the former MGP operations.

3.3.2 Subsurface Soil

Coal tar NAPL-coated or saturated soil was not identified in any of the soil borings advanced in the former gas production area, or in the adjacent areas sampled during the RI. Visible evidence of MGP-related impacts was limited to hydrocarbon-like staining and hydrocarbon sheen and blebs in soil and fill at the bottom of the subsurface Gas Holder foundation, and sheen in the soil matrix in a 7-foot interval below the bottom of the Gas Holder foundation floor. Soil borings advanced in all directions from the Gas Holder foundation, and below the holder floor have defined the horizontal and vertical extent of the MGP-impacted fill and soil, and the extent of soil with constituents of concern (COCs) in concentrations greater than Commercial Use SCOs. For the purposes of this FS, the Gas Holder foundation area is designated AOC 1 (Figure 7).

Note that for samples from two discrete soil borings outside of AOC 1, concentrations of TPAH17 exceeded the Commercial Use SCO of 500 mg/kg. The borings and samples included: SB20/TW3 (10-11) where the TPAH17 concentration was 1,063 mg/kg, and SB13(18-19) where the TPAH17 concentration was 1,869 mg/kg. The locations are shown on Figure 7.

For SB20/TW3, a location off site and adjacent to the Chemung River, the soil sample was collected from soil that exhibited a petroleum-like odor. Photo-ionization detector (PID) readings were not elevated for the soil interval, and no visible evidence of hydrocarbon impact was observed. Because it appears, based on the sample odor, that the impact is petroleum-related, impacted soil was not identified in adjacent borings, and groundwater is not impacted at this location, the area at SB20 is not considered to be a source area for the off-site area. This area therefore is not further identified for remedial action in this FS.

For SB13(18-19), a location in the footprint of the MGP Building, it is unknown why PAH concentrations exceeded the Commercial Use SCO. PID field screening results were not elevated for the sampled soil interval. No visible evidence of impact was identified for the sampled interval. No visible evidence of impact was identified in the adjacent soil borings, and groundwater is not impacted at adjacent wells. Because it appears the soil at this boring location does not exhibit the characteristics of source material, the collected sample was from below the 15-foot interval, and groundwater is not impacted at adjacent wells, remedial action in the area of this boring is not further identified in this FS.

For SB22/TW5, an off-site boring located in the access road area along the Chemung River, concentrations of one individual PAH was detected in a concentration greater than the respective Commercial Use SCO. Benzo(a)pyrene was detected in a concentration of 2 mg/kg, a concentration slightly greater than the Commercial Use SCO of 1 mg/kg. Similar to SB13(18-19), it is unknown why the individual PAH concentration exceeded the Commercial Use SCO. PID field screening results were not elevated for the sampled soil interval. No visible evidence of impact was identified for the sample interval. Groundwater was not impacted at this location. Because the sample concentration was below the SCO for TPAH17 for Commercial Use, the soil at this boring location does not exhibit the characteristics of source material, groundwater is not impacted at this location, therefore remedial action in the area of this boring is not proposed in this FS.

3.3.3 Groundwater

Volatile or semi-volatile organic COC or total cyanide were not identified in any of the groundwater samples collected from the monitoring wells and temporary well points in concentrations greater than the NYSDEC Groundwater Standards or Guidance Values.

RI groundwater samples were collected from monitoring wells installed on the site, and also from temporary wells points adjacent to the Chemung River. For the monitoring wells on the site, iron, manganese, and sodium were detected in most wells in concentrations exceeding the NYSDEC Groundwater Standard Values. These metals are commonly detected in elevated concentrations in groundwater samples collected in New York State. Because these metals are commonly detected, and also on the absence of the other MGP indicator COCs (volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), and total cyanide) in the samples, the iron, manganese, and sodium exceedances are attributed to naturally occurring conditions, not from MGP site impacts. For the temporary well point samples, iron, manganese, and sodium were also detected in elevated concentrations. The elevated metals in this area are also attributed to naturally occurring conditions. Barium was also detected at TW3 and TW4 in elevated concentrations. Because barium was not detected in elevated concentrations on the site, the barium exceedances at TW3 and TW4 in the off-site area do not appear to be site-related. Barium is not typically considered an MGP-related COC.

The metals exceedances at the site and off-site area are likely attributed to naturally occurring groundwater conditions. In addition, groundwater at the site is not extracted for drinking water or any other purpose, and will not be anticipated to be used in the future. Therefore, the metals exceedances identified during the RI do not represent a concern for the site.

3.3.4 Sediments

Visible evidence of hydrocarbon impacts was not observed during the probing of sediments in the Chemung River to the south of the site, or downstream at the nearest identified potential depositional area. PAHs were detected in very low-level concentrations in the sediment samples collected in the area adjacent to the site; however, the concentrations detected were similar to, or only slightly elevated above the concentrations of PAHs detected in the upstream samples.

The concentrations of COC detected in the sediments in the river area adjacent to the site were similar to or slightly elevated above the concentrations detected at the upstream areas. The TPAH14 concentrations in the upstream area ranged from 0.4 mg/kg (BSD7) to 6 mg/kg (BSD5). The TPAH14 concentrations in the Chemung River adjacent to the site for the surface sediment and vibracore samples ranged from 0.17 mg/kg (C1(1.5-2)), to 8.9 mg/kg (C3(1-1.5)). Therefore, the highest concentration of TPAH14 in the area adjacent to the site was only 2.9 mg/kg greater than the highest concentration detected in the upstream area. The PAHs detected in the area adjacent to the site are not a concern for the site because they are essentially the same as the upstream area, are not significantly elevated above NYSDEC sediment screening criteria, and as demonstrated by the RI, neither evidence of MGP tar nor evidence of MGP tar transport to the Chemung River was revealed during the field work. The Chemung River is clearly outside of the area with identified MGP-related impacts.

3.3.5 Surface Water

Three surface water samples were collected from the Chemung River and analyzed for VOCs, SVOCs, metals, and total cyanide. MGP-related COC were not identified in elevated concentrations in the surface water samples.

3.4 Fate and Transport Mechanisms

Five media were investigated at the NYSEG property and adjacent, down gradient areas during the RI. Conclusions for each media are summarized below.

3.4.1 Surface Soil

MGP-related residuals were not observed at the ground surface of the investigation area and surface soil is not significantly impacted at the site. There are no surface water features at the site. Based on the low concentrations of COC detected, the presence of a vegetative or pavement cover, and the absence of surface water features at the site, the potential for off-site migration of COC in surface soil is considered to be very low.

3.4.2 Subsurface Soil

The foundation for the Gas Holder contains MGP-impacted soil and fill. Subsurface soil with hydrocarbon sheen was also observed below the foundation floor. Borings advanced in all directions from the foundation have identified the horizontal limits of the MGP-related impacts. Figure 4 shows the mapped extent of impacts in AOC 1 defined as: 1) soil or fill samples containing Total PAH concentrations of 500 parts per million (ppm), or 2) soil observed to have MGP-related residual impacts (sheen, blebs, or hydrocarbon-like staining). MGP-related residuals were not observed to be migrating in the subsurface in any direction from AOC 1. The impacts identified for subsurface soil have not resulted in impacts to site groundwater.

3.4.3 Groundwater

Groundwater with concentrations of VOCs, SVOCs, or total cyanide exceeding NYSDEC groundwater standards or guidance values was not identified at the site or the adjacent down gradient areas. Some common metals were detected in elevated concentrations; however, it appears that the concentrations are indicative of naturally occurring conditions. Because groundwater is not impacted by MGP-related COCs, a potential migration pathway for residuals in the Gas Holder foundation to migrate from the foundation area in groundwater was not identified. Groundwater is not extracted and/or used in the area investigated during the RI, or in the surrounding area of the City of Elmira.

3.4.4 Sediments and Surface Water

Based on the sampling performed during the RI, MGP-related COC has not migrated in the subsurface of the site to the Chemung River area. The Chemung River is considered to be outside of the area of identified MGP impacts.

3.5 Exposure Pathways and Potential Receptors

The RIR includes an evaluation of exposure pathways and receptors at the MGP site and the adjacent parcels. The evaluation examined the following media and potential release mechanisms, and examined how each potential human receptor group might come into contact with impacted media:

- **Fugitive Dust.** COCs in surface and subsurface soil could be a potential source for fugitive dust via physical disturbance.
- **Volatilization.** Volatile COCs may potentially be transported from subsurface soil by volatilizing into soil-pore space and eventually emanate into ambient or indoor air.
- **Leaching.** COCs in surface or subsurface soil could potentially leach to groundwater.

There are three mechanisms by which COCs in groundwater can be transported to other media. These migration pathways include the following:

- **Adsorption.** COCs in groundwater may be sorbed onto subsurface soils.
- **Volatilization to Ambient Air.** Volatile COCs in groundwater may potentially desorb into soil vapor and be transported through the vadose zone into ambient or indoor air.
- **Extraction or Migration.** COCs in groundwater may migrate to other media by extraction or migration and use of impacted groundwater.

Each of these potential release mechanisms was evaluated for each potential receptor group, both on site and off site. The receptor groups included:

- On-site workers;
- On-site outdoor maintenance workers;
- On-site subsurface utility or construction workers;
- Site visitors; and
- Recreational users.

A qualitative human health exposure assessment was performed for the RI for the NYSEG property and the off-site areas characterized by the investigation. With one exception, the potential for an exposure to MGP-related residuals is considered to be low, or no potentially complete exposure pathway was identified.

For a subsurface utility worker or construction worker who may perform excavation work at AOC 1, the worker may potentially be exposed to MGP-related residuals mixed in the fill or soil matrix in the Gas Holder foundation, or in soils below the foundation floor. There are no utilities in the Gas Holder foundation area. Groundwater is not impacted at the site. Therefore, based on the low concentrations of COC, the depth of the impacted fill and soil, and the absence of utilities, the potential for an exposure for a subsurface utility worker in the Gas Holder foundation area is considered to be very low.

Ecological Receptors

The site is urban vacant land which is mostly paved. Therefore, a significant high-value habitat for wildlife does not exist at the site. The parcels around the site are used for commercial purposes. The area between the site and the Chemung River is a mowed flood control levee feature. The Chemung River has been demonstrated to be outside of the area of MGP-related impacts. Therefore, the potential for an ecological receptor in the area investigated during the RI to be exposed to MGP site-related COC is considered to be very low.

4. Remedial Goals and Remedial Action Objectives

4.1 Standards, Criteria, and Guidance (SCGs)

As defined in DER-10, standards and criteria are the New York State regulations or statutes that dictate the cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations which are generally applicable, consistently applied, officially promulgated, and are directly applicable to a remedial action.

The principal SCGs applicable to this site are:

- **6 NYCRR § 375-1**: General Remedial Program Requirements.
- **6 NYCRR§ 375-2**: Inactive Hazardous Waste Disposal Site Remedial Program.
- **6 NYCRR§ 375-6**: Remedial Program Soil Cleanup Objectives.
- **NYSDEC Policy Memorandum CP-51:** Soil Cleanup Guidance (Soil Cleanup Memo), October 21, 2010 [NYSDEC, 2010b].
- **NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1:** Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations.
- **New York State Department of Health (NYSDOH) Guidance:** Evaluating Soil Vapor Intrusion in New York [NYSDOH, 2006].
- **DER-10:** Technical Guidance for Site Investigation and Remediation [NYSDEC, 2010a].
- **DER-31:** Green Remediation [NYSDEC, 2010c].
- **DER-10:** Selection of Remedial Actions at Inactive Hazardous Waste Sites (formerly TAGM 4030).
- **NYSDEC Technical Guidance:** Screening Contaminated Sediments.

Detailed lists of the chemical-specific, action-specific, and location-specific SCGs are provided in Tables 4-1, 4-2 and 4-3, respectively.

The site-specific cleanup levels for the MGP-related COC in soil and groundwater are the SCGs that will be used to define the RAOs and to develop the remedial alternatives.

4.2 Soil Cleanup Levels

As stated in the NYSDEC Soil Cleanup Memo CP-51, Section 5, Paragraph A: *a soil cleanup level is the concentration of a given COC for a specific site that must be achieved under a remedial* *program for soil. The determination of soil cleanup levels is dependent on the following criteria* (the criteria are provided in *italics,* below):

1. ***The applicable regulatory program***, which for this site is the Inactive Hazardous Waste Disposal Site Remediation Program.
2. ***Whether the groundwater beneath or down gradient of the site is, or may become, impacted with site-related COC***, which for this site is confirmed by the RI.
3. ***Whether ecological resources constitute an important component of the environment at or adjacent to the site, and which are, or may be, impacted by site-related COCs***. Ecological resource considerations do not apply for this FS because the site is vacant land in an urban setting or is part of a mowed flood control levee embankment. Therefore, the site is not considered to be a high-value habitat for wildlife.
4. ***Other impacted environmental media such as surface water, sediment, and soil vapor***. These considerations for surface water and sediment are not applicable, as these media have been demonstrated to be outside the area of MGP-related impacts. Because no occupied buildings exist at the site, soil vapor is not currently applicable at this site. The prevention of potential inhalation of soil vapor COC due to soil vapor intrusion into any potential future building at the NYSEG property will be addressed by the removal or solidification of MGP-impacted soil combined with the current absence of COC in groundwater.

After evaluating the nature and extent of the soil impacts, this FS presents alternatives based on Approach 2: Restricted Use SCOs, as described in the NYSDEC Soil Cleanup Memo CP-51, Soil Cleanup Guidelines. Within the Restricted Use approach, the Commercial Use SCOs are applicable for the site soils based on the current and likely future land use, continued ownership by NYSEG, and the zoning designation for the property (City of Elmira – Gateway Commercial). The development of these SCOs is described in more detail below.

Protection of Groundwater. Protection of Groundwater SCOs (which are the Unrestricted SCOs for the PAHs and benzene, toluene, ethylbenzene, and xylene (BTEX) compounds at this site) may be deemed not applicable by the NYSDEC, allowing a Restricted Use approach, if the following conditions are met, as described in the NYSDEC Soil Cleanup Memo CP-51, Section V, Paragraph D2 (the Memo text is provided in *italics,* below):

- ***The groundwater standard contravention is the result of an on-site source which is addressed by the remedial program***. This condition is met because groundwater has been demonstrated to not be impacted with MGP-related COC.
- ***An environmental easement or other institutional control will be put in place which provides for a groundwater use restriction***. This provision has been included in the alternatives in this FS that are based on the Restricted Use approach.
- ***DEC determines that impacted groundwater at the site:***

   a) ***Is not migrating, nor likely to migrate, off-site****. or*

   b) ***Is migrating, or likely to migrate, off-site; however, the remedy includes active groundwater management to address off-site migration****.* Migration of groundwater with MGP-related COC was demonstrated to be not occurring.

- ***DEC determines that groundwater quality will improve over time.*** Groundwater is not impacted at the site.

4.3 Land Use and Cleanup Objectives

4.3.1 Soil Cleanup Levels

The SCOs as defined in 6 NYCRR Part 375-6 which apply to the site are determined based on the site use. The site consists of vacant land that is owned by NYSEG. The southern portion of the site and the adjacent off-site area is within a NYSDEC-maintained flood control levee easement area. The future use of the NYSEG property is projected to be for Commercial purposes, and the levee area is anticipated to remain in place for flood-control purposes. The following SCOs have been selected for the site:

- **Commercial Use Soil Standards – Applicable to Soil Less than 15 feet bgs:** This FS proposes to use a soil cleanup level for Total PAHs of 500 parts per million (ppm), applicable to a depth of 15 feet, as stated in CP-51 Paragraph H. The 500 ppm level will be used in lieu of achieving individual COC specific cleanup levels. For the purposes of this provision, subsurface soil will be defined as soil beneath at least 1 foot of soil cover or soil that meets the applicable SCOs. MGP-impacted soil below 15 feet bgs is also proposed to be addressed at this site, as the area of impact appears to be limited to an interval approximately 7 feet below the Gas Holder foundation floor. Addressing the MGP-impacted soil below the foundation floor would be an additional measure that may be undertaken to reduce the potential for future impact to groundwater at this site.

4.3.2 Groundwater Cleanup Levels

The SCGs for groundwater quality are the Ambient Water Quality Standards, Guidance Values, and Groundwater Effluent Limitations (AWQS) identified in "*NYSDEC Technical and Operational Guidance Series 1.1.1*" (TOGS) [NYSDEC, 1998 with addendums]. Based on this document, there is a single standard for groundwater in New York, based on the potential use of groundwater for drinking water purposes.

4.4 Remedial Action Objectives (RAOs)

The RAOs are established as the overall goals for the site remediation to provide protection of human health and the environment. The RAOs for this site were developed based on the applicable SCGs and the current and intended future land use. The RAOs are site-specific goals that address the media of concern, specific COCs, and the exposure pathways for the site. Specific COCs to be addressed in this FS are BTEX, PAHs, and cyanide.

Upon consideration of the SCGs, and the nature and extent of MGP-related residuals, as described in the RI, the following RAOs were developed. These RAOs are goals to be achieved to the extent practicable:

4.4.1 Soil

RAOs for Public Health Protection

- Prevent ingestion/direct contact with soil with COC levels exceeding the applicable SCOs.
- Prevent inhalation of, or exposure to COC volatilizing from soil.

RAOs for Environmental Protection

- Prevent migration of COC that would result in groundwater, surface water, or sediment impacts.
- Prevent impacts to biota from ingestion/direct contact with soil causing toxicity.

4.4.2 Groundwater

RAOs for Public Health Protection

- Prevent ingestion of groundwater with COC levels exceeding drinking water standards.
- Prevent contact with, or inhalation of, volatiles from impacted groundwater.

RAOs for Environmental Protection

- Prevent the discharge of COC to surface water or sediment.
- Remove the source of groundwater or surface water impacts, to the extent practicable.
- Restore groundwater aquifer to ambient groundwater quality criteria, to the extent practicable.

4.4.3 Surface Water

- **Not Applicable**. There are no surface water bodies at the site. Surface water sampling in the off-site area has demonstrated that surface water at the Chemung River is not impacted by MGP-related COC.

4.4.4 Sediment

- **Not Applicable**. There are no sediments at the site. Sediment sampling in the off-site area in the Chemung River has demonstrated that the river area is outside of the area with identified MGP-related impacts.

4.4.5 Soil Vapor

RAOs for Public Health Protection

- Mitigate potential impacts to public health from existing, or the potential for, soil vapor intrusion into buildings at a site. Note that no buildings are currently present at the site. The nearest buildings to the impacted area of AOC 1 are the buildings located to the north of East Water Street. These buildings are 300 feet from the identified impacted area.

5. General Response Actions and Estimated Volumes

In accordance with the guidance provided in DER-10 regarding the development and evaluation of remedial alternatives, this section describes the development of General Response Actions (GRAs) to address the RAOs identified in Section 4, and the estimated volumes of impacted media.

5.1 Potentially Site-Derived MGP Constituents

The potentially site-derived MGP COC, as identified in the RI, are BTEX, PAHs, and total cyanide. The 17 PAH compounds included in the Total PAH concentrations (Total PAH17) discussed in this FS include the following:

- acenaphthene
- acenaphthylene
- anthracene
- benzo(a)anthracene
- benzo(b)anthracene
- benzo(g,h,i)perylene
- benzo(k)fluoranthene
- chrysene
- flourene
- benzo(a)pyrene
- dibenzo(a,h)anthracene
- dibenzofuran indeno (1,2,3-cd) pyrene
- fluoranthene
- naphthalene
- phenanthrene
- 2-methylnaphthalene
- pyrene

5.2 Range of General Response Actions (GRAs)

GRAs are not specific to any single technology, but represent categories or approaches which may be combined and further defined to create remedial alternatives. To meet the RAOs developed for the site, the following GRAs were identified:

1. **No Action.** This response action is listed for compliance with DER-10 FS guidance, but would not result in meeting the RAOs, and is therefore not contemplated for this site.
2. **Institutional Controls and Engineering Controls (IC/ECs) Pertaining to Soil or Groundwater.** These actions, also known as IC/ECs, involve restrictions of legal access to soil or groundwater, and engineering controls to limit physical access.
3. **Containment of Soil and Groundwater.** Containment actions involve little or no treatment, but provide physical barriers to exposure, or otherwise remove pathways of exposure. These actions include vertical barriers and surface soil covers or impervious covers.
4. **In-situ Treatment of Soil and Groundwater.** These actions include on-site reduction in the volume, toxicity, and/or mobility of the COC. Technologies include in-situ solidification (ISS) of impacted soil, in-situ groundwater treatment, active enhancement of natural attenuation, and monitored natural attenuation (MNA) of groundwater.

5. **Removal and Off-Site Treatment/Disposal of Soil and NAPL and Impacted Groundwater**. These actions include excavation of impacted soil, extraction of NAPL, extraction of groundwater, and off-site treatment/disposal of these media in properly permitted facilities.

5.3 General Extent of Impacts

The nature and extent of the site and off-site COC in surface soil, subsurface soil, groundwater, sediments and surface water were described in Section 3. In accordance with the guidance provided in DER-10, this section presents the estimated extent of impacts in soil at the site, including the identified AOC 1. The extent of impacts in these areas was determined with reference to the data presented in the RIR. Laboratory data from the RI were tabulated and compared to chemical-specific SCGs for surface soil, subsurface soil, groundwater, sediments, and surface water in the RIR. The estimated areal and vertical extent of soil impacts in these areas possibly attributable to the MGP site, defined as exceedances of Part 375 Unrestricted and Commercial Use SCOs, is shown in Figures 6 and 7. Impacted groundwater was not identified at the site or the off-site areas.

5.4 Volume Estimates

The volumes of impacted soil present at the site were estimated for the purpose of providing a basis for the development and evaluation of remedial alternatives. Table 5-1 provides a summary of the volumes for each impacted medium. A volume calculation table is provided in Appendix B.

Table 5-1 - Estimated Volumes of Impacted Media

Medium	Estimated Volume
Identified Area - Surface Soil – Surface Soil Commercial SCOs (0-1 foot bgs)	375 CY
Remedial Investigation Area – Soil Unrestricted Use SCOs	13,000 CY
AOC 1:	
1. Gas Holder Foundation	800 CY
2. Subsurface Soil Below Holder Foundation Floor with Visible MGP Residual Impacts	600 CY
3. Volume of Supported Excavation to Remove Foundation and Deeper MGP-Impacted Soil	3,500 CY

Table Notes:
CY – cubic yards

5.4.1 Surface Soils

The sampling performed during the RI identified areas of the site where surface soil COC exceeded the Commercial Use SCOs for individual PAH compounds. The footprint of the area outside of the paved area with the exceedances of the Commercial Use SCOs is shown on Figure 8. This FS contains a provision for a 1-foot soil cover in this area, as shown on Figure 8. A demarcation layer will be installed in the excavated area.

5.4.2 Subsurface Soils

The approximate extent of impacted soil in AOC 1 is shown on Figure 7, and on the cross sectional views in Figures 10 and 12. The footprint of this area was estimated based on the observations and analytical laboratory results reported in the RIR and the exceedance criteria. The soil volumes were estimated as the product of the applicable areal extent and the applicable impacted depths.

The total volume of soil exceeding the Unrestricted SCOs was estimated to provide a maximum impacted soil volume, for comparison purposes. The horizontal extent of soil exceeding the Unrestricted SCOs is shown in Figures 6 and 13. The horizontal and vertical extent for this volume was estimated without regard to the accessibility of the soil. Soil adjacent to the interceptor sewer was included in the estimate. The soil volume was estimated as the product of the applicable areal extents and the applicable average impacted depths with the exception of several deep metal detections which are attributed to background conditions.

The site use is currently classified as Gateway Commercial based on the City of Elmira designation, and on the current and planned future use for the foreseeable future. Therefore, Commercial Use SCOs, with a soil cleanup level for Total PAHs of 500 parts per million (ppm), provided the basis for soil volume estimates in accordance with NYS Part 375 and the NYSDEC CP-51. The soil volumes were estimated for total extent, without regard to accessibility. Table 5-1 provides these soil volumes for soils within or below the identified MGP features or impacted soil intervals.

5.4.3 Groundwater

Because groundwater is not impacted by VOCs, SVOCs, or total cyanide at the site and metals exceedances are attributed to naturally occurring conditions, a total volume of impacted water was not calculated for this FS. The estimated volume of water present inside the Gas Holder foundation is included in Appendix B.

6. Identification and Screening of Technologies

Remediation technologies are the practical means used to address a specific environmental condition. The goal of the identification and screening of technologies is to enable the most effective and applicable technologies to be applied to meet the site-specific conditions and remedial objectives. The individual technologies and approaches are then grouped to form alternatives, with each alternative addressing the impacted area as a whole.

The identification and screening of technologies was conducted in three stages, in accordance with DER-10 guidance. An initial screening process was first used to determine the most applicable technologies for the site, using literature sources and GEI's experience at similar sites [FRTR, 2002; GRI, 1997; ITRC, 2002; NYSDEC, 1992]. For each of the GRAs identified in Section 5.2 – No Action, Institutional Controls/Engineering Controls, Containment, In-Situ Treatment, and Removal – one or more technologies and process options were identified, described, and screened with respect to site-specific applicability. The outcome of this initial screening is presented on Table 6-1 for surface soil, Table 6-2 for subsurface soil, and Table 6-3 for groundwater technologies.

Next, the technologies that were not eliminated from consideration due to site-specific applicability were further refined and evaluated. The evaluation at this stage used the criteria of effectiveness, implementability, and relative cost, in accordance with the DER-10 guidance. The outcome of this screening evaluation is presented on Table 6-4 for surface soil, Table 6-5 for subsurface soil, and Table 6-6 for groundwater technologies. As discussed in Section 3, groundwater is not impacted at this site. The discussion of groundwater technologies is retained due to the presence of MGP-related source material in AOC 1, which may pose a future threat to site groundwater until addressed by removal or solidification.

Finally, a more in-depth evaluation was conducted and technologies were then combined to form alternatives for analysis, as presented in Section 7.

The remainder of this section provides additional brief descriptions of the technologies, and a discussion of the evaluation issues for surface soil, subsurface soil, and groundwater.

6.1 Surface Soil Technologies

6.1.1 IC/ECs

Institutional controls can provide an effective measure to limit or prevent direct contact exposure to soil. Applicable actions may include access control protocols, deed restrictions with an environmental easement, and the establishment of a Site Management Plan (SMP) for managing ground-intrusive activities through the implementation. Because an SMP would be applicable as an institutional control that would establish protocols for soil-disturbing activities at the site, institutional controls were retained for alternative development.

Engineering controls, such as fencing or signage, provide a physical barrier or deterrent between potential receptors and potential exposure pathways. These controls are not believed to be consistent with NYSEG's long-term goals for the property. Engineering controls were not retained for alternative development.

6.1.2 Surface Soil Barriers

Physical barriers may be used to limit the transport of COC, and to prevent potential exposures. Site covers or caps can be constructed of any combination of soil, gravel, asphalt, concrete, clay, or synthetic materials. The design and materials utilized to construct the cap or cover system depends upon the intended post-remedial use of the site and flood control easement areas, the resistance to potential erosion required, and the desired permeability. Areas to be re-used for roadways and parking are typically gravel, asphalt or concrete covered. Permeability will depend on the degree to which the cover/cap reduces infiltration of precipitation and the required resistance to erosion. Low permeability covers (e.g., asphalt, concrete, clay or a synthetic material) are used to restrict infiltration and reduce the leaching of soil COC in the vadose zone. Soil covers are more permeable and are used where infiltration and erosion are not major concerns.

A permeable or impermeable cover or cap could be used at the designated areas of the site to prevent direct contact with soil and potential transport via water and wind erosion. In combination with the retained institutional controls (SMP), a cover or cap would attain the soil RAOs for the protection of public health. By preventing potential off-site migration of impacted soil, a properly maintained cover would also meet the soil RAOs for environmental protection. Permeable and low permeability cover options are therefore retained for further consideration in the development of remedial alternatives. Note that, an asphalt pavement cover already exists in the majority of the site and surrounding NYSEG property. A vegetation layer is already established in non-paved areas.

6.1.3 Surface Soil Removal

Surface soil removal by conventional excavators and graders was retained as a possible technology for alternative development. Removal alone has limited effectiveness if the soil beneath the surface soil is also impacted. Therefore, this technology was retained for possible use for soil removal in combination with placement of soil cover materials.

The NYSDEC has indicated that no soil may be added adjacent to the flood control levee wall, therefore, only soil removal and restoration is discussed in this FS.

6.2 Subsurface Soil Technologies

6.2.1 IC/ECs

IC/ECs for soils can be an important component during site remediation when combined with other response actions. An example would include the combination of an appropriate access restriction and soil management procedures with measures to control fugitive dust generation, and provisions for long-term maintenance to achieve the soil RAOs for the protection of human health and the environment. Site access protocols, soil management protocols and site maintenance planning (in an environmental easement as an SMP) are therefore retained for alternative development.

6.2.2 In-Situ Treatment of Subsurface Soil

Subsurface soil treatment technologies include in-situ soil solidification (ISS), in-situ chemical oxidation (ISCO), and enhanced in-situ bioremediation.

ISCO

ISCO would have limitations regarding its effectiveness at this site, as highly impacted soils would have limited treatability. Delivery of the oxidizing agents to all of the deeper impacted soil intervals would be difficult due to the presence of subsurface structures (Gas Holder foundation). Therefore, ISCO was not retained for alternative development.

Enhanced In-Situ Bioremediation

Enhanced in-situ bioremediation involves the use of microorganisms to assimilate and degrade the COC present in soil. It relies on changing the nutrient and oxygenation characteristics in the subsurface by distribution of active agents throughout the affected saturated zone. However, the presence of fine-grained soils, and highly impacted soil, can limit this distribution and limit the enhancement of bioremediation beyond natural attenuation. With the additional effectiveness of this technology substantially limited by the presence of highly impacted soils, this technology was not retained for alternative development.

In-Situ Soil Solidification

ISS is increasingly becoming an accepted means of remediation at MGP sites [EPA, 2000], including MGP sites in New York State. ISS of impacted soil involves the in-place mixing of cementitious reagents (such as Portland cement) with impacted soil with a vertical or horizontal-mounted auger or excavator bucket to create a solidified mass that substantially decreases the ability of groundwater to come into contact with the impacted soil. The resulting material is typically a homogeneous mixture of soil and grout that hardens into a low permeability soil/cement material.

ISS results in the formation of a solid monolith of relatively impermeable material in the saturated zone. Groundwater is forced around and under the ISS monolith, thus preventing contact of groundwater with the COC contained in the monolith. For the alternative for ISS developed for this site, the ISS monolith would extend to approximately 7 feet below the floor of the Gas Holder foundation to address MGP-impacted soil to that depth. Surface infiltration and downward potential for groundwater flow would be substantially reduced by the ISS monolith. ISS results in an expansion of about 30% in the volume of treated soil, thus requiring pre-excavation of soil to a depth such that the final ISS monolith does not exist in the frost zone. At this site, it is assumed that all of the MGP-impacted material can be reached by an ISS system, including the impacted soil interval beneath the Gas Holder floor. This technology was retained for alternative analysis development.

Jet Grouting

The jet grouting process involves the use of high pressure to inject and mix a liquid cement bentonite grout into a column or area of soil. The high pressure mixing accomplished with this method allows for a smaller diameter drill or auger hole to be used, which allows use of this method around obstructions such as utilities or foundations. An advantage of this method includes the ability to target specific depth intervals for treatment, including thin lenses of impacted media at depth or obstructions. However, the homogenization of the soil is difficult to accomplish for this method for larger applications. Because of its limited applicability at this site, this technology was not retained for alternative analysis development.

6.2.3 Subsurface Soil Removal

Excavation of soil is implementable and highly effective when coupled with an appropriate treatment or disposal option. Removal of impacted soils would completely achieve the RAO for this media and would remove a potential source of future groundwater impacts. Technologies for excavation include use of conventional trackhoe equipment for excavation to depths of 20 feet, extended arm trackhoe equipment for excavation to depths of 30 feet. At this site, excavation for removal of impacted soils would extend to an approximate depth of 30 feet. A combination of conventional trackhoe and extended arm trackhoe technologies, and staged, shored excavations, would be used to accomplish the excavation work and are therefore carried forward for the development of the alternatives. The excavation of soils below the saturated zone is feasible but additional cost will be incurred due to measures needed to maintain a stable excavation area, and to dewater both the excavation area as needed, and the excavated soils prior to off-site transport.

Control of odors and VOC emissions will be an important aspect of all excavation scenarios. Excavation and loading activities could be conducted using a temporary fabric structure (as determined during the design phase of the project), odor-controlling foam, temporary plastic covering, fabric-covered perimeter fencing, and direct load-out. All of these controls have effectively been implemented during remedial actions at other MGP sites.

6.2.4 Subsurface Soil Off-Site Treatment and Disposal

On-site soil treatment processes conducted on excavated soil include biological, chemical, or thermal treatment. The effectiveness of these processes is variable and each requires a site-specific demonstration to determine the degree of treatment, time, and land area required. These processes require a location with an appropriate distance from residential or commercial areas. These considerations resulted in on-site treatment processes not being retained for alternative development.

Subsurface soil off-site treatment and disposal technologies include conventional landfilling (Subtitle D landfill), low-temperature thermal desorption (LTTD), and disposal in waste-to-energy facilities. Each of these technologies has its place as a potentially applicable approach for certain soils or solid debris, and may be advantageous under particular conditions. Therefore, all were retained for alternative development.

6.3 Groundwater Technologies

6.3.1 IC/ECs

The institutional controls for groundwater that may be applicable to alternatives for this site include an environmental easement for site use, and a restriction for extraction and use of site groundwater.

The engineering controls that may be applicable to alternatives for this site include fencing and signage. These controls are not believed to be consistent with NYSEG's long-term goals for the property therefore were not retained.

6.3.2 Groundwater Containment Technologies

Groundwater containment technologies include (as discussed above in the soils discussion) soil cover, and low-permeability caps such as asphalt parking lots. The technologies also include subsurface vertical barriers such as steel sheet pile walls, slurry walls (cement-bentonite mixtures), clay walls, and active process barriers such as biologically active zones which form treatment walls preventing off-site migration of COC. These technologies are most applicable to sites characterized by off-site migration of impacted groundwater. As discussed in Section 3, impacts to groundwater have not been identified at the site. Therefore, while these technologies may be potentially applicable for alternative development, they were not brought forward into the development of specific alternatives for this site.

6.3.3 In-Situ Treatment

Air sparging/soil vapor extraction is the injection of pressurized air into the subsurface below the water table to induce volatilization of dissolved phase COC. The volatilized compounds are then removed by active vapor extraction wells. This technology is applicable to sites such as gasoline spills where VOCs are predominant. Because impacted groundwater has not been identified at this site, this technology is not being retained for alternative development.

Groundwater MNA relies upon the natural degradation and mitigation processes which occur in the subsurface to remedy groundwater impacts over time. The natural attenuation processes include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of COC in soil or groundwater. These processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological solidification, transformation, or destruction of COC.

A recent study of MNA at an MGP site has shown its effectiveness following source removal and with favorable subsurface conditions [Neuhauser, et al, 2009]. Implementation is determined as a function of an evaluation of physical and chemical soil and groundwater characteristics including soil and groundwater chemistry, groundwater hydraulics, and biodegradation processes associated with microbial activity related to such compounds as oxygen, carbon dioxide, nitrate, sulfate and iron. Groundwater MNA was not retained for alternative development because site groundwater is not impacted by VOC, SVOC, or total cyanide COC.

Enhanced biological treatment of groundwater may use aerobic or anaerobic microbial degradation of COC. These are active management processes in which natural groundwater conditions are modified in order to facilitate bioremediation of the COC to innocuous end-products. Engineered saturated zone bioremediation processes are designed to treat the dissolved constituents of the groundwater plume by ensuring the existence of a bioactive zone which is sufficient to degrade the constituents before they reach an environmental receptor. Aerobic biological treatment is the most applicable to MGP sites. In this process, an oxygen additive product or direct air/oxygen injection is used in wells to deliver oxygen to the affected groundwater over the required time period to achieve the desired amount of oxygen. Enhancements such as increasing the dissolved oxygen content in the subsurface have been shown to be effective at MGP sites [Levinson, 2009]. These technologies are used to treat dissolved COC in groundwater. These technologies were not retained for alternative development for groundwater because groundwater is not impacted at the site.

6.3.4 Removal Technologies for Addressing Groundwater

It would be feasible to extract impacted groundwater for above-ground treatment at this site. On-site treatment technology options for extracted groundwater may include air stripping and/or granular activated carbon (GAC). Although the MGP COC is amenable to biological treatment, the concentrations in groundwater are typically too low for biological treatment to be effective without addition of large amounts of co-substrate to maintain a viable biomass. Pumped groundwater would be appropriate for off-site treatment at a publically owned treatment works (POTW), though some pre-treatment may be required by the City. Groundwater extraction with air stripping, GAC and/or discharge to the POTW is not retained for further consideration in development of alternatives because site groundwater is not impacted.

6.4 Secondary Technology Screening

The secondary technology screening retained technologies that are an appropriate and effective means to prevent exposure to site-related COC. These technologies are retained for incorporation into the remedial alternatives. The use of a permeable cover (with appropriate soil management provisions and drainage controls) would provide a reliable means to prevent direct contact exposures and transport via wind and water erosion on the site, and is retained for incorporation into remedial alternatives for AOC 1. ISS was retained for potential consideration for the identified area of concern (AOC 1). Excavation was also retained given the anticipated depth of excavation of 30 feet. With proper solidification and contingency measures, this deeper excavation could be performed. Off-site LTTD would be feasible for treatment of excavated soils. The retained technology options and media are summarized as follows:

Technology Option	***Media***
No Action	All
Institutional Controls (Deed Restrictions, Environmental Easements):	
• SMP	Soil
• Groundwater Use Prohibitions	Groundwater (institutional control)
• Access Restriction	Soil
Barriers:	
• Permeable Cover	Soil
• Low Permeability Cap	Soil
In-Situ Treatment:	
• ISS	Soil
Removal and Ex-Situ Treatment:	
• Excavation	Soil
• Landfilling	Soil
• LTTD	Soil

7. Development and Analysis of Alternatives

In this section, the remedial alternatives for the site are developed and evaluated. A comparison of alternatives is presented at the conclusion of this section. A summary of how the alternatives address the RAOs is provided in Table 7-1. A summary and comparison of the remedial alternatives is provided in Table 7-2. The recommended alternative is further described in Section 8.

7.1 Development of Alternatives for Additional Remedial Actions

A range of alternatives for additional remedial actions were developed for the site, based on the land use approaches, RAOs, and GRAs identified in Sections 3, 4 and 5, and the screened and selected applicable technologies identified in Section 6. A total of five alternatives were developed and retained for detailed analysis:

Alternative 1: No Action

- No Action (required for comparison purposes by DER-10).

Alternative 2: Soil Cover and Institutional Controls

- Isolation of MGP-impacted soil (parking lot and soil cover).
- IC/ECs implemented by a Site Management Plan (SMP) (site use restrictions, and an environmental easement).
- Periodic Certification of IC/ECs in accordance with Part 375-1.8(h)(3).

A Monitoring Plan (included in the SMP) would be developed to assess the performance of the remedy. Soil cover areas would be inspected annually, and a Periodic Review Report prepared in accordance with Part 375-1.8(h)(3).

Alternative 3: ISS Inside Intact Gas Holder Foundation

- Pre-Design Investigation (PDI), including an evaluation of the need to protect NYSDEC Flood Control Easement area features.
- Protection and/or relocation of utilities.
- Support of the Gas Holder foundation, if needed.
- Removal of fill/soil to account for ISS swell.
- ISS of fill within the Gas Holder foundation to address soil exceeding 500 parts per million (ppm) for Total PAHs. ISS of visibly MGP-impacted soil below the foundation floor to address the potential for future groundwater impacts.
- Repaving pavement areas disturbed by construction activities.

- Removal and restoration of unpaved site surface soils in the identified area north of the levee wall to accommodate a 1-foot thickness of soil meeting the SCOs specified in 6 NYCRR Part 375-6.7(d) for Commercial Use. A demarcation layer will be installed in the excavated area.
- Monitoring of groundwater for a period of 5 years following remediation to assess post-remedial conditions, followed by a re-evaluation of the need for any continued monitoring.
- IC/ECs implemented by an SMP (site and groundwater use restrictions, and an environmental easement).
- Periodic Certification of IC/ECs in accordance with Part 375-1.8(h)(3).

A Monitoring Plan (included in the SMP) would be developed to assess the performance of the remedy. Soil cover areas would be inspected annually and a Periodic Review Report prepared in accordance with Part 375-1.8(h)(3).

Alternative 4: Removal of the Gas Holder Foundation Contents, Foundation, and Deeper Impacted Soil by Excavation

- PDI, including an evaluation of the need to protect NYSDEC Flood Control Easement area features during remediation.
- Protection and/or relocation of utilities along East Water Street or on the site.
- Installation of excavation support around the Gas Holder foundation.
- Removal of the Gas Holder foundation contents to address soil exceeding 500 ppm for Total PAHs, removal of the Gas Holder foundation and soils/materials within the foundation support, and removal of visibly MGP-impacted soil below the Gas Holder foundation floor to address the potential for future groundwater impacts.
- Backfill of the excavation area with material meeting NYSDEC criteria.
- Repaving of the excavation area.
- Removal and restoration of unpaved site surface soils in the identified area outside of AOC 1 north of the levee area to accommodate a 1-foot thickness of soil meeting the SCOs specified in 6 NYCRR Part 375-6.7(d) for Commercial Use. A demarcation layer will be installed in the excavation.
- Monitoring of groundwater for a period of 5 years following remediation to assess post-remedial conditions, followed by a re-evaluation of the need for any continued monitoring.
- IC/ECs implemented by an SMP (site and groundwater use restrictions, and an environmental easement).
- Periodic Certification of IC/ECs in accordance with Part 375-1.8(h)(3).

A Monitoring Plan (included in the SMP) would be developed to assess the performance of the remedy. Soil cover areas would be inspected annually and a Periodic Review Report prepared in accordance with Part 375-1.8(h)(3).

Alternative 5: Soil Removal to Unrestricted Use SCOs

- Protection and/or relocation of utilities.
- Removal of MGP Building and Gas Holder foundations, and any MGP piping encountered.
- Removal of soil with COC that may possibly be attributed to the former MGP operations to allow for Unrestricted site use.
- IC/ECs implemented by an SMP (including groundwater use restrictions, and an environmental easement agreement).

It is not anticipated that the flood control features would need to be removed and reconstructed; however, the features would need to be protected during the soil removal activities. A Monitoring Plan (included in the SMP) would be developed to assess the performance of the remedy. A Periodic Review Report would be prepared in accordance with Part 375-1.8(h)(3).

7.2 Detailed Analysis of Alternatives

The following sections present descriptions of each of the remedial alternatives and the results of the evaluation of the alternatives with regard to the following eight criteria defined by DER-10:

1. Overall protection of human health and the environment
2. Conformance with SCGs
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility, or volume of COC through treatment
5. Short-term impacts and effectiveness of controls
6. Implementability
7. Cost effectiveness
8. Land Use

When performing this evaluation, the first two evaluation criteria are threshold criteria and must be met for an alternative to be considered for selection. The next six evaluation criteria are balancing criteria which are used to compare the positive and negative aspects of each of the remedial alternatives, contingent on whether the alternative satisfies the threshold criteria.

A Ninth Criterion - Community Acceptance, is considered after a decision document has been subject to public comment. This modifying criterion is evaluated after any public comments on the remedy have been received, prior to NYSDEC’s final approval of the remedy.

In accordance with the NYSDEC guidance document DER-31 – Green Remediation, aspects of environmental sustainability were evaluated as part of the detailed analysis of alternatives. These aspects were included in the considerations of the short-term impacts for each alternative.

Estimated costs are presented for the proposed remedies. These include capital and operations, maintenance, and monitoring (OM&M) costs. OM&M costs are associated with the maintenance of the soil cover, and with the limited short-term post-remedial groundwater monitoring anticipated for this site, and are presented as present worth costs calculated based on a maximum period of 30 years with a discount rate of 5 percent. This value was selected based on recommendations by the NYSDEC. Costs have been prepared to present a range that may vary between +50 % and -30 % from actual costs.

7.2.1 Alternative 1 Evaluation

The No Action Alternative is used as a baseline condition for comparison to other alternatives. It involves no monitoring, active remediation, or IC/ECs. There is no cost associated with this baseline alternative. Because it would not address the subsurface impacts present at the site, the No Action Alternative would not achieve the threshold criterion of conformance with SCGs required by DER-10. It would have low long-term effectiveness and permanence, and would not reduce mobility, toxicity, or volume. However, because there is a very low potential for a human or ecological receptor to be exposed to COC at the site under current conditions, overall protection of human health and the environment is close to being achieved under the No Action Alternative. While No Action would have a very low potential for negative short-term impacts, and would be implementable and cost effective, it would not meet the RAOs to the extent practicable, and is therefore not considered to be a viable alternative.

7.2.2 Alternative 2 Evaluation

Description

This alternative consists of the establishment and maintenance of a soil cover and IC/ECs. This alternative provides for protection of human health and the environment while having low short-term impacts and remedial action cost by installation of a soil cover, and IC/ECs implemented under an SMP (including site and groundwater use restrictions, and an environmental easement). The remedy would allow the current land use (vacant property and flood control levee) to continue, provided an SMP is in place to address control of any future excavation within the impacted areas. This remedial alternative is shown on Figure 8.

An environmental easement would be established with NYSEG as the property owner, in accordance with DER-33 [NYSDEC, 2010d]. The NYSDEC easements for the flood control levee area would continue. An SMP would be established such that any future excavation in AOC 1 or the identified area of surface soil impacts would be conducted under a NYSDEC-approved work plan. There are currently no wells for groundwater use on the site, and future installation of wells and groundwater use on the properties would be restricted by the environmental easement established under this alternative.

The soil cover in the identified areas would be inspected annually and a Periodic Review Report would be prepared in accordance with Part 375-1.8(h)(3). Short-term groundwater monitoring would be performed. The results would be evaluated with the NYSDEC to determine the need for continued monitoring. For the estimate of costs for this FS, it is assumed that the groundwater monitoring would be performed twice a year for 5 years and once a year for the subsequent 25 years.

Overall Protection of Human Health and the Environment

The potential for contact with COC in surface soil is reduced by the establishment and maintenance of a soil cover, the existing parking lot, and by the IC/ECs. The presence of the MGP-impacted soil in the subsurface poses a continued concern for any utility work that may be needed at the site, as well as for any future construction. There is no current or anticipated future use of groundwater within the impacted area of the site.

Conformance with SCGs

This alternative does not conform to the applicable SCGs for soil. Sources of COC that may possibly contribute to the future exceedances of the NYSDEC Ambient Groundwater Water Quality Standards will be present at the identified AOC 1. Table 7-1 provides a summary of how this alternative addresses the RAOs.

Long-Term Effectiveness and Permanence

Other than the addition of a soil cover, Alternative 2 does not include active remediation. Site controls include an SMP to provide appropriate procedures for handling and managing impacted soil encountered during future invasive activities, and methods to address potential soil vapor intrusion should future construction occur. Remaining fill or soil with MGP residuals mixed in the matrix, which may possibly act as a source of COC impacts to groundwater or soil vapor, will remain.

Reduction of Mobility, Toxicity, or Volume Through Treatment

This remedial alternative will not reduce the toxicity, mobility, or volume of COC in surface soil, and subsurface soil.

Short-Term Impacts and Effectiveness of Controls

Implementation of this alternative does not pose any short-term risks because no remedial activities other than the establishment of the soil cover, and a limited period for groundwater monitoring would be performed on the site. This alternative is highly effective in the short-term.

Implementability

- **Technical Feasibility.** This action is readily implementable from a technical standpoint.

- **Administrative Feasibility.** This alternative is administratively feasible. NYSEG owns the property, with a NYSDEC flood control easement in the southern portion of the site.
- **Availability of Services and Materials.** The services and materials required for this alternative are readily available.

Cost Effectiveness

This alternative has a low cost effectiveness because some of the remedial objectives are not met. The estimated present worth cost is $530,000.

The projected costs for this alternative are as follows:

Capital and Engineering Cost	$190,000	
OM&M Cost	$254,000	
Contingency	$89,000	(20% for undefined costs and conditions)
Rounded Total	$530,000	

Details of the cost estimate are provided in Table A-2 of Appendix A.

Land Use

Future land use for the site would be limited under this alternative.

7.2.3 Alternative 3 Evaluation

Description

This alternative consists of the removal of soil / fill for swell, the ISS of fill and soil to a depth of 30 feet at AOC 1, the installation of a soil cover in the identified area, and IC/ECs.

This alternative provides for protection of human health and the environment by addressing surface soil COC exceedances at the site, and the impacted material in the identified AOC 1, while having moderate short-term impacts and remedial action cost. This remedial alternative is shown on Figure 9, and in Cross Section A-A' on Figure 10.

Short-term post-remedial groundwater monitoring would be performed. Groundwater monitoring over a period of 5 years on the site would identify any changed conditions following remediation.

The details of the monitoring program, including the number and location of the wells and frequency of sampling, would be described in a NYSDEC-approved SMP, which would be prepared during remedial design. For the purposes of the cost estimate in the FS, it was assumed that groundwater sampling of four wells would occur twice per year for a period of 5 years followed by inspections each year for the subsequent 25 years.

The soil removal and re-grading area shown on Figure 9 addresses PAH exceedances in surface soil at the NYSEG property, and the area to the north of the levee wall. The area for soil removal and restoration would be finalized during the design of the remedy.

Estimated excavation of debris and soil, and soil addressed by ISS volumes, are summarized as follows:

Alternative 3				
Excavation Area[1]	***Total Excavated (CY)***	***Total Transported to Facility (CY)***	***Facility Option (CY)***	
			Landfill	***LTTD***
Surface Soil	375	375	375	0
Subsurface Fill, Soil and Debris	230	230	0	230
ISS	***ISS Soil (CY)***	***Total Transported to Facility (CY)***	***Facility Option (CY)***	
			Landfill	***LTTD***
ISS	1170	0	NA	NA
ISS Swell (estimate)	300	300	0	300
TOTAL	**N/A**	**905**	**375**	**530**

(1) Excavation to clear fill and soil from frost zone in ISS area

Overall Protection of Human Health and the Environment

Alternative 3 will be effective at meeting RAOs, and will be protective of human health and the environment. The potential for direct contact with COCs in surface soils would be addressed by the soil removal and establishment and maintenance of a soil cover. The ISS would be effective at reducing potential exposure to COCs in subsurface soil; however, some level of concern would remain for a potential exposure as the COC will remain on site in the solidified mass. Potential future groundwater impacts would be addressed by the solidification of the COC in the ISS mass; however, some level of concern would remain for future groundwater impact because COC would remain in the ISS mass.

Conformance with SCGs

This alternative conforms to the applicable soil SCGs through the implementation of ISS. The SCGs for groundwater are not applicable because site groundwater is not impacted. Table 7-1 provides a summary of how this alternative addresses the RAOs.

Long-Term Effectiveness and Permanence

This alternative would be effective because the MGP-related COC would be solidified by the ISS. The COC that would remain would be addressed by institutional controls. These institutional controls can be maintained indefinitely. COC in groundwater does not pose a risk to human health because site groundwater is not impacted, and would not be anticipated to be impacted as a result of the remedial activities.

Reduction of Mobility, Toxicity, or Volume Through Treatment

Significant direct reduction of mobility, and toxicity of the COC would occur by the physical solidification of the soil by ISS; however, some level of concern for a potential exposure would continue since the COC would remain in the solidified mass. Short-term post-remedial groundwater monitoring would be performed to assess any change in groundwater conditions.

Short-Term Impacts and Effectiveness of Controls

Implementation of this alternative poses minimal short-term risks from the removal, loading and restoration of the soil cover, the removal of some debris and fill and soil for ISS swell, and the implementation of the ISS at AOC 1.

- **Protection of Community.** During the implementation of this alternative, measures would be taken to monitor and reduce the potential for air emissions during the soil placement actions, the excavation of fill and soil, and the ISS.
- **Protection of Workers.** Workers involved in the remedial and OM&M activities will wear the appropriate personal protective equipment (PPE) as specified in a site-specific health and safety plan (HASP).
- **Environmental Impacts.** The potential for negative environmental impacts from this alternative would be low due to the solidification of the MGP-impacted material, and the absence of groundwater impacts.
- **Time Until Response Objectives are Achieved.** The post-remedial groundwater monitoring program would be re-evaluated after a 5-year period. For the cost estimate in this FS, it is assumed that the timeframe for this alternative, following ISS, would be a 5 year monitoring period.
- **Green Remediation Considerations**. This alternative would require use of fossil fuels and disposal facilities for the excavation and cover placement actions, and the ISS. Other resource utilization would include the clean soils brought onto the site for cover, and the solidification additives for the ISS.

Implementability

- **Technical Feasibility.** It is technically feasible to re-route the existing utilities at the site, should this action be necessary. ISS is a newer technology but has been proven to be implementable and is gaining wider acceptance for application at MGP sites by the regulatory agencies. ISS batch plants may be constructed in areas as small as 40 feet by 80 feet, so there would be sufficient space to construct the temporary facility at this site. The subsurface foundation for the Gas Holder is not believed to have the potential to impede this remedy, therefore, foundations would not need to be removed by excavation prior to initiation of ISS. A small-diameter ISS auger is assumed to be able to advance the ISS through, and below the Gas Holder foundation floor. Institutional controls such as an environmental easement are commonly adopted and are considered readily implementable.

- **Administrative Feasibility.** This alternative is administratively feasible because NYSEG owns the property. Other than the surface soil removal and restoration of the area, the NYSDEC flood control features are outside of the area identified for remedial action.
- **Availability of Services and Materials.** The services and materials required for this alternative are available. The ISS unit is the only piece of equipment that may not be readily available, thus scheduling its time at the site will be an important logistical consideration.

Cost Effectiveness

This alternative has a moderate cost effectiveness because some level of monitoring will be necessary following remediation. The projected costs for this alternative are as follows:

Capital and Engineering Cost	$1,070,000	
OM&M Cost	$171,000	
Contingency	$248,000	(20% for undefined costs and conditions)
Rounded Total	$1,490,000	

Land Use

The current and planned future land uses for the NYSEG property as a Commercial property would be allowed to continue under this alternative. The future land use would be restricted in accordance with the institutional controls.

7.2.4 Alternative 4

Description

This remedial alternative is shown on Figures 11 and 12. This alternative consists of the protection of utilities if needed, support of the excavation area, the removal of the Gas Holder contents, removal of the Gas Holder foundation, and the removal of visibly impacted soil from below the foundation floor to an approximate 30-foot depth. Following excavation, backfilling would be performed with soil that meets the criteria identified by the NYSDEC. AOC 1 and areas disturbed by construction would then be re-paved. Following remediation, post-remedial monitoring would be performed and IC/ECs established. For the identified area with surface soil exceedances of

Commercial SCOs, or subsurface soil exceeding the Commercial SCO in the top 1-foot of soil would be removed to a minimum depth of 1-foot below ground surface to establish the cover identified in DER-10 for Commercial Use. Based on preliminary discussions with the NYSDEC Flood Control Office in Elmira, New York, soil would need to be removed and replaced for this action, instead of building-up a cover adjacent to the flood control levee wall.

This alternative is similar to Alternative 3, except for the method used to address the MGP-impacted materials. This remedial alternative is shown on Figure 11, and on Cross Section B-B' on Figure 12.

During implementation, excavation support would be needed to shore the recommended excavation area to allow for the removal of soil to the target depth. For costing purposes, this FS assumes that secant piles would be used for this support; however, the actual methods to be employed would be finalized in the Remedial Design phase. The use of secant piles would allow for several advantages at this site. Compared to driven metal sheet piles, the installation of secant piles would produce less vibrations which could be important given the close proximity of the utilities along East Water Street, and the City of Elmira interceptor sewer in the flood control easement area.

Debris would be transported to a local landfill, or if impacted, potentially to a waste-to-energy facility for disposal. Alternative 4 would require dewatering during excavation. Dewatering the alluvium may generate a substantial volume of water requiring treatment, depending on how the excavation activities are managed. Soil meeting NYSDEC criteria would be used to backfill the remedial excavation area. The excavation area for AOC 1 would be re-paved following backfilling.

To assess potential changed conditions following remediation, groundwater monitored will be performed for a period of 5 years, and the results discussed with the NYSDEC. The details of the monitoring program, including the number and location of the wells and frequency of sampling, would be described in a NYSDEC-approved SMP. For the purposes of the cost estimate in the FS, it was assumed that groundwater sampling of four wells would occur twice per year for a period of 5 years. Because site groundwater is not impacted and is not anticipated to be impacted by the remedial activities, only short-term monitoring is anticipated.

This alternative provides for protection of human health and the environment by addressing surface soil impacts, and MGP-impacted material in AOC 1, while having low short-term impacts and moderate remedial action cost.

Estimated excavation and disposal volumes are as follows:

Alternative 4				
Excavation Area	***Total Excavated (CY)***	***Total Transported to Facility (CY)***	***Facility Option (CY)***	
			Landfill	***LTTD***
Surface Soil Area	375	375	375	0
AOC 1	3,815	3,815	0	3,816
TOTAL	**4,190**	**4,190**	**375**	**3,816**

Overall Protection of Human Health and the Environment

This remedial alternative is protective of human health and the environment. The potential for contact with COC in surface soils and subsurface soils would be mitigated by the removal and restoration of identified area north of the levee wall with surface soil impacts, and the removal of MGP-impacted fill and subsurface soil. The presence of deeper MGP-impacted soil below the holder foundation would no longer pose a potential future threat to site groundwater. The potential for human exposure or an ecological receptor exposure would be addressed by the removal of the MGP-impacted media.

Conformance with SCGs

This alternative conforms to the applicable soil SCGs through the removal of the fill and soil which would be a highly effective measure to address the MGP-related impacted material. Groundwater conditions following the removal would be monitored; however, groundwater impacts are not anticipated because groundwater is not impacted at the site, or at down gradient areas. Table 7-1 provides a summary of how this alternative addresses the RAOs.

Long-Term Effectiveness and Permanence

This alternative would be highly effective and permanent because the MGP-impacted material would be removed and disposed of off site, and impacts to groundwater during remediation would not be anticipated. The potential for off-site migration of COCs would be addressed by the removal of the MGP-impacted material.

Reduction of Mobility, Toxicity, or Volume Through Treatment

This remedial alternative will result in a reduction of the volume of COCs by the removal of impacted fill and soil. The excavated fill and soil would be treated and disposed of at off-site facilities. This alternative would greatly reduce the potential for future contact between groundwater and impacted soil. Alternative 4 would have a low potential short-term adverse impact from the remedial action upon the community, the workers, and the environment.

Short-Term Impacts and Effectiveness of Controls

The primary short-term impacts of this alternative are associated with the relocation of the utilities (if necessary), the removal and restoration of the identified surface soil remedial area, and the excavation of the fill and soil in AOC 1. There is potential for exposure to dust and odor by the construction workers and community members during excavation activities. As determined in the design phase of the project, the excavation may be performed inside of a temporary fabric structure, or other controls may be implemented.

- **Protection of Community.** Truck traffic from the operations would be a moderate short-term impact. Truck traffic would include mobilization and demobilization of heavy construction equipment, trucking of impacted material from the site, and trucking of backfill material onto the property. During the implementation of this alternative, measures would be taken to monitor and reduce the potential for air emissions during the excavation, as determined in the design phase of the project. The excavation may be performed inside of a temporary fabric structure or other controls may be implemented.
- **Protection of Workers.** Workers would be protected during implementation of this alternative as direct contact with impacted material will be minimized by use of heavy equipment to perform the excavation and loading activities. Workers involved in the remedial activities will wear the appropriate PPE as required in a site-specific HASP. Workers involved in the remedial and OM&M activities will wear the appropriate PPE as required in a site-specific HASP.
- **Environmental Impacts.** The potential for negative environmental impacts from this alternative would be low. Impacts during the soil and debris removal operations will be addressed by use of spill prevention and control measures.
- **Time Until Response Objectives are Achieved.** The objectives for this remedy would be met upon completion of the soil excavation. For the purposes of cost estimating and comparison to other alternatives, a 5 year post-remedial groundwater monitoring task and a 30 year OM&M period was assumed.
- **Green Remediation Considerations**. This alternative would require use of fossil fuels and disposal facilities for the excavation and cover placement actions. Other resource utilization would include the clean soils brought onto the site for cover and backfill.

Implementability

- **Technical Feasibility.** It is technically feasible to re-route the existing utilities to the site (if necessary). Soil excavation is technically feasible using conventional equipment and construction methods. Shoring of the excavation to protect critical infrastructure (East Water Street) is an important consideration, which can be addressed in the remedial design. Dewatering of the excavation is feasible but difficult to predict because of the porosity of the alluvium. While this can be addressed in the remedial design, it contributes to the uncertainty in the cost and technical feasibility.

- **Administrative Feasibility.** This alternative is administratively feasible because NYSEG owns the property, and the NYSDEC controls the activities performed in the easement areas.
- **Availability of Services and Materials.** The services and materials required for this alternative are readily available.

Cost Effectiveness

Alternative 4 is considered to be a cost-effective option because the remedial objectives are addressed over a short time period, and the impacted surface soil and the impacted subsurface soil is removed from the site. Monitoring for groundwater is anticipated to occur twice per year for 5 years, with the monitoring scope and duration re-evaluated with the NYSDEC. Details of the cost estimate are provided in Appendix A.

The projected costs for this alternative are as follows:

Capital and Engineering Cost	$2,512,929	
OM&M Cost	$171,000	
Contingency	$536,725	(20% for undefined costs and conditions)
Rounded Total	$3,220,000	

Land Use

The current and planned future land use for the NYSEG property as a Commercial property would be allowed to continue under this alternative. This alternative would be consistent with this land use as restricted in accordance with the institutional controls. This alternative would likely provide for a wider-range of potential future land re-use options when compared to Alternative 3.

7.2.5 Alternative 5

Description

This remedial alternative is shown on Figure 13. This alternative consists of the removal of the MGP feature foundations (MGP Building and Gas Holder), followed by the removal of approximately 12,800 CY of soil with COC present that may possibly be attributed to MGP-related impacts. The remedial action would allow for Unrestricted use of the site.

As identified by the data obtained during the RI, it is estimated that an average of approximately 8 feet of soil would need to be removed in the western portion of the site, and an average of approximately 25 feet of soil would need to be removed in the eastern portion of the site. These target depths for the soil removal would need to be further determined in a pre-design investigation.

Removal of soil adjacent to the flood control features, including the interceptor sewer, would have substantial technical concerns, as engineering controls would be needed to protect these features.

However, it is not anticipated that removal and reconstruction of any of the flood control features would be necessary, based on the data collected during the RI and also because of the extensive soil removal and reconstruction activities already performed in this area.

This alternative provides for protection of human health and the environment, but has very high short-term impacts and remedial action costs.

Because of the completeness of the removal, and the current non-impacted conditions, treatment of groundwater would not be anticipated to be needed.

For the cost estimate in this FS, it is assumed that the monitoring would be performed for a period of 5 years following remediation, to assess the post-remedial groundwater conditions.

The estimated excavation and disposal volumes are as follows:

Alternative 5				
Excavation Area	***Total Excavated (CY)***	***Total Transported to Facility (CY)***	***Facility Option (CY)***	
			Landfill	***LTTD***
Identified Area	12,800	12,800	8,960	3,840
TOTAL	**12,800**	**12,800**	**8,960**	**3,840**

<u>Overall Protection of Human Health and the Environment</u>

Alternative 5 meets all RAOs. This remedial alternative is protective of human health and the environment. A high-level of overall protection would be achieved by the complete removal action defined by this alternative. As determined by the remedial design, the excavation may be performed inside a temporary fabric structure.

<u>Conformance with SCGs</u>

SCGs for soils will be achieved by the removal of soils exceeding Part 375 Unrestricted Use levels that may possibly be attributed to the MGP site. It is anticipated that this complete removal action would achieve groundwater RAOs for groundwater because site groundwater is not impacted, and the future threat to groundwater would be addressed by the soil removal. Table 7-1 provides a summary of how this alternative addresses the RAOs.

<u>Long-Term Effectiveness and Permanence</u>

This remedy relies primarily on removal actions which will be effective and permanent, and will eliminate direct exposure potential to soil upon removal.

<u>Reduction of Mobility, Toxicity, or Volume Through Treatment</u>

This remedial alternative will result in rapid substantial reduction of mobility, toxicity, and volume of COC through the removal action.

<u>Short-Term Impacts and Effectiveness</u>

The primary short-term impacts of this alternative are associated with the removal and replacement of soil. The extensive excavation and backfilling in the soil removal area would also have a very large negative short-term impact. As determined by the remedial design, the excavation activities may be performed inside a temporary fabric structure. Greenhouse gas emissions and other green remediation considerations would be higher for this alternative.

- **Protection of Community.** During the implementation of this alternative, measures would be taken to monitor and reduce the potential for air emissions during source removal actions and transportation off site. Truck traffic from the operations would be a significant impact. Truck traffic would include mobilization and demobilization of heavy construction equipment, trucking of impacted material from the site, and trucking of backfill material onto the site.
- **Protection of Workers.** Workers would be protected during implementation of this alternative as direct contact with impacted material will be minimized by use of heavy equipment to perform the excavation and loading activities. Workers involved in the remedial activities will wear the appropriate PPE.
- **Environmental Impacts.** The potential for negative environmental impacts for this alternative would be high due to impacts from trucking and LTTD treatment of soil will include the generation of greenhouse gasses.
- **Time Until Response Objectives are Achieved.** The SCOs for soil would be met upon completion of the removal, which is estimated to take a year to complete, including the reconstruction of the levee features, if needed.
- **Green Remediation Considerations**. This alternative would have the highest required use of fossil fuels and disposal facilities for the excavation and cover placement actions. Other resource utilization would include the clean soils brought onto the site for cover.

<u>Implementability</u>

- **Technical Feasibility.** Although very costly and technically challenging, the removal of soil and features is technically feasible using conventional equipment. Removal by excavation is technically feasible using conventional excavation equipment. Excavation, transportation, and disposal of impacted soils are conventional remedial methods.
- **Administrative Feasibility.** This alternative is administratively feasible because the remedial area is owned by NYSEG. Permits for the remedial work in the flood control easement areas would need to be obtained from the NYSDEC and USACE.

- **Availability of Services and Materials.** The services and materials required for this alternative are readily available. Multiple facilities may need to be identified for both treatment of excavated soil and provision of clean backfill material, acceptable to the NYSDEC, due to the significant quantities of material involved. Excavation uses conventional construction equipment that is readily available.

Cost Effectiveness

This remedy would not be cost effective, as the extremely high costs would not have a commensurably high value in additional environmental protection or increase in actual land use. The use of the site for Commercial purposes and as the flood control levee are the only current and planned future uses.

The projected costs for this alternative are as follows:

Capital and Engineering Cost	$5,252,000	
OM&M Cost	$99,000	
Contingency	$1,070,000	(20% for undefined costs and conditions)
Rounded Total	$6,420,000	

Details of the cost estimate are provided in Table A-5 in Appendix A.

Land Use

This alternative would remediate the site to allow for any use. Commercial site use, and flood protection are believed to be the only likely future land uses.

7.3 Comparison of Alternatives

A comparative analysis was conducted in which the alternatives were compared to one another with regard to each of the eight analysis criteria. A summary of the comparative analysis is presented in Table 7-2. The following discussion provides a comparison of the four substantive alternatives, without the No Action Alternative, which is not considered a viable alternative.

Overall Protection of Human Health and the Environment

All four of the substantive alternatives include common elements that would result in overall protection of human health and the environment. All four alternatives would be protective of human health and the environment by reducing or eliminating the potential for an exposure to COC, either by removal or IC/ECs.

With respect to this criterion, the alternatives are ranked as follows:

1. **Alternative 5** would be the most protective, because it would involve the most complete removal of COC.
2. **Alternative 4** would be the next most protective, as removal of COC in the identified AOC 1, and the establishment of the soil cover would provide a similar level of protection. It would also decrease potential for accidental exposure from uncontrolled future excavation activities, with the complete removal of MGP-impacted material.
3. **Alternative 3** would be the next most protective, as solidification of COC in the identified AOC 1 and soil cover would provide a similar level of protection. Some level of concern would remain for potential exposure following ISS due to the COC remaining on site within the solidified ISS mass. Some level of concern would also remain for potential future groundwater impacts.
4. **Alternative 2** would be least protective because, while the IC/ECs would be in place (including the existing soil cover), it would only minimally address the subsurface soil impacts, and would not meet the RAOs for these media.

Conformance with SCGs

Alternative 4 would provide substantial conformance with the SCGs appropriate for the current and future land uses for each alternative, to the extent practicable, in accordance with the RAOs. Alternative 3 would also provide substantial conformance with the SCGs appropriate for the current and future land uses for each alternative, to the extent practicable, in accordance with the RAOs; however, COC would remain at the site in the solidified ISS mass. Alternative 5 would provide additional conformance to SCGs, if it were effective in removing all soils exceeding Unrestricted Use levels. Additional comparisons of the alternatives with regard to the RAOs are provided in Table 7-1.

Long-Term Effectiveness and Permanence

Alternatives 4 and 5 would provide substantial long-term effectiveness and permanence. Alternative 3 would provide a similar level of long-term effectiveness and permanence; however, the MGP-related COC would remain on site in the ISS solidified mass.

With respect to this criterion, the alternatives are ranked as follows:

1. **Alternative 5** would be the most effective and permanent, because it would involve the removal of COC to Unrestricted levels.
2. **Alternative 4** would rank as the next most effective and permanent option due to the removal of COC using excavation, and would eliminate the source of potential future groundwater impacts.
3. **Alternative 3** would rank as the next most effective and permanent option. COC would remain in the subsurface soil; however, the COC would be solidified by ISS.

4. **Alternative 2** would be ranked as the least effective and permanent. The IC/ECs, and soil cover would not be as effective or permanent because MGP-impacted material is not addressed.

Reduction of Toxicity, Mobility, or Volume

Alternative 5 would remove COC to Unrestricted Use SCOs in the identified area. Alternative 4 would provide substantial reductions of toxicity, mobility, and volume. Alternative 3 would provide a similar reduction in mobility; however, the MGP-related material would remain in the solidified material. With respect to this criterion, the alternatives are ranked as follows:

1. **Alternative 5** would result in the most reduction, because it would involve the most complete removal of COC.
2. **Alternative 4** would result in the next most reduction due to the soil removal and the reduced potential for future impacts to groundwater.
3. **Alternative 3** would result in the next most reduction because of the combination of partial soil removal, and soil solidification. COC would remain in the soil; however, the COC would be solidified by ISS.
4. **Alternative 2** would not involve substantial reduction of toxicity, mobility, or volume.

Short-Term Impacts and Effectiveness of Controls

With respect to this criterion, the alternatives are ranked as follows:

1. **Alternative 2** would have the least short-term impact because, other than the installation of the soil cover, it would not involve any invasive actions.
2. **Alternatives 3 and 4** rank next because of the greater short-term impacts resulting from either the ISS or the soil removal. The methods available to control these impacts would be reliable and effective.
3. **Alternative 5** would involve the greatest excavation quantities and depths, resulting in the greatest negative short-term impacts. A larger truck traffic volume would be required.

Implementability

With respect to this criterion, the alternatives are ranked as follows:

1. **Alternative 2** would be most implementable, because it involves the least intrusive site work, with little uncertainty with regard to the methods utilized.
2. **Alternative 4** would rank as next most implementable, because soil removal is implementable using conventional technologies which are widely available.
3. **Alternative 3** would be less implementable than Alternative 4 because ISS involves specialized equipment and contractors. However, the use of this technology is becoming common at MGP sites.

4. **Alternative 5** would be implementable; however, would require a high level of staging and coordination with a very high cost.

Cost Effectiveness

The alternatives are ranked as follows with respect to cost effectiveness:

1. **Alternative 4** is the most cost-effective option as it provides for the current and widest-range of future land use, and addresses potential exposure issues for surface soil and subsurface soil, and is protective of groundwater. It has a relatively moderate total cost of approximately $3.2 million. The cost of Alternative 4 is higher than the cost of Alternative 3; however, Alternative 4 has the significantly added benefit of allowing for the complete removal of MGP-impacted material from the site, which will greatly reduce the potential for on-going exposure or groundwater concerns, and is believed likely to allow for the widest-range of potential future land re-use options.
2. **Alternative 3** is the next most cost-effective option as it provides for the current and future land use, addresses potential exposure issues for surface soil, addresses MGP-impacted fill and soil with solidification, and has a relatively moderate total cost of approximately $1.5 million.
3. **Alternative 2** is the next most cost-effective option. Although it has a relatively moderate total cost of approximately $0.5 million, it does not address the MGP-impacted material at the site. In addition, it does not address the potential for an on-going exposure concern, or future groundwater impacts.
4. **Alternative 5** is the least cost effective as its high cost of $6.4 million would not have a commensurably high value in additional environmental protection or increase in actual land use.

Land Use

The alternatives are ranked as follows with respect to land use:

1. **Alternative 4** would allow for the removal of COC, and allow for the current land use, and is believed to be likely to allow for a wider-range of potential future uses.
2. **Alternative 3** would be supportive of current and future planned land uses with some level of additional concern due to the COC remaining in the solidified mass.
3. **Alternative 2** would be supportive of current and future planned land uses with a higher level of additional concern due to the COC remaining at the site.
4. **Alternative 5** would cause significant short-term disruption for the current land use, and therefore would rank last for this criterion among the alternatives.

8. Recommended Remedy

Upon consideration of the results of the RI, and on the evaluated alternatives and their respective attributes and limitations, remedial action is recommended for the Elmira Water Street MGP site. The elements detailed in Alternative 4 emerged as the recommended remedy. Alternative 4 is comprised of the following elements:

- PDI, including an evaluation of the need to protect NYSDEC Flood Control Easement area features during remediation.
- Protection and/or relocation of utilities along East Water Street or on the site.
- Installation of excavation support at AOC 1 around the Gas Holder foundation.
- Removal of the contents of the Gas Holder foundation to address soil exceeding 500 ppm for Total PAHs, removal of the Gas Holder foundation, removal of the soils/materials inside of the excavation support, and removal of visibly MGP-impacted soil below the Gas Holder foundation floor to address the potential for future impacts to groundwater.
- Backfill of the excavation area with material meeting NYSDEC criteria.
- Repaving of the excavation area.
- Removal and restoration of unpaved site surface soils in the identified area outside of AOC 1 north of the levee wall to accommodate a 1-foot thickness of soil meeting the SCOs specified in 6 NYCRR Part 375-6.7(d) for Commercial Use. A demarcation layer will be installed in the excavated area.
- Monitoring of groundwater for a period of 5 years following remediation to assess post-remedial conditions, followed by a re-evaluation of the need for any continued monitoring.
- IC/ECs implemented by an SMP (site and groundwater use restrictions, and an environmental easement).
- Periodic Certification of IC/ECs in accordance with Part 375-1.8(h)(3).

The remedy for the site will include the implementation of an institutional control in the form of an environmental easement for the site which will require: the submittal of a periodic certification of institutional and engineering controls to the NYSDEC in accordance with Part 375-1.8 (h)(3); will allow the use and development of the site for Commercial Use as defined by Part 375-1.8(h)(3); and will restrict the use of groundwater as a source of potable or process water.

A NYSDEC-approved Site Management Plan will be developed which will include an Institutional and Engineering Control Plan that will identify all use restrictions and engineering controls for the site, and will detail the steps and media-specific requirements necessary to ensure the engineering controls remain in place and are effective for the management and inspection of the identified engineering controls. The plan will also have provisions for maintaining site access controls and procedures for NYSDEC notification.

A Monitoring Plan (included in the SMP) for the site will also be developed. The plan will include a schedule of monitoring and frequency of submittals to the NYSDEC. The duration of the groundwater monitoring program is anticipated to be for 5 years and is expected to be of minimal scope and duration because site groundwater is not impacted, and is not anticipated to be impacted following remediation. Following this period, the results of the monitoring and any trends identified will be reviewed with the NYSDEC, and revisions to the program will be made as needed.

The estimated cost for implementation of Alternative 4 is $3.2 million.

The recommended remedy represents a thorough and appropriate approach to address the MGP-related impacts present at the site given the current and future planned uses of the property. The remedy is also believed to be likely to allow for a wider-range of potential future land re-use options. The potential impact to the adjacent NYSDEC and City of Elmira flood control and drainage features is anticipated to be minimal. Green remediation principals and techniques will be implemented to the extent feasible in the remedial design, site remediation, and site management of the remedy in accordance with the specifications provided in DER-31.

The next step is a NYSDEC-issuance of a Proposed Remedial Action Plan (PRAP) for public comment. The PRAP will be followed by a Record of Decision (ROD). A design for the remedy including detailed drawings and specifications for remedial construction will follow the issuance of the ROD. A Pre-Design Investigation is anticipated to be implemented to define the basis for design.

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Tables

Table 4-1
Chemical-Specific Standards, Criteria, and Guidance
Elmira Water Street MGP Site

Media	Requirements	Citation	Description	SCG or TBC	Comment
Soil	NYSDEC Soil Cleanup Objectives (SCOs) for Inactive Hazardous Waste Sites	NYSDEC DER-10, May 2010	Establishes recommended Soil Cleanup Objectives (SCOs), and SCOs for protection of groundwater.	SCG	Specified screening-level goals may be applicable in determining site-specific soil objectives.
	NYSDEC Guidance for implementing SCOs	NYSDEC Policy Memorandum on Soil Cleanup Guidance CP-51, October 2010	Provides guidance on use of SCOs.	TBC	Guidance may be applicable to site-specific soil cleanup alternatives. Provides modification to SCOs for MGP sites.
	NYSDEC Remedial Program SCOs	6 NYCRR Part 375 Subpart 375-6	Establishes SCOs based on Residential, Commercial, and Industrial land use; protection of ecological resources; and protection of groundwater quality.	SCG	Specified screening-level goals may be applicable in determining site-specific soil objectives.
Groundwater	NYSDEC Groundwater Objectives	6 NYCRR Part 700-706 NYSDEC, Division of Water, TOGS (1.1.1) - 6 NYCRR 703.5	Establishes Guidance or Standard values for groundwater quality objectives.	SCG	May be applicable in determining site-specific groundwater objectives.
Surface Water	NYSDEC Surface Water Objectives	6 NYCRR Part 700-706 NYSDEC, Division of Water, TOGS (1.1.1) - 6 NYCRR 703.5	Establishes Guidance or Standard values for surface water quality objectives.	TBC	Not applicable to this site. There are no surface water bodies at the site.
Sediment	NYSDEC Sediment Quality Criteria Development Process	NYSDEC Screening and Assessment of Contaminated Sediment, June 24, 2014. Evaluating Ecological Risk to Invertebrate Receptors From PAHs in Sediments at Hazardous Waste Sites (USEPA, 2009).	Describes the procedures for assessing whether or not contaminants present in sediment have the potential to pose a risk to aquatic life.	TBC	Not applicable to this site. There are no sediments at the site.
	Bioavailability Methods	ASTM D-7363-07 Standard Test Method for Solid-Phase Micro Extraction and PAH analysis	Describes an updated process for developing sediment quality criteria.		
Soil Vapor	Indoor Air Quality Objectives	NYSDOH Soil Vapor Intrusion Guidance October 2006	Establishes methods and guidance regarding data acquisition, interpretation, and mitigation.	TBC	Not currently applicable to this site. There are no buildings at the site. May be applicable to any future construction if MGP-related source material is not addressed.

Notes:

SCG = Standards, Criteria, and Guidance
TBC = Other Criteria To Be Considered

Table 4-2
Action-Specific Standards, Criteria, and Guidance
Elmira Water Street MGP Site

Action	Requirements	Citation	Description	SCG or TBC	Comment
Water Treatment Discharge	NYSDEC Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations	Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1	Compilation of ambient water quality standards and guidance values for toxic and non-conventional pollutants for use in NYSDEC programs (i.e., SPDES).	TBC	These standards and guidance values are applicable in establishing discharge limitations to surface waters. Potentially applicable during remedial construction.
	NYSDEC Industrial SPDES Permit Drafting Strategy for Surface Waters	TOGS 1.2.1	Guidance for developing effluent and monitoring limits for point source releases to surface water.	TBC	These standards and guidance values are applicable in establishing discharge limitations to surface waters. Potentially applicable during remedial construction.
	Clean Water Act	Section 401	Water Quality Certification.	SCG	Potentially applicable.
	SPDES	6 NYCRR Parts 750-01, 750-02	Requirements for obtaining a SPDES permit and requirements for operating in accordance with a SPDES permit.	SCG	Potentially applicable to constructing and operating a water treatment system for discharge to surface water during remedial construction.
	Wastewater Treatment Plant	TOGS 1.3.8	Limits on new or changed discharges to Publicly Owned Treatment Works (POTWs), strict requirements regarding bioaccumulative and persistent substances, plus other considerations.	TBC	Potentially applicable to constructing and operating a temporary water treatment system for discharge to POTWs.
Construction Stormwater	SPDES Permit Requirements	NYSDEC SPDES General Permit for Stormwater Discharge	Requirements to protect stormwater from construction impacts including preparation of a Stormwater Pollution Prevention Plan (SWPPP).	SCG	Potentially applicable. A permit itself is not needed, only that the substantive requirements are fulfilled.
In-Situ Treatment of Soils and Groundwater	Underground Injection Control Program	40 CFR Part 144	Includes requirements for injection of chemicals.	SCG	Potentially applicable for In-Situ Chemical Oxidation.
	NYSDEC Ambient Water Quality Standards and Guidance Values	Division of Water Technical and Operational Guidance Series (TOGS) 2.1.2	Applicability of SPDES permits and groundwater effluent standards to the use of underground injection/recirculation as a remediation measure.	SCG	Potentially applicable.
Indoor Air	NYSDOH Background Air Levels	Guidance for Evaluating Soil Vapor Intrusion in the State of New York, October 2006	Includes a database of background indoor air concentrations and description of decision-making process for remediation of indoor air impacts.	TBC	Not applicable. No buildings are present at the site.
Waste Management	Solid Waste Management Facility	6 NYCRR 360	Includes solid waste management facility requirements.	SCG	Applicable if soil is removed.
	Waste Transporter Permits	6 NYCRR 364	Regulates collection, transport, and delivery of regulated waste. Requires that wastes be transported by permitted waste haulers.	SCG	Applicable if soil is removed.
MGP-Impacted Soil and Sediment	Management of Soil and Sediment Impacted with Coal Tar from Manufactured Gas Plant Sites	NYSDEC TAGM 4060 and NYSDEC DER-4	This guidance outlines the criteria for MGP coal tar waste. Soils and sediment only exhibiting the toxicity characteristic for benzene (D018) may be conditionally excluded from the requirements of 6 NYCRR Parts 370-374 and 376 when they are destined for permanent thermal treatment.	SCG	Applicable for off-site treatment and disposal of soil.

Table 4-2
Action-Specific Standards, Criteria, and Guidance
Elmira Water Street MGP Site

Action	Requirements	Citation	Description	SCG or TBC	Comment
Hazardous Waste	**Federal:** *Resource Conservation and Recovery Act (RCRA) Subtitle C – Hazardous Waste Management*				
	Generation, Management, and Treatment of Hazardous Waste	40 CFR Parts 261-265	Outlines criteria for determining if a solid waste is a hazardous waste and establishes requirements for hazardous waste management.	SCG	Because of New York State policy for management of wastes from MGP sites, hazardous waste will not be generated as part of implementation of the remedial actions. Potentially applicable.
	State: NYSDEC Division of Hazardous Substances Regulation				
	New York State Hazardous Waste Management Regulations	6 NYCRR Parts 370-376	Outlines criteria for determining if a solid waste is a hazardous waste and establishes a hazardous waste management program.	SCG	Because of New York State policy for management of wastes from MGP sites, hazardous waste will not be generated as part of implementation of the remedial actions. Potentially applicable.
Off-Site Management of Non-Hazardous Waste	RCRA Subtitle D	42 U S C Section 6901 *et seq.*	State and local governments, in accordance with USEPA's guidance, are the primary planning, regulating, and implementing entities for the management of non-hazardous solid waste, such as household garbage and non-hazardous industrial solid waste.	SCG	Applicable if soil is removed from site.
Air Emissions	***Clean Air Act (CAA)***				
	New Source Review (NSR) and Prevention of Significant Deterioration (PSD) Requirements	40 CFR Part 52	New sources or modifications which emit greater than the defined threshold for listed pollutants must perform ambient impact analysis and install controls which meet best available control technology (BACT).	SCG	Not applicable. No new sources will be generated.
	National Emission Standards for Hazardous Air Pollutants (NESHAPs)	40 CFR Part 61; 40 CFR Part 63	Source-specific regulations which establish emissions standards for hazardous air pollutants (HAPs).	SCG	Not applicable.
	New York State Air Pollution Control Regulations	6 NYCRR Parts 120, 200-203, 207, 211, 212, 219, Air Guide-1	Establishes emissions standards and permitting requirements for new sources of air pollutants and specific contaminants.	SCG	Requirements would be applicable to remediation alternatives that result in emissions of air contaminants, including particulate matter and volatile or semi-volatile COCs.
	New York State Ambient Air Quality Standards	6 NYCRR Part 257	Establishes state ambient air quality standards and guidelines for protection of public health.	SCG	May be applicable in evaluating air impacts during remediation activities. Establishes short-term exposure action limits for occupational exposure.
	Fugitive Dust Suppression and Particulate Monitoring	NYSDEC - DER-10, Appendix 1B	Fugitive dust suppression and particulate monitoring during source area remedial activities.	SCG	For implementation under a site health and safety plan and CAMP during remedial activities. Applicable to site disturbance activities.
Construction-Related Air Emissions	Community Air Monitoring Plan (CAMP)	NYSDEC - DER-10, Appendix 1A	Air Quality Requirements	SCG	Applicable to remedial site construction activities, or well installation activities.
Work Near Overhead Power Lines	Safety and Health Regulations for Construction	Occupational Safety and Health Administration (OSHA) 29 CFR Part 1926, Subpart K; Part 1926.550(a)(15)	Establishes minimum clearances and grounding requirements for work near electrical equipment and for the operation of cranes and derricks in the vicinity of electrical distribution and transmission lines.	SCG	The minimum required clearances will be maintained and equipment grounding will be established when work is performed in the vicinity of overhead power lines.
	Worker Protection - Safety and Health	New York State Department of Labor (NYSDOL) High-Voltage Proximity Act, Code Rule 57, Section 202-h	Establishes minimum clearances and grounding requirements for work near high-voltage power lines.	SCG	The minimum required clearances will be maintained and equipment grounding will be established when work is performed in the vicinity of overhead power lines.

Table 4-2
Action-Specific Standards, Criteria, and Guidance
Elmira Water Street MGP Site

Action	Requirements	Citation	Description	SCG or TBC	Comment
Institutional Controls	Institution of an Environmental Easement	NYSDEC Policy on Environmental Easements: Environmental Conservation Law (ECL) Article 71, Title 36	NYSDEC has developed a draft standard form and procedure for establishing environmental easements.	TBC	Institutional controls will be established in accordance with NYSDEC policy.
Monitored Natural Attenuation (MNA)	Provides Specific Requirement for Implementation of MNA	*Use of MNA at Superfund, RCRA Corrective Action and UST Sites* (USEPA, 1997)	This guidance document establishes the technical basis for implementing MNA.	TBC	MNA would be implemented in accordance with USEPA guidance.
Site Management Plan (SMP)	Template document intended to expedite development and approval of a site-specific SMP by providing format and general content guidelines.	*Site Management Plan Template* (NYSDEC, April 2009)	NYSDEC has developed an SMP template for remedial projects performed under the management of the NYSDEC Division of Environmental Remediation.	TBC	An SMP will be utilized following remedial action, to address the means for implementing the Institutional Controls and Engineering Controls that will be required by an Environmental Easement for the site.
Land Disturbing Activities	Excavation of Impacted Soil	DER-10; Technical Guidance for Site Investigation and Remediation	Requirements for collection and analysis of compliance and documentation samples.	TBC	Applicable.
			Requirements for CAMP implementation.	TBC	Applicable.
	Backfill	DER-10; Technical Guidance for Site Investigation and Remediation	Requirements for procedures to document that imported backfill is not impacted by COC.	TBC	Applicable.

Notes:

SCG = Standards, Criteria, and Guidance
TBC = Other Criteria To Be Considered

Table 4-3
Location-Specific Standards, Criteria, and Guidance
Elmira Water Street MGP Site

Location	Requirements	Citation	Description	SCG or TBC	Comment
Entire Site	Chemung County	General Regulations	County transportation and site use regulations.	TBC	Requirements of County, and City would be applicable to all remediation alternatives, especially those requiring transportation.
	City of Elmira	Redevelopment Plans	None identified.	TBC	Any master plan for redevelopment would be considered when planning future land use at the site.
	City of Elmira	General Ordinances	City regulations regarding transportation, noise, zoning, building permits, etc.	TBC	Requirements of County, and City would be applicable to all remediation alternatives, especially those requiring transportation.
Floodplains	Executive Order 11988 - Floodplain Management	40 CFR Part 6, Subpart A; 40 CFR Part 6.302	Activities taking place within floodplains must be done to avoid adverse impacts and preserve the beneficial values in floodplains.	SCG	The site in Zone X of the FEMA Flood Insurance Map. Area of 500 year flood; area of 100 year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100 year flood.
	Floodplain Management Regulations	6 NYCRR Part 500	Establishes floodplain management requirements.	SCG	The site in Zone X of the FEMA Flood Insurance Map. Area of 500 year flood; area of 100 year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100 year flood.
	100-year floodplain regulations	Federal Emergency Management Agency	Administers floodplain management requirements.	SCG	The site in Zone X of the FEMA Flood Insurance Map. Area of 500 year flood; area of 100 year flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 100 year flood.
Wetlands/Waters of the U.S.	Executive Order 11990 - Protection of Wetlands	40 CFR Part 6, Subpart A	Activities taking place within wetlands must be done to avoid adverse impacts.	SCG	Not applicable. Wetlands are not present at the site.
	Dredging and Filling regulations	Clean Water Act, Section 404; Rivers and Harbors Act	Regulates the discharge of dredged or fill material into waters of the United States. Requires a permit from the USACE.	SCG	Requirements of the NYSDEC and USACE would be applicable to all remediation alternatives.
	Wetlands Regulations	NYSDEC Freshwater Wetlands Act	Regulates use and development of freshwater wetlands.	SCG	Not applicable. Wetlands are not present at the site.
	Protection of Water Regulations	6 NYCRR Part 608	Protection of Water Permit/ Water Quality Certification.	SCG	Not applicable.
Critical Habitat	Endangered Species Act and Fish and Wildlife Coordination Act	U.S. Fish and Wildlife Coordination Act 16 USC 661; U.S. Fish and Wildlife Endangered Species Act 16 USC 1531	Actions must be taken to conserve critical habitat in areas where there are endangered or threatened species.	SCG	Not applicable. A high-value habitat for wildlife is not present at the site.
Historic Preservation	New York State Department of Parks, Recreation, and Historic Preservation	Historic Preservation Act	Establishes requirements for the identification and preservation of historic and cultural resources.	SCG	Applicable to the management of historic or archeological artifacts identified on the site. A "No Findings" determination is required prior to excavation.

Notes:
SCG = Standards, Criteria, and Guidance
TBC = Other Criteria To Be Considered

Table 6-1
Initial Technology Screening for Surface Soil
Elmira Water Street MGP Site

General Response Action	Remedial Technology Type	Technology Process Option	Description	Site-Specific Screening Evaluation
No Action	No Action	No Action	No additional remedial action.	No Action is included for comparison purposes in accordance with NYSDEC DER-10.
Institutional Controls/ Engineering Controls (IC/ECs)	Institutional Controls	Environmental Easement / Deed Restriction	Legal agreement or notice restricting site use in accordance with NYSDEC DER-10.	NYSEG owns the site. Retained for further evaluation. There is a NYSDEC flood control easement in the southern portion of the site.
		Site Management Plan	Contingency plans for property owner actions, such as procedures for excavation and handling of surface soil. They are administered through environmental easements, deed restrictions or third-party property agreements.	NYSEG owns the site. Retained for further evaluation. There is a NYSDEC flood control easement in the southern portion of the site.
	Engineering Controls	Fencing	Fencing or other physical barriers prevent potential receptors from exposures. For surface soil, this may include site perimeter fencing.	Effective to prevent direct contact with surface soil but not consistent with NYSEG's long-term goals for the property. Not retained.
		Signage	Signs, which deter potential receptors from exposures, such as trespassing on surface soil.	Potentially effective to prevent direct contact with surface soil but not consistent with NYSEG's long-term goals for the property. Not retained.
Containment	Surface Barriers	Soil Covers	One foot clean soil cover, for Commercial Site use, with site grading for drainage.	Eliminates exposure pathway for contact with surface soils. Retained for further evaluation.
		Low Permeability Surface Caps	Includes low permeability covers including pavement and concrete building pads.	Eliminates exposure pathway for contact with surface soils. Considered equivalent to a soil cover. Retained for further evaluation.
Removal	Excavation	Conventional excavators and graders	Excavation of the top one-foot of soil (for Commercial site use). Addition of a soil cover is necessary if soil below surface soil is impacted.	Eliminates exposure pathway for contact with surface soils. Retained for further evaluation.
Treatment and Disposal	Off-Site Disposal or Treatment	Landfill	Disposal at a permitted off-site landfill.	A widely used conventional technology. Retained for further evaluation.
		Low-temperature Thermal Desorption	Treatment at a permitted thermal desorption facility. The soil is heated in order to volatilize COCs, which are then destroyed in an afterburner.	A widely used conventional technology for MGP-impacted soils. Retained for further evaluation.
		Waste-to-Energy/ Management of NAPL-impacted large debris	Co-fired boiler or other waste-to-energy facilities, resulting in destruction of COCs and energy production.	Potentially applicable for impacted site debris that is too large for LTTD. Capacity of facilities is limited and may not be applicable for bulk soil. Retained for further evaluation.
		Soil Washing/ Chemical Treatment	Soil washing and chemical treatment by addition of oxidants.	Not applicable for MGP-impacted fill or soils. Not retained.
		Biological Treatment	Landfarming or soil windrow tilling to enhance biological treatment of COCs in soil.	No active facilities are available for MGP-impacted soils. Not retained.
	On-Site Disposal or Treatment	Landfill	Disposal at an on-site location constructed as a permitted landfill.	Not likely to be acceptable to surrounding community. Not retained.
		Low-Temperature Thermal Desorption	Treatment on site with a mobile permitted thermal desorption facility. The soil is heated in order to volatilize COCs which are then destroyed in an afterburner.	Not likely to be acceptable to surrounding community. Not retained.
		Incineration	High temperature burning on site with a mobile permitted incinerator.	Not likely to be acceptable to surrounding community. Not retained.
		Soil Washing/ Chemical Treatment	Soil washing and chemical treatment by addition of oxidants.	Not applicable to MGP-impacted soils. Not retained.
		Biological Treatment	Landfarming or soil windrow tilling to enhance biological treatment of contaminants in soil.	Not likely to be acceptable to surrounding community. Not retained.

Table 6-2
Initial Technology Screening for Subsurface Soil
Elmira Water Street MGP Site

General Response Action	Remedial Technology Type	Technology Process Option	Description	Site-Specific Screening Evaluation
No Action	No Action	No Action	No additional remedial action.	No Action is included for comparison purposes in accordance with NYSDEC DER-10.
Institutional Controls/ Engineering Controls (IC/ECs)	Institutional Controls	Environmental Easement / Deed Restriction	Legal agreement or notice restricting site use in accordance with NYSDEC DER-10.	NYSEG owns the site. Retained for further evaluation. There is a NYSDEC flood control easement in the southern area of the site.
		Site Management Plan	Contingency plans for property owner actions, such as procedures for handling subsurface soil during excavations for underground utilities or basements. They are administered through environmental easements, deed restrictions or third-party property agreements.	NYSEG owns the site. Retained for further evaluation. There is a NYSDEC flood control easement in the southern area of the site.
	Engineering Controls	Temporary Fencing	Temporary fencing during excavation in which subsurface soil is encountered.	Applicable for on-site construction activities. Retained for further evaluation.
		Temporary Signage	Temporary signs which deter potential receptors from exposures during excavation in which subsurface soil is encountered.	Applicable for on-site construction activities. Retained for further evaluation.
Containment	Subsurface Vertical Barriers	Steel Sheet Piling Bentonite/Cement Slurry Walls HDPE Sheeting Walls Drilled Grout and Solidified Earth Column Walls Jet Grout Column Walls	Subsurface vertical barrier walls have been used at MGP sites to prevent the migration of NAPL in subsurface soil. (See Table 6-3, Initial Technology Screening for Groundwater, for descriptions.)	Based on the sampling performed during the RI, free-phase NAPL has not been identified at the site. Migration of MGP-related residual in groundwater is not occurring. Not retained.
In-Situ Treatment	Immobilization	In-Situ Solidification (ISS) using Auger Mixing method	Overlapping columns are augered as a grout/soil mixture to form a solid monolith of low permeability. Most effective to a depth of approximately 40 feet but constructable to a depth of approximately 50 feet. Physically binds or encloses a COC mass and/or induces a chemical reaction between the stabilizing agent and the COCs to reduce their mobility within the subsurface and to decrease permeability of the mass so that groundwater does not contact the COCs.	Effective for meeting soil-related RAOs. Retained for further evaluation.
		In-Situ Solidification (ISS) using Pressure Grouting method	High pressure jet grouting displaces soil to form a grout column. Overlapping grout columns form a solid monolith of low permeability. Most effective to a depth of approximately 40 feet.	Potentially effective for meeting soil-related RAOs. Retained for further evaluation.
		In-Situ Solidification (ISS) using Excavator Bucket Mixing method	Bulk soil is mixed into a grout/soil mixture to form a solid monolith of low permeability. Constructable to a depth of approximately 20 feet (deeper if larger excavator with extended long reach boom is utilized).	Effective for meeting soil-related RAOs. Retained for further evaluation.
	Chemical Treatment	In-Situ Chemical Oxidation (ISCO)	Treatment by a field of wells in the impacted area, which are used to chemically degrade the COCs, usually by addition of an oxidant such as ozone, hydrogen peroxide, or potassium permanganate.	Limited applicability due to technology uncertainty. Not retained.

Table 6-2 (Cont'd.)
Initial Technology Screening for Subsurface Soil
Elmira Water Street MGP Site

General Response Action	Remedial Technology Type	Technology Process Option	Description	Site-Specific Screening Evaluation
In-Situ Treatment (cont.)	Air Sparging/Soil Vapor Extraction	Air Sparging/Soil Vapor Extraction	This technology is the injection of pressurized air into the subsurface below the water table to induce volatilization of dissolved phase COCs.	Effective for VOCs in groundwater and soil vapor. Not effective for meeting soil-related RAOs. Not retained.
	Enhanced Recovery technologies	Steam	Uses injected steam to heat subsurface soil and groundwater and enhance mobility to allow for more effective treatment or extraction. This technology is in the experimental phase. Substantial risk of uncontrolled migration of contaminants.	Experimental technologies with a substantial risk for uncontrolled migration. Not retained.
		Electro-Thermal	Uses electrical current to heat subsurface soil and groundwater and enhance mobility to allow for more effective treatment or extraction. This technology is in the experimental phase. Substantial risk of uncontrolled migration of COCs.	Experimental technologies with a substantial risk for uncontrolled migration. Not retained.
		Surfactants	Uses surfactant chemicals (soap formulations) injected in the subsurface to enhance mobility to allow for more effective treatment or extraction. This technology is in the experimental phase. Substantial risk of uncontrolled migration of COCs.	Experimental technologies with a substantial risk for uncontrolled migration. Not retained.
		Acoustic Vibrations	Uses sound to vibrate subsurface soil and groundwater and enhance mobility to allow for more effective treatment or extraction. This technology is in the experimental phase. Substantial risk of uncontrolled migration of COCs.	Experimental technologies with a substantial risk for uncontrolled migration. Not retained.
Removal	Excavation	Conventional and Long-Stick Excavators/ Shoring	For excavations to approximately 20 feet (slightly deeper for long-stick excavators). Shoring and benching required for deeper excavations.	A widely used conventional technology. Retained for further evaluation.
		Slurry Trench Excavation	Excavations deeper than the typical reach of an excavator, with flowing sand and artesian conditions. A slurry is used to maintain sidewall support. Requires additional equipment and more extensive dewatering and earth support structures.	During the RI, MGP-impacts were not observed to be deeper than 30 feet. Subsurface soils containing COCs are within the typical reach of conventional and long-stick excavators. Not retained.
Treatment and Disposal	Off-Site Treatment and Disposal	Landfill	Disposal at a permitted off-site landfill.	A widely used conventional technology for the management of MGP-impacted soils. Retained for further evaluation.
		Low-Temperature Thermal Desorption (LTTD)	Treatment at a permitted thermal desorption facility. The soil is heated in order to volatilize COCs, which are then destroyed in an afterburner.	A widely used conventional technology for the management of MGP-impacted soils. Retained for further evaluation.
		Waste-to-Energy/Management of NAPL-impacted large debris	Co-fired boiler or other waste-to-energy facilities, resulting in destruction of COCs and energy production.	Potentially applicable for impacted site debris that is too large for LTTD. Capacity of facilities is limited and may not be applicable for bulk soil. Retained for further evaluation.
		Soil Washing/ Chemical Treatment	Soil washing and chemical treatment by addition of oxidants.	Not applicable for MGP-impacted soils. Not Retained.
		Biological Treatment	Landfarming or soil windrow tilling to enhance biological treatment of COCs in soil.	No active facilities are available for MGP-impacted soils. Not Retained.

Table 6-2 (Cont'd.)
Initial Technology Screening for Subsurface Soil
Elmira Water Street MGP Site

General Response Action	Remedial Technology Type	Technology Process Option	Description	Site-Specific Screening Evaluation
Treatment and Disposal (Cont'd)	On-Site Treatment and Disposal	Landfill	Disposal at an on-site location constructed as a permitted landfill.	Insufficient land area available. Not likely to be acceptable to surrounding community. Not retained.
		Low-Temperature Thermal Desorption	Treatment on site with a mobile permitted thermal desorption facility. The soil is heated in order to volatilize COCs, which are then destroyed in an afterburner.	Not likely to be acceptable to surrounding community. Not retained.
		Incineration	High temperature burning on site with a mobile permitted incinerator.	Not likely to be acceptable to surrounding community. Not retained.
		Soil Washing/ Chemical Treatment	Soil washing and chemical treatment by addition of oxidants.	Not applicable to MGP-impacted soils. Not retained.
		Biological Treatment	Landfarming or soil windrow tilling to enhance biological treatment of COCs in soil.	Not likely to be acceptable to surrounding community. Not retained.

Table 6-3
Initial Technology Screening for Groundwater
Elmira Water Street MGP Site

General Response Action	Remedial Technology Type	Technology Process Option	Description	Site-Specific Screening Evaluation
No Action	No Action	No Action	No remedial action.	No Action is included for comparison purposes in accordance with NYSDEC DER-10.
Institutional Controls/ Engineering Controls (IC/ECs)	Institutional Controls	Environmental Easement/ Deed Restriction	Legal agreement or notice restricting site use in accordance with NYSDEC DER-10.	NYSEG owns the site. Retained for further evaluation. There is a NYSDEC flood control easement at the site.
		Local Groundwater Use Ordinance	Legal restriction placed by the local municipality preventing installation of new wells or use of existing wells.	Can prevent potential contact with COCs in on-site groundwater. Retained for further evaluation.
		Site Management Plan	Contingency plans for property owner actions, such as use of site groundwater and handling of groundwater during excavations for underground utilities or for future construction. They are administered through environmental easements, deed restrictions, or third-party property agreements.	Can prevent potential contact with COCs in on-site groundwater. Retained for further evaluation.
	Engineering Controls	Fencing	Fencing or other physical barriers prevent potential receptors from exposures.	Potentially effective to prevent direct contact with on-site groundwater but not consistent with NYSEG's long-term goals for the property. Not retained.
		Signage	Signs, which deter potential receptors from exposures.	Potentially effective to prevent direct contact with on-site groundwater but not consistent with NYSEG's long-term goals for the property. Not retained.
Containment	Surface Barriers: Cover Soil and Caps	Soil Covers	One foot clean soil cover (for Commercial Site use), with site grading for drainage.	Can prevent potential exposure and can decrease infiltration of precipitation and therefore have a positive effect on groundwater quality. Retained for further evaluation.
		Low Permeability Surface Caps	Includes low permeability covers including pavement and concrete building pads.	Surface barriers minimize infiltration of precipitation to source areas, reducing migration of dissolved COCs. However, low permeability surface caps do not allow for maintenance of sub-station currently on site. Not retained.
	Subsurface Vertical Barriers	Steel Sheet Piling	Interlocking steel sheets are driven by vibration or hammer to pre-determined depths.	Has been selected for use to contain NAPL and groundwater containing COCs at MGP sites in New York. Retained for further evaluation.
		Bentonite/Cement Slurry Walls	Slurry walls involve excavation of a 1.5 to 5 foot wide trench followed by immediate placement of slurry which hardens to form the barrier.	Considered equivalent to a sheet pile wall. Not retained for further evaluation.
		HDPE Sheeting Walls	HDPE interlocking sheeting is installed through a slurry-supported trench.	Considered equivalent to a sheet pile wall. Not retained for further evaluation.
		Drilled Grout and Solidified Earth Column Walls	Overlapping columns are drilled and filled with grout or grout/soil mixture to form a barrier wall with low permeability.	Considered equivalent to a sheet pile wall. Not retained for further evaluation.
		Jet Grout Column Walls	High pressure jet grouting displaces soil to form a grout column. Overlapping grout columns form a barrier wall.	Considered equivalent to a sheet pile wall. Not retained for further evaluation.

Table 6-3 (Cont'd.)
Initial Technology Screening for Groundwater
Elmira Water Street MGP Site

General Response Action	Remedial Technology Type	Technology Process Option	Description	Site-Specific Screening Evaluation
Containment (Cont'd.)	Process Barriers	Biological Containment	Containment by a line of wells downgradient of the impacted area, which are used to stimulate microbial activity, usually by air sparging. The groundwater is treated in-situ before it migrates off site.	Potentially effective for containment of COC in groundwater. Retained for further evaluation.
		Chemical Containment	Containment by a line of wells downgradient of the impacted area, which are used to chemically degrade the COCs, usually by addition of an oxidant such as ozone, hydrogen peroxide, or potassium permanganate. The groundwater is treated in-situ before it migrates off site.	Potentially effective for containment of COC in groundwater. Retained for further evaluation.
		Permeable Reactive Barrier	Containment by construction of a vertical treatment zone downgradient of the impacted area, which is used to chemically and biologically degrade the COCs, usually by the placement of a reactive material such as iron filings or activated carbon. This can also be combined with NAPL capture, biological and chemical in-situ treatment. The groundwater is treated in-situ before it migrates off site.	Potentially effective for containment of COC in groundwater. Retained for further evaluation.
		Hydraulic Containment	Containment by extracting groundwater by wells or trenches around the impacted area. Just enough groundwater is captured so that an inward hydraulic gradient is maintained and off-site migration does not occur. The captured groundwater is treated prior to discharge to surface water or the local sewage treatment system.	Potentially effective for containment of COC in groundwater. Retained for further evaluation.
In-Situ Treatment	Natural Attenuation	Monitored Natural Attenuation (MNA)	MNA refers to the reliance on natural treatment processes to achieve site-specific remedial objectives. The natural attenuation processes include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume, or concentration of COCs in soil or groundwater. These processes include biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of COCs.	Effective for meeting groundwater RAOs when mobility of COCs in source material is also addressed. Retained for further evaluation.
	Immobilization	In-Situ Solidification (ISS) using Auger Mixing method	Overlapping columns are augered as a grout/soil mixture to form a solid monolith of low permeability. Most effective to a depth of approximately 40 feet but constructable to a depth of approximately 50 feet.	Effective for meeting groundwater and soil-related RAOs. Retained for further evaluation.
		In-Situ Solidification (ISS) using Pressure Grouting method	High pressure jet grouting displaces soil to form a grout column. Overlapping grout columns form a solid monolith of low permeability. Constructable to a depth of approximately 40 feet.	Potentially effective for meeting groundwater and soil-related RAOs. Retained for further evaluation.
		In-Situ Solidification (ISS) using Excavator Bucket Mixing method	Bulk soil is mixed into a grout/soil mixture to form a solid monolith of low permeability. Constructable to a depth of approximately 20 feet (deeper if larger excavator with extended long reach boom is utilized).	Effective for meeting groundwater and soil-related RAOs. Retained for further evaluation.
	Chemical Treatment	In-Situ Chemical Oxidation (ISCO)	Treatment by a field of wells in the impacted area, which are used to chemically degrade the COCs, usually by addition of an oxidant such as ozone, hydrogen peroxide, or potassium permanganate.	Limited applicability due to technology uncertainty. Not retained.
	Biological Treatment	Enhanced In-Situ Bioremediation: Aerobic Biodegradation	Air sparging, oxygen injection and addition of oxygen releasing compounds (ORC).	Effective for meeting groundwater RAOs when mobility of COCs in source material is also addressed. Retained for further evaluation.

Table 6-3 (Cont'd.)
Initial Technology Screening for Groundwater
Elmira Water Street MGP Site

General Response Action	Remedial Technology Type	Technology Process Option	Description	Site-Specific Screening Evaluation
In-Situ Treatment (Cont'd.)	Biological Treatment (Cont'd.)	Enhanced In-Situ Bioremediation: Anaerobic Biodegradation	Addition of a carbon substrate or electron acceptor as a reducing agent to maintain anaerobic conditions.	Effective for meeting groundwater RAOs when mobility of COCs in source material is also addressed. Retained for further evaluation.
		Phytoremediation	Trees or other plants are placed to remove groundwater and immobilize or treat COCs.	Potentially effective. Retained for further evaluation.
	Air Sparging/Soil Vapor Extraction	Air Sparging/Soil Vapor Extraction	This technology is the injection of pressurized air into the subsurface below the water table to induce volatilization of dissolved phase COCs.	Effective for VOCs in groundwater and soil vapor. Not effective for SVOCs. Not retained.
Source Material Removal	Excavation (Refer to Table 6-2 for Treatment Technology Screening)	Excavation and Removal of Soil Containing Source Material	Removal of soil using a hydraulic excavator or other excavation equipment. For deeper excavations, it is likely that shoring and dewatering operations will be required as part of excavation.	Effective for meeting soil-related RAOs and for meeting groundwater-related RAOs over time. Retained for further evaluation.
Groundwater Removal	Groundwater Extraction and Treatment	Groundwater Pumping via Centralized Extraction Wells, with On-Site Treatment	Removal of groundwater by extracting groundwater from wells in the impacted area. The captured groundwater is treated prior to discharge to surface water or the POTW.	Limited effectiveness if soil containing source material is present around wells. Not retained.
	NAPL Recovery	Recovery Wells and Trenches	This technology involves the extraction of free-phase NAPL from wells or trenches. The NAPL accumulates in the well, and is then pumped into a holding tank prior to off-site disposal or recycling at an appropriate facility. Partially addresses source material and aids in meeting groundwater and soil-related RAOs. Effective at removing free-phase NAPL from the subsurface; and therefore reducing the COC flux into the groundwater. Pilot tests are typically required to determine recovery rates, NAPL recoverability, well or trench design, pumping and control equipment.	Based on the sampling performed during the RI, free-phase NAPL has not been identified at the site. Not retained.
	Enhance Recovery Technologies	Steam/Hot Water	Uses injected steam and/or hot water to heat subsurface soil and groundwater and enhance mobility to allow for more effective treatment or extraction. This technology is in the experimental phase. Substantial risk of uncontrolled migration of COCs.	Experimental technologies with a substantial risk for uncontrolled migration of COCs to off-site areas. High cost. Not retained.
		Electro-Thermal	Uses electrical current to heat subsurface soil and groundwater and enhance mobility to allow for more effective treatment or extraction. This technology is in the experimental phase. Substantial risk of uncontrolled migration of steam and COCs.	Experimental technologies with a substantial risk for uncontrolled migration of COCs to off-site areas. High cost. Not retained.
		Surfactants	Uses surfactant chemicals (soap formulations) injected in the subsurface to enhance mobility to allow for more effective treatment or extraction. This technology is in the experimental phase. Substantial risk of uncontrolled migration of COCs.	Experimental technologies with a substantial risk for uncontrolled migration of COCs to off-site areas. Not retained.
		Acoustic Vibrations	Uses sound to vibrate subsurface soil and groundwater and enhance mobility to allow for more effective treatment or extraction. This technology is in the experimental phase. Substantial risk of uncontrolled migration of COCs.	Experimental technologies with a substantial risk for uncontrolled migration of COCs to off-site areas. Not retained.

Table 6-3 (Cont'd.)
Initial Technology Screening for Groundwater
Elmira Water Street MGP Site

General Response Action	Remedial Technology Type	Technology Process Option	Description	Site-Specific Screening Evaluation
Treatment	Organic Treatment	Air Stripping	Air is used to volatilize VOCs in groundwater so that they can be removed, collected, and treated.	Potentially feasible for use in excavation water treatment at the site. Specific unit processes for treatment of organic COCs in groundwater will be evaluated during design. Generic organic water treatment is retained for further evaluation.
		Granular Activated Carbon	Treatment by adsorption of COCs on carbon.	Potentially feasible for use in excavation water treatment at the site. Specific unit processes for treatment of organic COCs in groundwater will be evaluated during design. Generic organic water treatment is retained for further evaluation.
		Oil/Water Separation	Removal of NAPL from extracted water using gravity separation.	Potentially feasible for use in excavation water treatment at the site. Specific unit processes for treatment of organic COCs in groundwater will be evaluated during design. Generic organic water treatment is retained for further evaluation.
	Inorganic Treatment	Chemical/UV Oxidation	Groundwater treatment using ion exchange resins that remove ionized inorganic COCs from water.	Potentially feasible for use in excavation water treatment at the site. Specific unit processes for treatment of inorganic COCs in groundwater will be evaluated during design. Generic inorganic water treatment is retained for further evaluation.
		Chemical Precipitation	Addition of coagulants to water to promote precipitation of inorganic COCs.	Potentially feasible for use in excavation water treatment at the site. Specific unit processes for treatment of inorganic COCs in groundwater will be evaluated during design. Generic inorganic water treatment is retained for further evaluation.
		Ion Exchange/Adsorption	Use of equipment to remove and treat COC in groundwater.	Potentially feasible for use in excavation water treatment at the site. Specific unit processes for treatment of inorganic COCs in groundwater will be evaluated during design. Generic inorganic water treatment is retained for further evaluation.
		Filtration	Use of a filter to remove COC absorbed to particulates.	Potentially feasible for use in excavation water treatment at the site. Specific unit processes for treatment of inorganic COCs in groundwater will be evaluated during design. Generic inorganic water treatment is retained for further evaluation.
		Peroxide Oxidation	Addition of hydrogen peroxide to water to treat inorganic COCs, particularly cyanide.	Potentially feasible for use in excavation water treatment at the site. Specific unit processes for treatment of inorganic COCs in groundwater will be evaluated during design. Generic inorganic water treatment is retained for further evaluation.

Table 6-4
Remedial Technology Evaluation for Surface Soil
Elmira Water Street MGP Site

General Response Action	Remedial Technology Type	Technology Process Option	Effectiveness	Implementability	Relative Cost	Site-Specific Applicability and Screening Evaluation
No Action	No Action	No Action	Not effective for achieving RAOs for surface soil in an acceptable timeframe.	Readily implemented.	No Cost	No Action is included for comparison purposes in accordance with NYSDEC DER-10. Retained for alternative development.
Institutional Controls/ Engineering Controls (IC/ECs)	Institutional Controls	Environmental Easement / Deed Restriction	Effective in preventing exposures to construction/utility workers and residents.	Readily implemented.	Low	NYSEG owns the site. Retained for alternative development.
		Site Management Plan	Effective in preventing exposures to construction/utility workers and residents.	Readily implemented.	Low	NYSEG owns the site. Retained for alternative development.
Containment	Surface Barriers	Soil Cover	Effective in preventing exposures for construction/utility workers and residents.	Technology proven and readily implemented.	Moderate	Retained for alternative development.
Removal	Excavation	Conventional Excavators	Effective at meeting surface soil RAOs.	Technology proven and readily implemented.	Moderate	Retained for alternative development.
Treatment and Disposal	Off-Site Disposal or Treatment	Landfill	Effective and widely used technologies.	Readily implemented.	Moderate	Retained for alternative development.
		Low-temperature Thermal Desorption	Effective and widely used technologies.	Readily implemented.	High	Retained for alternative development.
		Waste-to-Energy	Effective and widely used technologies.	Readily implemented.	High	Retained for alternative development.

Table 6-5
Remedial Technology Evaluation for Subsurface Soil
Elmira Water Street MGP Site

General Response Action	Remedial Technology Type	Technology Process Option	Effectiveness	Implementability	Relative Cost	Site-Specific Applicability and Screening Evaluation
No Action	No Action	No Action	Not effective for achieving RAOs for subsurface soil in an acceptable timeframe.	Readily implemented.	No Cost	No Action is included for comparison purposes in accordance with NYSDEC DER-10. Retained for alternative development.
Institutional Controls/ Engineering Controls (IC/ECs)	Institutional Controls	Environmental Easement/Deed Restriction	Effective in preventing exposures to construction/utility workers. Not effective in limiting subsurface migration of COCs, volume reduction, or treatment.	Readily implemented.	Low	Retained for alternative development.
	Engineering Controls	Temporary Fencing and Signage	Effective in preventing exposures for construction/utility workers. Not effective in limiting subsurface migration of COCs, volume reduction, or treatment.	Readily implemented.	Low	Retained for alternative development.
In-Situ Treatment	Immobilization	In-Situ Solidification (ISS): Auger Mixing, Excavator Bucket Mixing, and Pressure/Jet Grouting	The ISS monolith physically prevents exposures to impacted subsurface soils. Physically binds or encloses a COC mass and/or induces a chemical reaction between the stabilizing agent and the COCs to reduce their mobility within the subsurface and to decrease permeability of the mass so that groundwater does not contact the COCs. Pressure/Jet Grouting method may be less effective due to unpredictability in extent of ISS monolith.	Technology proven and implementable under some conditions.	High mobilization costs. Costs of ISS for saturated soils can be less than excavation/off-site disposal.	Auger mixing and excavator bucket mixing method retained for alternative development. Pressure/Jet grouting method not retained due to unpredictability in effective implementation.
Removal	Excavation	Conventional and Long-Stick Excavators/ Shored Excavation	Effective at meeting soil RAOs and addressing groundwater RAOs.	Technology is proven and readily implemented for accessible soils. Excavations deeper than the typical reach of an excavator, approximately 20 feet, would require additional equipment and more extensive dewatering and earth support structures.	High	Retained for alternative development.
Treatment and Disposal	Off-Site Treatment and Disposal	Landfill LTTD Waste-to-Energy	Effective and widely used technologies.	Readily implemented.	Moderate	All Retained for alternative development.

Table 6-6
Remedial Technology Evaluation for Groundwater
Elmira Water Street MGP Site

General Response Action	Remedial Technology Type	Technology Process Option	Effectiveness	Implementability	Relative Cost	Site-Specific Applicability and Screening Evaluation
No Action	No Action	No Action	Not effective for achieving RAOs for groundwater in an acceptable timeframe.	Readily implemented.	No Cost	No Action is included for comparison purposes in accordance with NYSDEC DER-10. Retained for alternative development.
Institutional Controls/ Engineering Controls (IC/ECs)	Institutional Controls	Environmental Easement/ Deed Restriction Local Groundwater Use Ordinance Site Management Plan	Effective in preventing exposures to construction/utility workers. Not effective in limiting subsurface migration of COCs, volume reduction, or treatment.	Readily implemented. NYSEG owns the site.	Low	Retained for alternative development. Restrictions on the use of groundwater will be required.
Containment	Surface Barriers	Soil Cover	Supports surface vegetation and can decrease infiltration of precipitation with site grading and draining.	Readily implemented.	Low	Not retained for alternative development. MGP COC - VOCs, SVOCs, or total cyanide COC exceedances not identified for site groundwater.
	Subsurface Vertical Barriers	Steel Sheet Piling	Effective for minimizing migration of NAPL and directing groundwater flow.	Technology proven and readily implemented.	Moderate	Not retained for alternative development. MGP COC - VOCs, SVOCs, or total cyanide COC exceedances not identified for site groundwater.
	Process Barriers	Biological Containment Chemical Containment Permeable Reactive Barrier Hydraulic Containment	Effective for limiting potential off-site migration of COCs in groundwater. Treats groundwater in-situ before it can migrate off site.	Implementable. This site has a low groundwater gradient and slow groundwater movement, enhancing implementability.	Moderate capital costs, High OM&M cost	Not retained for alternative development. MGP COC - VOCs, SVOCs, or total cyanide COC exceedances not identified for site groundwater.
In-Situ Treatment	Natural Attenuation	Monitored Natural Attenuation (MNA)	Effective over time for meeting groundwater RAOs once sources of groundwater impacts have been addressed. If sources cannot be fully addressed, MNA is effective in providing a decreasing trend of groundwater COCs.	Implementable.	Low capital costs, Moderate OM&M costs.	Not retained for alternative development. MGP COC - VOCs, SVOCs, or total cyanide COC exceedances not identified for site groundwater.
	Immobilization	In-Situ Solidification (ISS): Auger Mixing Excavator Bucket Mixing Pressure/Jet Grouting	Effective for meeting groundwater RAOs. Physically binds or encloses a COC mass and/or induces a chemical reaction between the stabilizing agent and the COCs to reduce their mobility within the subsurface and to decrease permeability of the mass so that groundwater does not contact the COCs. Pressure/Jet Grouting method may be less effective due to unpredictability in extent of ISS monolith.	Technology proven and implementable.	High mobilization costs. Costs of ISS for saturated soils can be less than excavation/off-site disposal.	Not retained for alternative development. MGP COC - VOCs, SVOCs, or total cyanide COC exceedances not identified for site groundwater..
	Biological Treatment	Enhanced In-Situ Groundwater Bioremediation: Aerobic and Anaerobic Biodegradation Phytoremediation	Effectiveness dependent upon contact through the groundwater column and therefore is less effective in less porous soils such as clays and silts, and more effective in sandy soils and sand lenses within alluvium. Long-term management and monitoring may be required to achieve groundwater RAOs. May be effective for moderate to low COC concentrations in soil and groundwater. Less effective if ongoing sources of groundwater impacts cannot be fully	Readily implementable. Technology is proven and is being implemented at MGP sites in New York State.	Moderate	Not retained for alternative development. MGP COC - VOCs, SVOCs, or total cyanide COC exceedances not identified for site groundwater.

Table 6-6 (Cont'd.)
Remedial Technology Evaluation for Groundwater
Elmira Water Street MGP Site

General Response Action	Remedial Technology Type	Technology Process Option	Effectiveness	Implementability	Relative Cost	Site-Specific Applicability and Screening Evaluation
			addressed.			
Source Material Removal	Excavation (Refer to Table 6-5 for Treatment Technology Evaluation)	Excavation and removal of soil containing source material or COCs.	Effective at meeting soil RAOs and addressing groundwater RAOs through the removal of source material.	Technology is proven and readily implemented for accessible soils. Excavations deeper than the typical reach of an excavator, approximately 20 feet, would require additional equipment and more extensive dewatering and earth support structures.	Moderate	Not retained for alternative development. MGP COC - VOCs, SVOCs, or total cyanide COC exceedances not identified for site groundwater.
Treatment	Organic Treatment	Air Stripping Granular Activated Carbon Oil/Water Separation	The technology would be effective at meeting the RAOs for prevention of exposure to COCs in groundwater. Processes would potentially be used as part of a treatment train to treat groundwater removed from excavation areas. Has potential to be used as part of a treatment system to meet the RAOs.	The technology is implementable.	Moderate capital costs, Moderate to High OM&M costs	Retained for treatment of groundwater removed during on-site excavation.
	Inorganic Treatment	Chemical/UV Oxidation Chemical Precipitation Ion Exchange/Adsorption Filtration Peroxide Oxidation	The technology would be effective at meeting the RAOs for prevention of exposure to COCs in groundwater. Processes would potentially be used as part of a treatment train to treat groundwater removed from excavation areas. Has potential to be used as part of a treatment system to meet the RAOs.	The technology is implementable.	Moderate capital costs, Moderate to High OM&M costs	Retained for treatment of groundwater removed during on-site excavation.

Table 7-1
Media, RAOs – Addressed by Alternatives
Elmira Water Street MGP Site

SMP = Site Management Plan COC = Constituent of Concern IC/ECs = Institutional Controls / Engineering Controls RAO = Remedial Action Objective SCO = Soil Cleanup Objective		**Alternative 1 – No Action**	**Alternative 2 – Isolation**	**Alternative 3 – ISS** **ISS of the Gas Holder Foundation Contents and Deeper MGP-Impacted Soil Below the Gas Holder Foundation Floor**	**Alternative 4 – Removal** **Removal of the Gas Holder Foundation Contents, the Foundation, and MGP-Impacted Soil Beneath the Gas Holder Foundation Floor**	**Alternative 5 – Removal** **Soil Removal to Unrestricted Use SCOs**
		--No Action	--Soil cover --IC/ECs	-- Pre-Design Investigation (PDI), including an evaluation of the need to protect NYSDEC and City of Elmira Flood Control Easement area features --Protection / relocation of utilities adjacent to AOC 1 at East Water Street and on the site (if needed) --Support of the Gas Holder foundation (if needed) --Removal of fill/soil from the Gas Holder foundation to account for ISS swell --ISS of fill and soil in the Gas Holder foundation, and soil below the foundation floor --Pavement restoration in the ISS area to maintain existing pavement cover --Removal and restoration of surface soil to establish a 1-foot minimum soil cover in identified areas outside of AOC 1 to be consistent with Commercial Use SCOs, including the installation of a demarcation layer --Post-remedial monitoring of groundwater for a period of 5 years, followed by a re-evaluation of the need for any continued monitoring --IC/ECs implemented by an SMP (site and groundwater use restrictions, and an environmental easement) --Periodic Certification of IC/ECs in accordance with Part 375-1.8(h)(3)	--Pre-Design Investigation (PDI), including an evaluation of the need to protect NYSDEC and City of Elmira Flood Control Easement area features --Protection / relocation of utilities adjacent to AOC 1 at East Water Street and on the site (if needed) --Installation of excavation support around the Gas Holder foundation -- Removal of the fill and soil in the Gas Holder foundation; removal of the Gas Holder foundation, including the fill/soil materials between the engineering support and the Holder; and removal of soil below the foundation floor --Re-paving of the excavation area to maintain existing pavement cover --Removal and restoration of surface soil to establish a 1-foot minimum soil cover in identified areas outside of AOC 1 to be consistent with Commercial Use SCOs, including the installation of a demarcation layer --Post-remedial monitoring of groundwater for a period of 5 years, followed by a re-evaluation of the need for any continued monitoring --IC/ECs implemented by an SMP (site and groundwater use restrictions, and an environmental easement) --Periodic Certification of IC/ECs in accordance with Part 375-1.8(h)(3)	--Relocation / protection of utilities adjacent to AOC 1 at East Water Street and on the site --Installation of excavation support --Removal of MGP-impacted soil to allow for Unrestricted site use --Backfill and restoration of the excavation area
Applicable Medium	**RAOs**					
Surface Soil	--Prevent ingestion / direct contact with soil containing COC levels exceeding the applicable SCOs. --Prevent inhalation of or exposure to COCs in surface soil. --Prevent migration of COCs that would result in groundwater or surface water impacts. --Prevent impacts to biota from ingestion/direct contact with soil causing toxicity.	Not addressed outside of parking lot.	Addressed by soil cover, pavement cover, and SMP.	Addressed by soil cover and SMP.	Addressed by soil cover and SMP.	Addressed by soil removal.

Table 7-1
Media, RAOs – Addressed by Alternatives
Elmira Water Street MGP Site FS

SMP = Site Management Plan COC = Constituent of Concern IC/ECs = Institutional Controls / Engineering Controls RAO = Remedial Action Objective SCO = Soil Cleanup Objective		**Alternative 1 – No Action**	**Alternative 2 – Isolation**	**Alternative 3 – ISS** **ISS of the Gas Holder Foundation Contents and Deeper MGP-Impacted Soil Below the Gas Holder Foundation Floor**	**Alternative 4 – Removal** **Removal of the Gas Holder Foundation Contents, the Foundation, and MGP-Impacted Soil Beneath the Gas Holder Foundation Floor**	**Alternative 5 – Removal** **Soil Removal to Unrestricted Use SCOs**
Applicable Medium	**RAOs**					
Subsurface Soil	--Prevent ingestion/direct contact with soil containing COC levels exceeding the applicable SCOs. --Prevent inhalation of, or exposure to, COCs in subsurface soil. --Prevent migration of COCs that would result in groundwater or surface water impacts. --Prevent impacts to biota from ingestion/ direct contact with soil causing toxicity.	Not addressed.	Partially addressed by soil cover, pavement cover, and SMP.	Addressed by ISS, soil cover, and SMP.	Addressed by soil excavation, soil cover, and SMP.	Addressed by soil removal.
Groundwater	--Prevent ingestion of groundwater with COC levels exceeding drinking water standards. --Prevent contact with, or inhalation of, volatiles from impacted groundwater. --Prevent discharge of COCs to surface water. --Remove the source of groundwater impacts to the extent practicable. --Restore groundwater aquifer to ambient groundwater quality criteria, to the extent practicable.	Site groundwater is not impacted. VOC, SVOC or Total Cyanide exceedances not identified.	Site groundwater is not impacted. VOC, SVOC or Total Cyanide exceedances not identified.	Site groundwater is not impacted. VOC, SVOC or Total Cyanide exceedances not identified.	Site groundwater is not impacted. VOC, SVOC or Total Cyanide exceedances not identified.	Site groundwater is not impacted. VOC, SVOC or Total Cyanide exceedances not identified.
Soil Vapor	--Prevent the migration of COC in soil vapor to occupied areas with buildings.	Not Applicable. There are no buildings at the site.	Not Applicable. There are no buildings at the site.	Not Applicable. There are no buildings at the site.	Not Applicable. There are no buildings at the site.	Not Applicable. There are no buildings at the site.

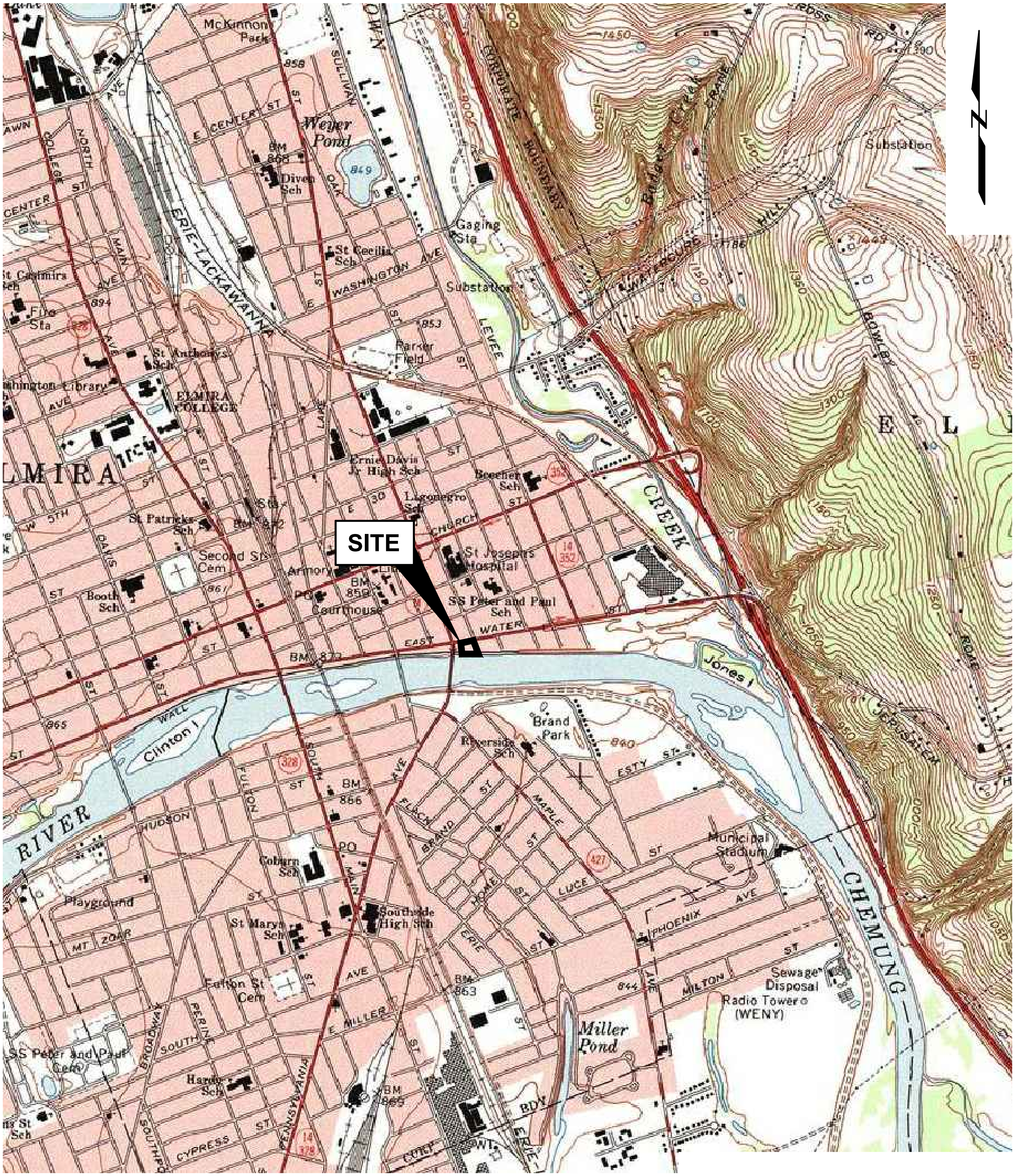
Table 7-2
Comparative Ranking of Alternatives
Elmira Water Street MGP Site FS

Alternative	Description	Threshold Criteria		Balancing Criteria						
		Overall Protection of Human Health and the Environment	Compliance with SCGs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, & Volume Through Treatment	Short-Term Effectiveness	Implementability	Total Cost (FS accuracy +50% to - 30%)	Cost Effectiveness	Land Use
1	No Action	Not Protective	Not Compliant	5th	5th	1st	1st	No Cost	No Cost	5th
2	Soil Cover and IC/ECs	4th	4th	4th	4th	2nd	2nd	$530,000	3rd	4th
3	PDI, Excavate for Swell, ISS Gas Holder Contents, ISS Soil Below the Gas Holder Floor, Pavement cover for AOC 1, Soil Removal and Cover for Identified Adjacent Areas Outside of AOC 1, and IC/ECs	3rd	3rd	3rd	3rd	4th	4th	$1,490,000	2nd	3rd
4	PDI, Temporary Support Structure, Excavation of Gas Holder Contents and Foundation, Excavation of Deeper MGP-impacted Soil, Backfill and Paving, Removal and Cover of Soil Outside of AOC 1, IC/ECs	2nd	2nd	2nd	2nd	3rd	3rd	$3,220,000	1st	2nd
5	PDI, Engineering Controls, Excavation of Soil with Impacts that May be Attributed to the MGP, Backfill, Paving and Restoration	1st	1st	1st	1st	5th	5th	$6,420,000	4th	1st

Comparative Ranking:

1st - Ranked First, Best
2nd - Ranked Second
3rd - Ranked Third
4th - Ranked Fourth
5th - Ranked Fifth, Last
Duplicate ranks indicate equivalent ranking.

Figures



SOURCE:
U.S.G.S. TOPOGRAPHIC MAP ELMIRA, NY 1969, CREATED WITH TOPO!
® ©2001 NATIONAL GEOGRAPHIC (www.nationalgeographic.com/topo)

0 2000' 4000'
SCALE: 1" = 2000'

Feasibility Study Report Elmira Water Street MGP Site Elmira, New York	GEI	SITE LOCATION MAP
NYSEG Binghamton, New York	Project 116120	November 2015 Fig. 1

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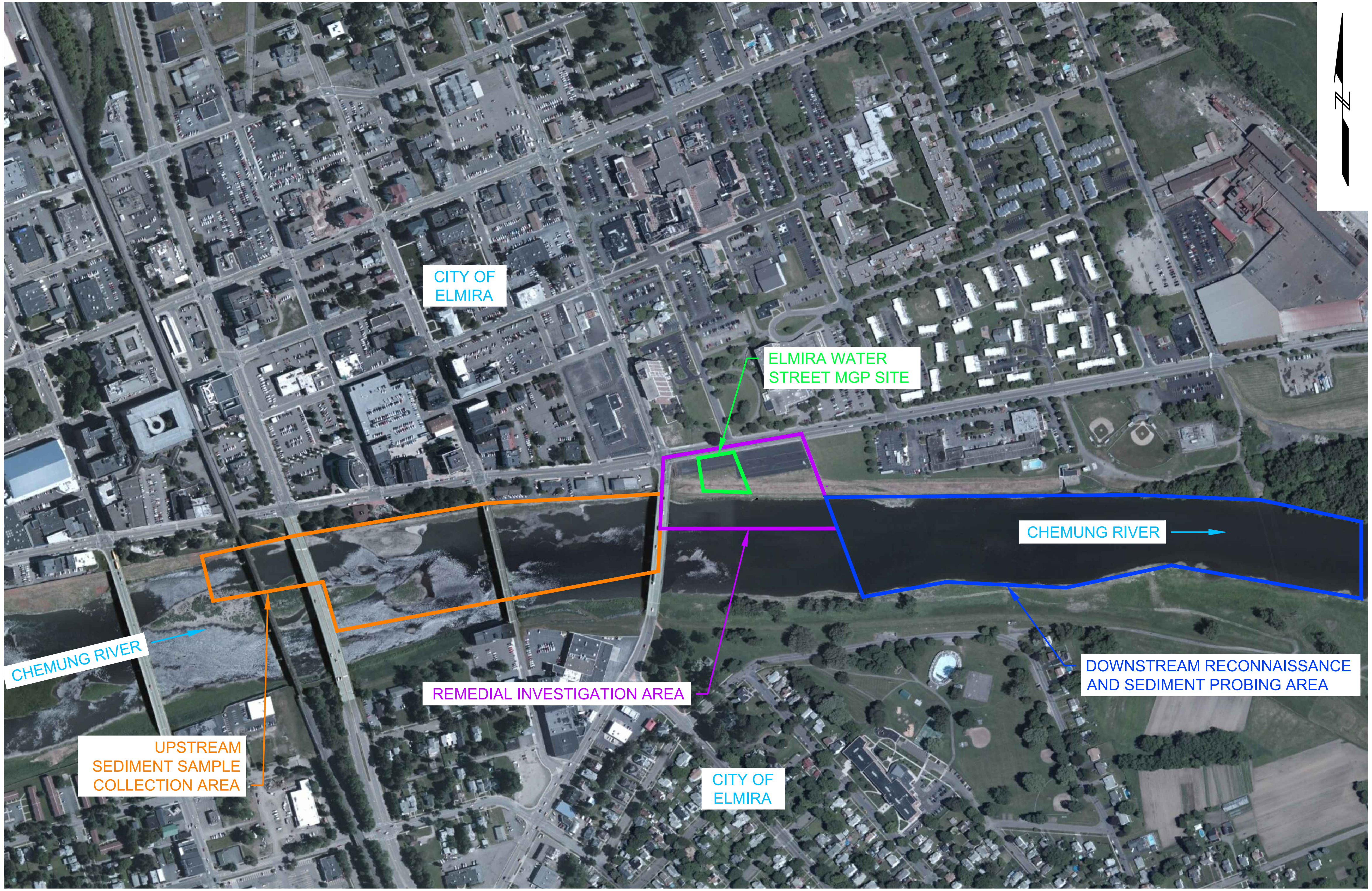

LEGEND

- REMEDIAL INVESTIGATION AREA
- UPSTREAM SEDIMENT SAMPLE COLLECTION AREA
- ELMIRA WATER STREET MGP SITE
- DOWNSTREAM RECONNAISSANCE AND SEDIMENT PROBING AREA

SOURCES

1. 2010 AERIAL PHOTOGRAPH FROM NEW YORK STATE ORTHOS ONLINE, (http://www.orthos.dhses.ny.gov/).
2. 5/30/13 KEYSTONE ASSOCIATES PLS, SURVEY.

0 500' 1000'

SCALE: 1" = 500'

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ELMIRA WATER STREET MGP SITE LOCATION AND INVESTIGATION AREAS

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Fig. 2

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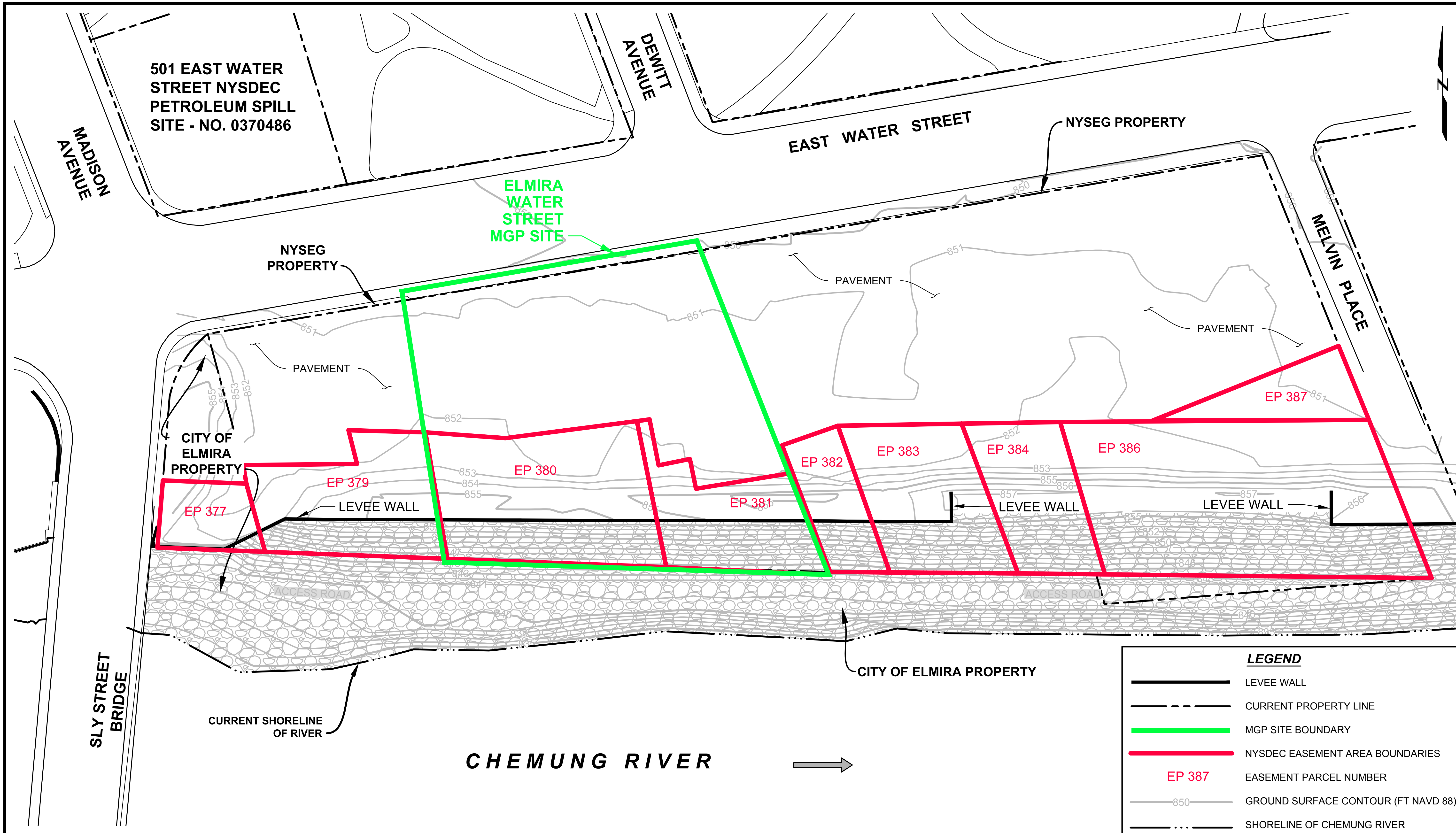

SOURCES:

1. 5/30/13 KEYSTONE ASSOCIATES PLS, SURVEY.
2. NYSDEC/USACE ELMIRA FLOOD PROTECTION PROJECT FIGURE C-1851 - FINAL PROJECT MAP, DATED 4/26/57.

Feasibility Study Report Elmira Water Street MGP Site Elmira, New York	GEI Consultants	CURRENT FEATURES AND NYSDEC FLOOD CONTROL EASEMENT AREAS
NYSEG Binghamton, New York	Project 116120	November 2015 Fig. 3

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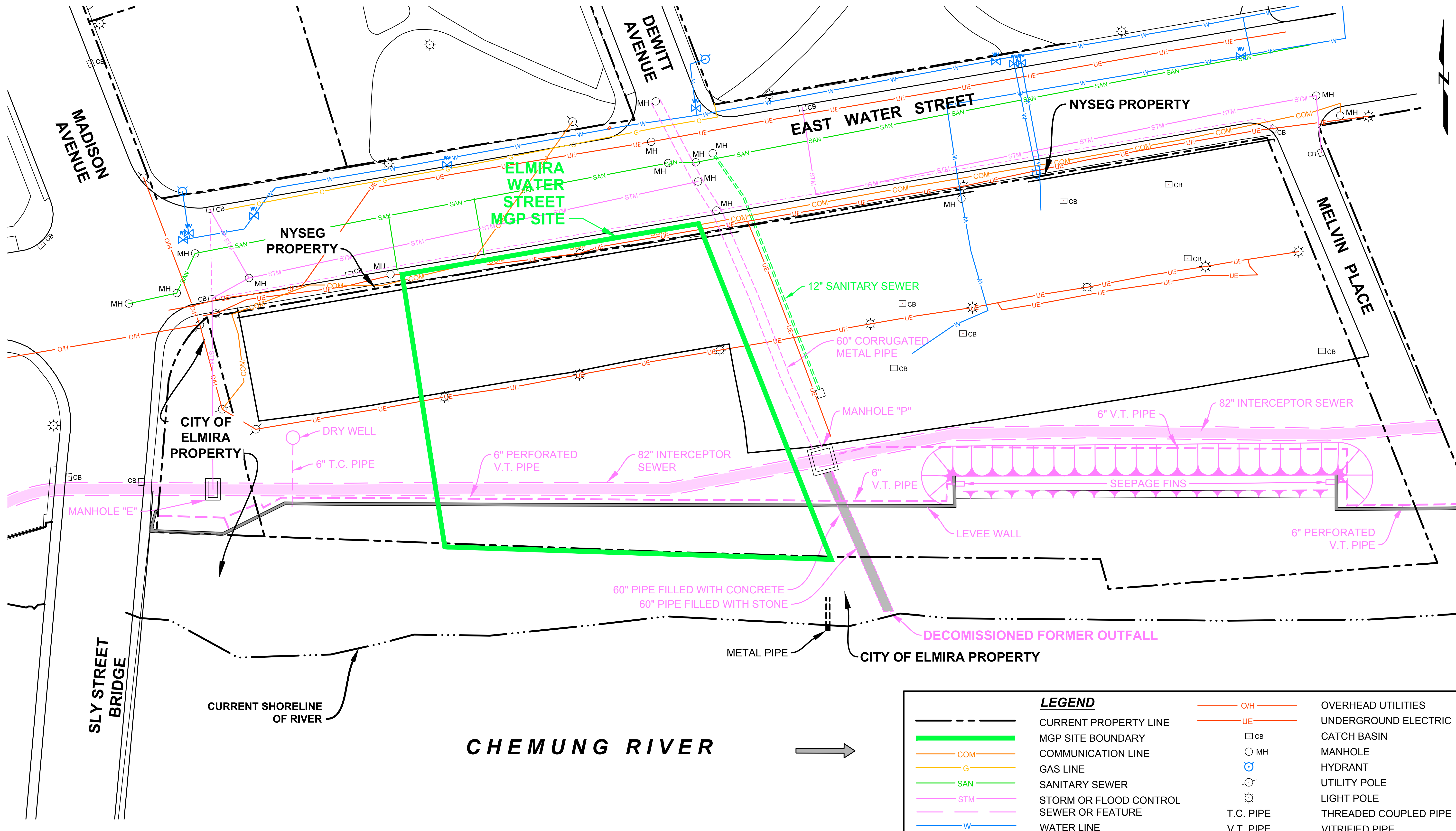

SOURCES:

1. 5/30/13 KEYSTONE ASSOCIATES PLS, SURVEY.
2. *ELMIRA, NY SECTION NO. 2, CHEMUNG RIVER, LEFT BANK, PLAN AND PROFILE,* PREPARED BY: ARMY CORPS OF ENGINEERS, 1" = 50', DATE: 1/10/1944.

0 50' 100'

SCALE: 1" = 50'

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CURRENT FEATURES AND UTILITIES

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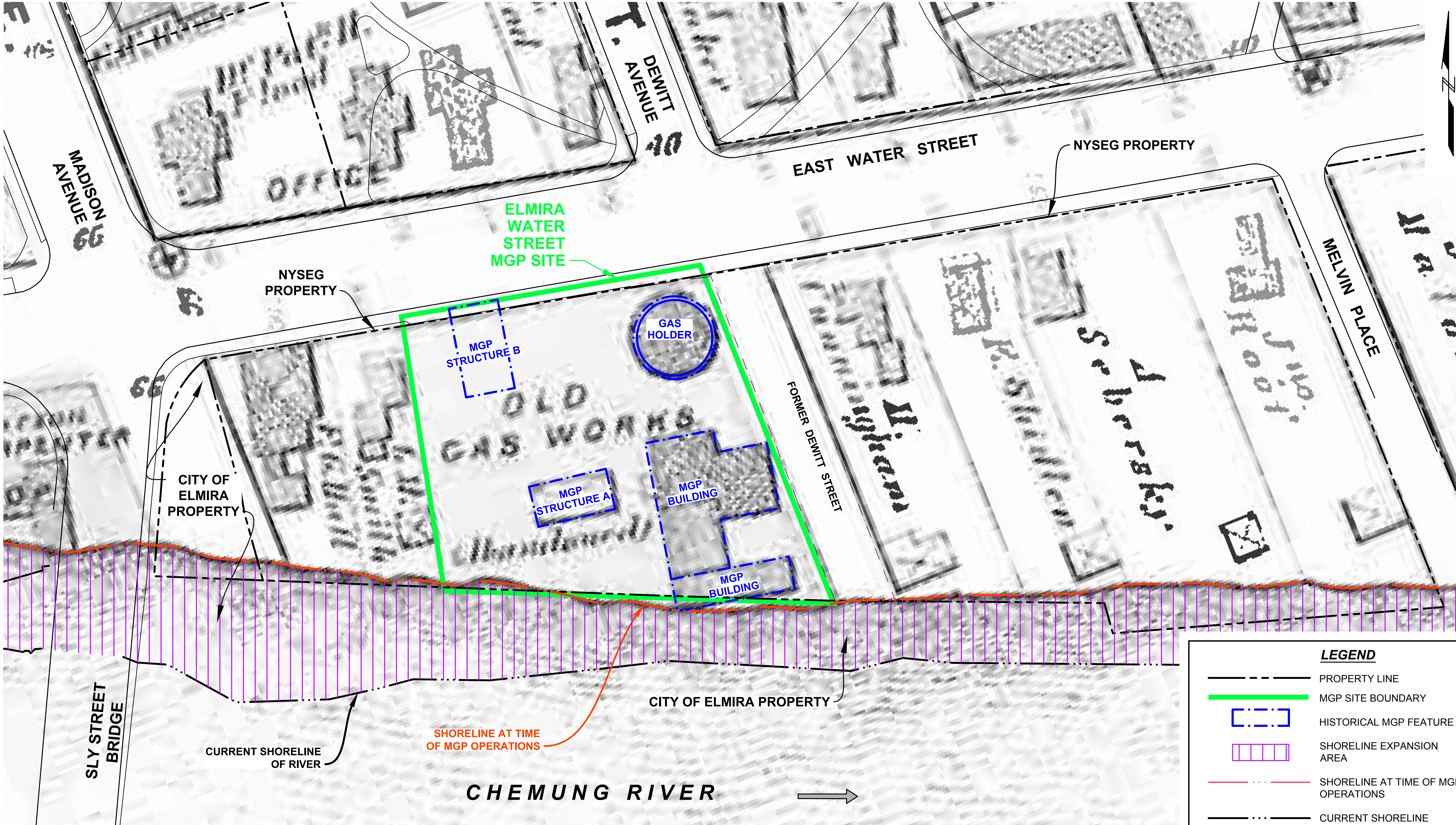

SOURCES

1. 1876 HISTORICAL ATLAS MAP.
2. 5/30/13 KEYSTONE ASSOCIATES PLS, SURVEY.

0 50' 100'
SCALE: 1" = 50'

Feasibility Study Report Elmira Water Street MGP Site Elmira, New York	GEI Consultants	CURRENT AND HISTORICAL MGP FEATURES
NYSEG Binghamton, New York	Project 116120	November 2015 Fig. 5

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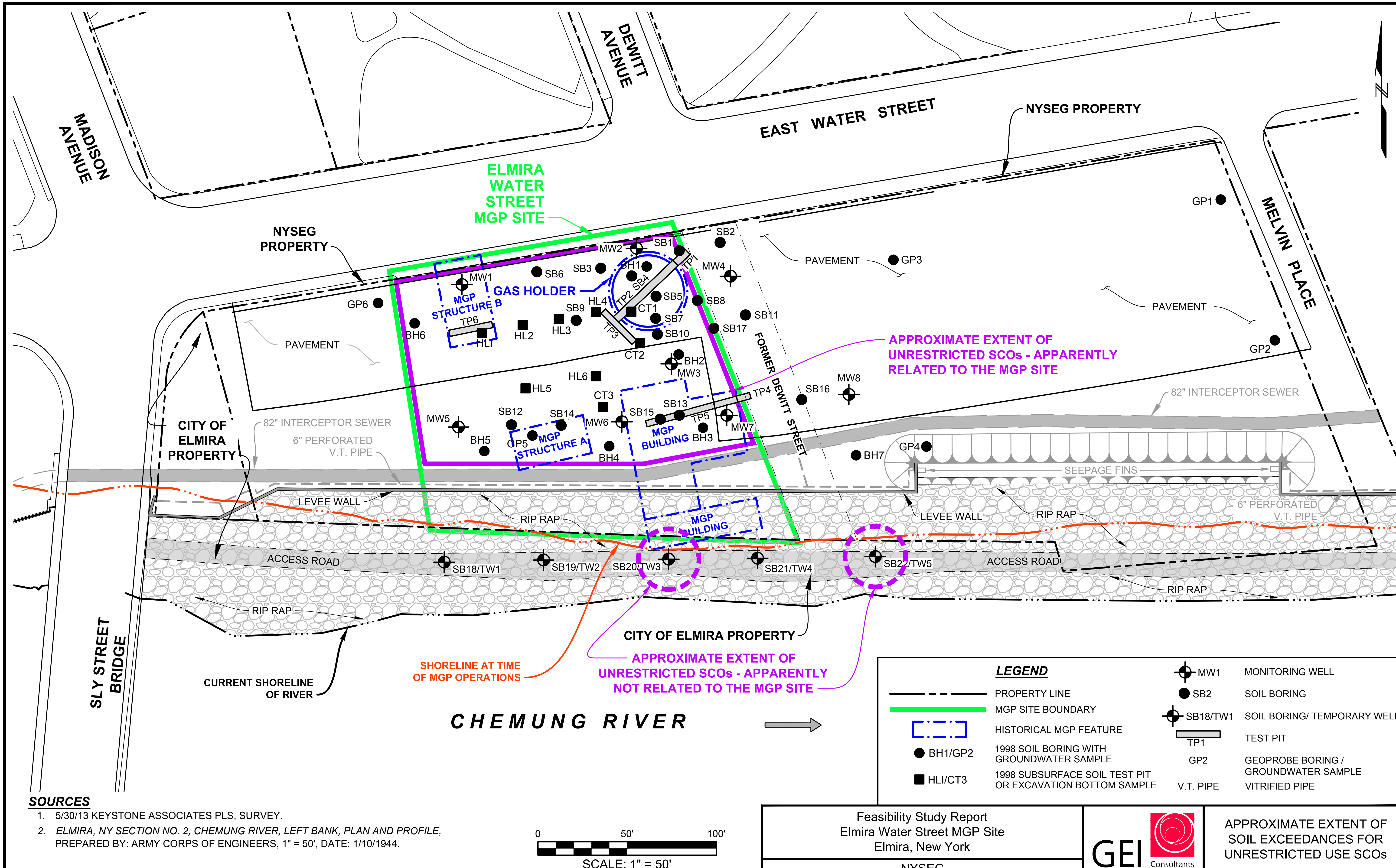

SOURCES

1. 5/30/13 KEYSTONE ASSOCIATES PLS, SURVEY.
2. *ELMIRA, NY SECTION NO. 2, CHEMUNG RIVER, LEFT BANK, PLAN AND PROFILE,* PREPARED BY: ARMY CORPS OF ENGINEERS, 1" = 50', DATE: 1/10/1944.

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APPROXIMATE EXTENT OF SOIL EXCEEDANCES FOR UNRESTRICTED USE SCOs

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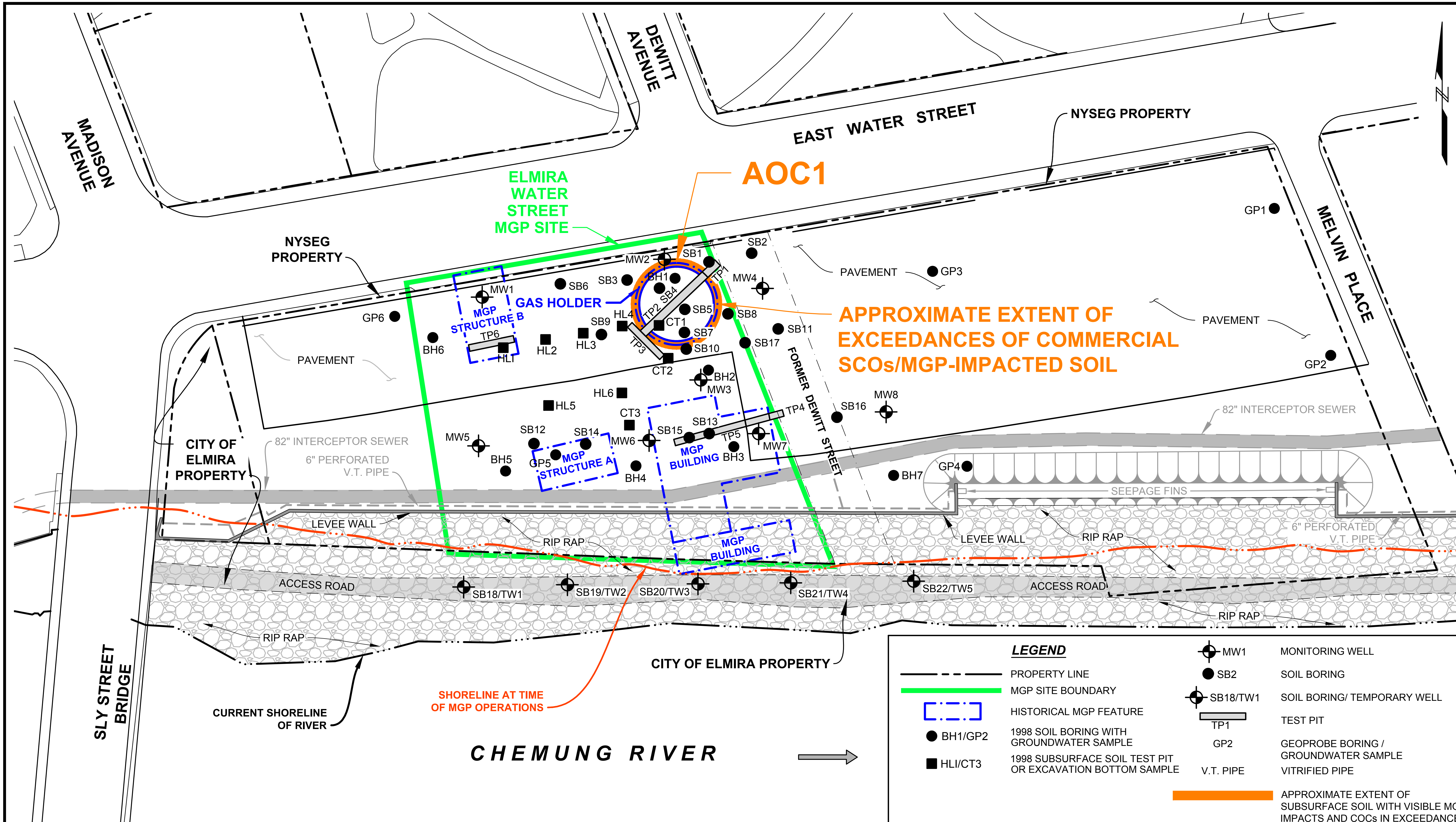

SOURCES

1. 5/30/13 KEYSTONE ASSOCIATES PLS, SURVEY.
2. *ELMIRA, NY SECTION NO. 2, CHEMUNG RIVER, LEFT BANK, PLAN AND PROFILE,* PREPARED BY: ARMY CORPS OF ENGINEERS, 1" = 50', DATE: 1/10/1944.

0 50' 100'
SCALE: 1" = 50'

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APPROXIMATE EXTENT OF COMMERCIAL SCO EXCEEDANCES AND VISIBLE MGP-IMPACTED SOIL

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Fig. 7

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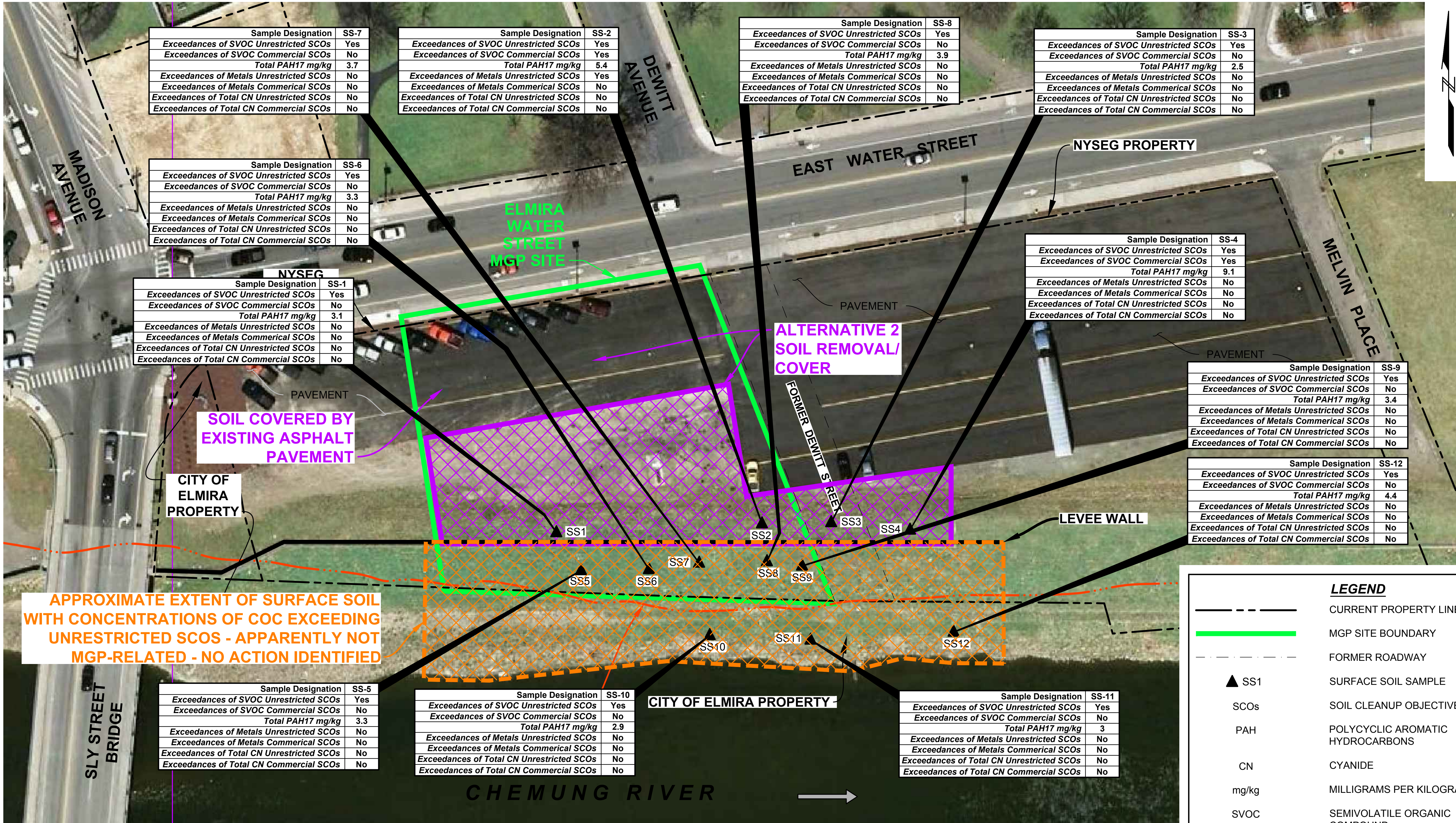

Sample Designation	SS-7
Exceedances of SVOC Unrestricted SCOs	Yes
Exceedances of SVOC Commercial SCOs	No
Total PAH17 mg/kg	3.7
Exceedances of Metals Unrestricted SCOs	No
Exceedances of Metals Commercial SCOs	No
Exceedances of Total CN Unrestricted SCOs	No
Exceedances of Total CN Commercial SCOs	No

Sample Designation	SS-2
Exceedances of SVOC Unrestricted SCOs	Yes
Exceedances of SVOC Commercial SCOs	Yes
Total PAH17 mg/kg	5.4
Exceedances of Metals Unrestricted SCOs	Yes
Exceedances of Metals Commercial SCOs	No
Exceedances of Total CN Unrestricted SCOs	No
Exceedances of Total CN Commercial SCOs	No

Sample Designation	SS-8
Exceedances of SVOC Unrestricted SCOs	Yes
Exceedances of SVOC Commercial SCOs	No
Total PAH17 mg/kg	3.9
Exceedances of Metals Unrestricted SCOs	No
Exceedances of Metals Commercial SCOs	No
Exceedances of Total CN Unrestricted SCOs	No
Exceedances of Total CN Commercial SCOs	No

Sample Designation	SS-3
Exceedances of SVOC Unrestricted SCOs	Yes
Exceedances of SVOC Commercial SCOs	No
Total PAH17 mg/kg	2.5
Exceedances of Metals Unrestricted SCOs	No
Exceedances of Metals Commercial SCOs	No
Exceedances of Total CN Unrestricted SCOs	No
Exceedances of Total CN Commercial SCOs	No

Sample Designation	SS-6
Exceedances of SVOC Unrestricted SCOs	Yes
Exceedances of SVOC Commercial SCOs	No
Total PAH17 mg/kg	3.3
Exceedances of Metals Unrestricted SCOs	No
Exceedances of Metals Commercial SCOs	No
Exceedances of Total CN Unrestricted SCOs	No
Exceedances of Total CN Commercial SCOs	No

Sample Designation	SS-1
Exceedances of SVOC Unrestricted SCOs	Yes
Exceedances of SVOC Commercial SCOs	No
Total PAH17 mg/kg	3.1
Exceedances of Metals Unrestricted SCOs	No
Exceedances of Metals Commercial SCOs	No
Exceedances of Total CN Unrestricted SCOs	No
Exceedances of Total CN Commercial SCOs	No

Sample Designation	SS-4
Exceedances of SVOC Unrestricted SCOs	Yes
Exceedances of SVOC Commercial SCOs	Yes
Total PAH17 mg/kg	9.1
Exceedances of Metals Unrestricted SCOs	No
Exceedances of Metals Commercial SCOs	No
Exceedances of Total CN Unrestricted SCOs	No
Exceedances of Total CN Commercial SCOs	No

Sample Designation	SS-9
Exceedances of SVOC Unrestricted SCOs	Yes
Exceedances of SVOC Commercial SCOs	No
Total PAH17 mg/kg	3.4
Exceedances of Metals Unrestricted SCOs	No
Exceedances of Metals Commercial SCOs	No
Exceedances of Total CN Unrestricted SCOs	No
Exceedances of Total CN Commercial SCOs	No

Sample Designation	SS-12
Exceedances of SVOC Unrestricted SCOs	Yes
Exceedances of SVOC Commercial SCOs	No
Total PAH17 mg/kg	4.4
Exceedances of Metals Unrestricted SCOs	No
Exceedances of Metals Commercial SCOs	No
Exceedances of Total CN Unrestricted SCOs	No
Exceedances of Total CN Commercial SCOs	No

Sample Designation	SS-5
Exceedances of SVOC Unrestricted SCOs	Yes
Exceedances of SVOC Commercial SCOs	No
Total PAH17 mg/kg	3.3
Exceedances of Metals Unrestricted SCOs	No
Exceedances of Metals Commercial SCOs	No
Exceedances of Total CN Unrestricted SCOs	No
Exceedances of Total CN Commercial SCOs	No

Sample Designation	SS-10
Exceedances of SVOC Unrestricted SCOs	Yes
Exceedances of SVOC Commercial SCOs	No
Total PAH17 mg/kg	2.9
Exceedances of Metals Unrestricted SCOs	No
Exceedances of Metals Commercial SCOs	No
Exceedances of Total CN Unrestricted SCOs	No
Exceedances of Total CN Commercial SCOs	No

Sample Designation	SS-11
Exceedances of SVOC Unrestricted SCOs	Yes
Exceedances of SVOC Commercial SCOs	No
Total PAH17 mg/kg	3
Exceedances of Metals Unrestricted SCOs	No
Exceedances of Metals Commercial SCOs	No
Exceedances of Total CN Unrestricted SCOs	No
Exceedances of Total CN Commercial SCOs	No

LEGEND

(line)	CURRENT PROPERTY LINE
(line)	MGP SITE BOUNDARY
(line)	FORMER ROADWAY
▲ SS1	SURFACE SOIL SAMPLE
SCOs	SOIL CLEANUP OBJECTIVES
PAH	POLYCYCLIC AROMATIC HYDROCARBONS
CN	CYANIDE
mg/kg	MILLIGRAMS PER KILOGRAM
SVOC	SEMIVOLATILE ORGANIC COMPOUND

SOURCES

1. AERIAL PHOTOGRAPH FROM GOOGLE-IMAGERY COPYRIGHT 2011 GEOEYE, NEW YORK GIS.
4. 5/30/13 KEYSTONE ASSOCIATES PLS, SURVEY.

0 50' 100'

SCALE: 1" = 50'

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ALTERNATIVE 2: SOIL REMOVAL/COVER ICs/ECs

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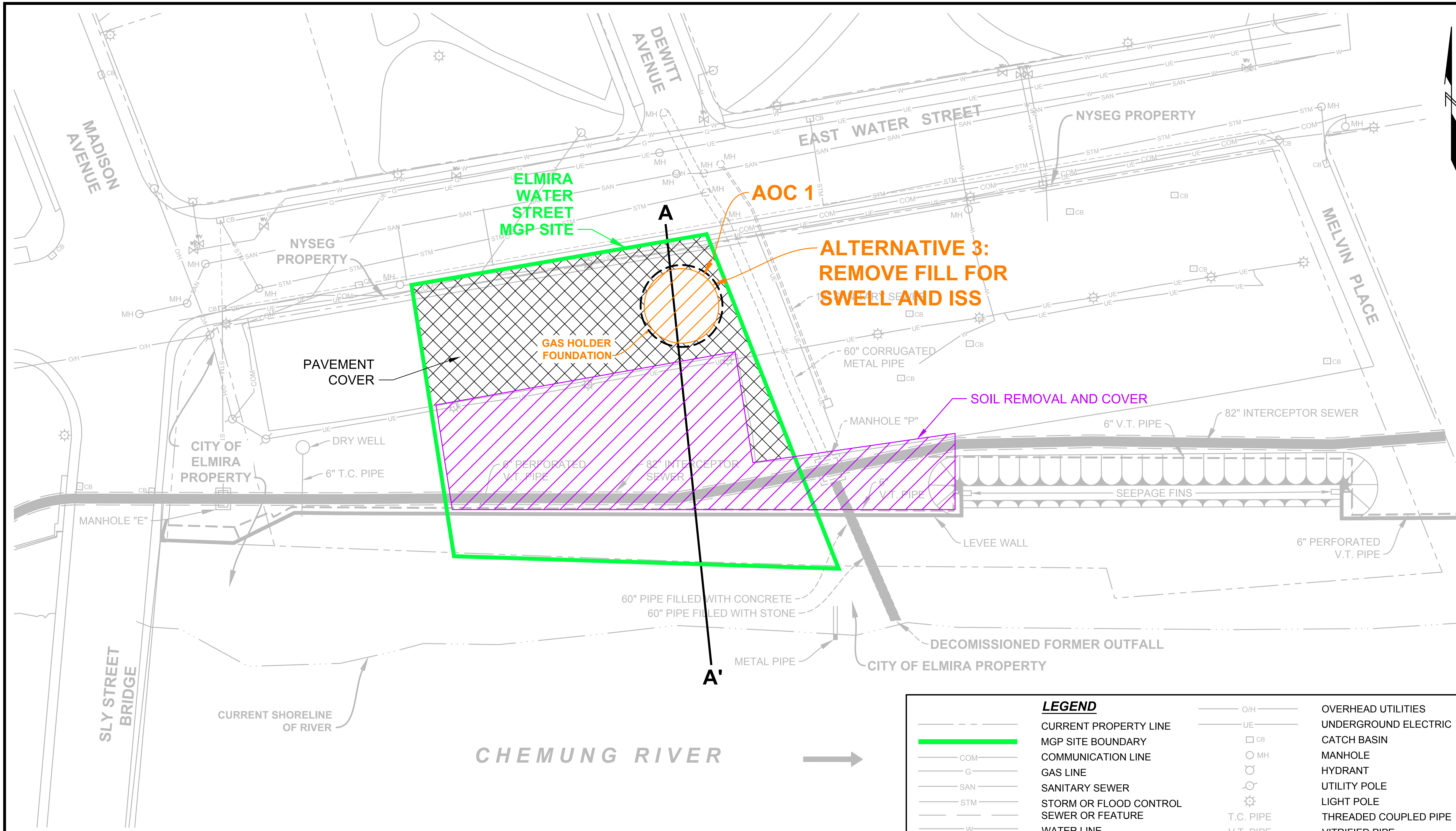

SOURCES:

1. 5/30/13 KEYSTONE ASSOCIATES PLS, SURVEY.
2. *ELMIRA, NY SECTION NO. 2, CHEMUNG RIVER, LEFT BANK, PLAN AND PROFILE,* PREPARED BY: ARMY CORPS OF ENGINEERS, 1" = 50', DATE: 1/10/1944.

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Elmira, New York

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ALTERNATIVE 3:
AOC 1 - ALTERNATIVE 3 ISS;
SOIL REMOVAL/COVER; ICs/ECs

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Fig. 9

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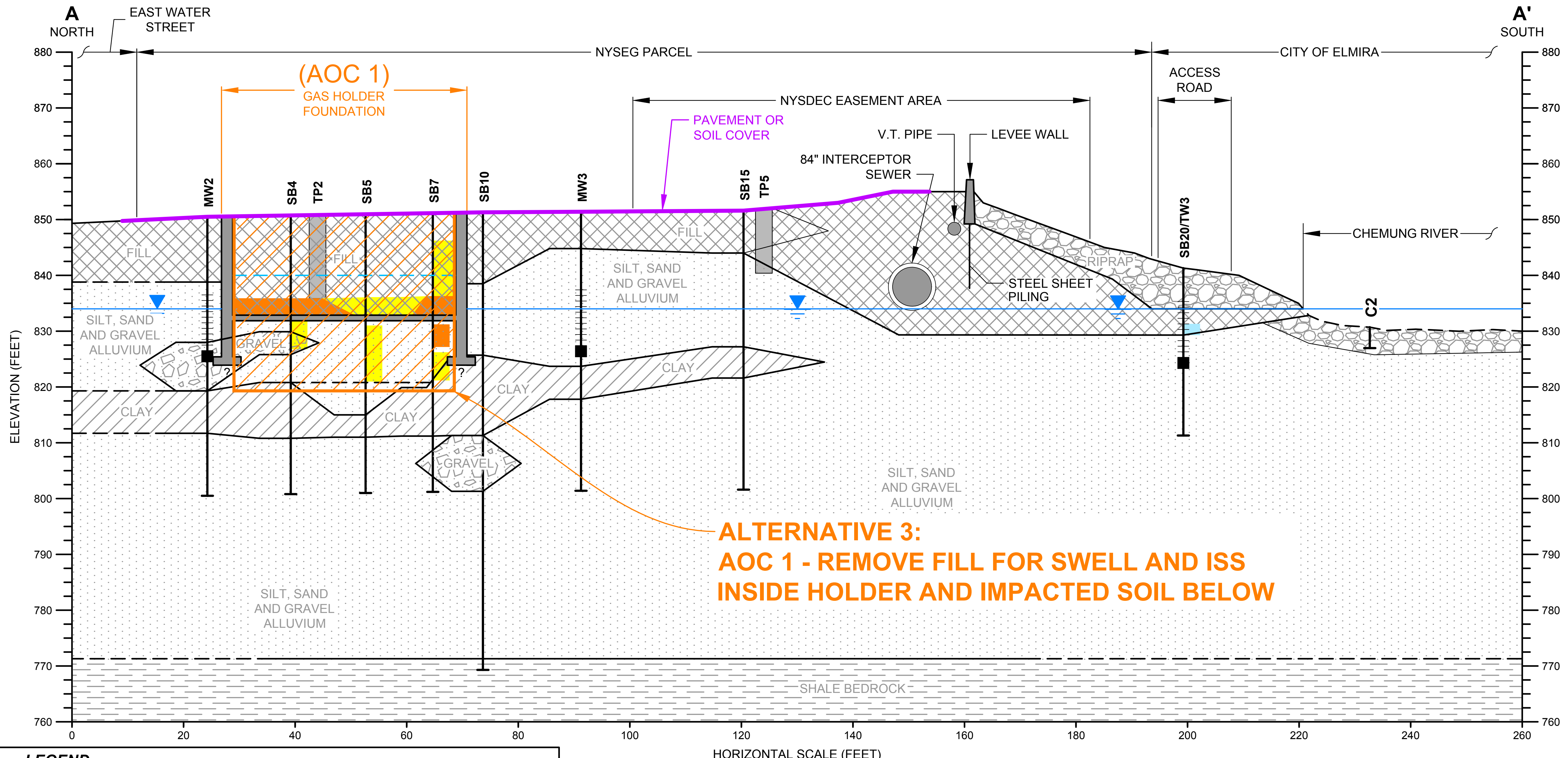

LEGEND

WATER LEVEL IN GAS HOLDER FOUNDATION	
GROUNDWATER TABLE (JUNE 18, 2013)	
CONTACT	
INFERRED CONTACT	
MW1	SOIL BORING/WELL IDENTIFICATION
	SCREEN INTERVAL
	DNAPL SUMP
	BOTTOM OF BORING
GP2	GEOPROBE BORING / GROUNDWATER SAMPLE
V.T. PIPE	VITRIFIED PIPE
TP2	TEST PIT
	FILL
	SILT, SAND AND GRAVEL ALLUVIUM
	CLAY
	GRAVEL
	SHALE BEDROCK
	HYDROCARBON STAIN OR ODOR
	BLEBS, GLOBS OR SHEEN
	PETROLEUM IMPACTS STAINING AND ODOR

HORIZONTAL SCALE: 1" = 20'
0 20' 40'
VERTICAL SCALE: 20'
NOTE: 1x VERTICAL EXAGGERATION

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ALTERNATIVE 3:
CROSS SECTION A-A'

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Fig. 10

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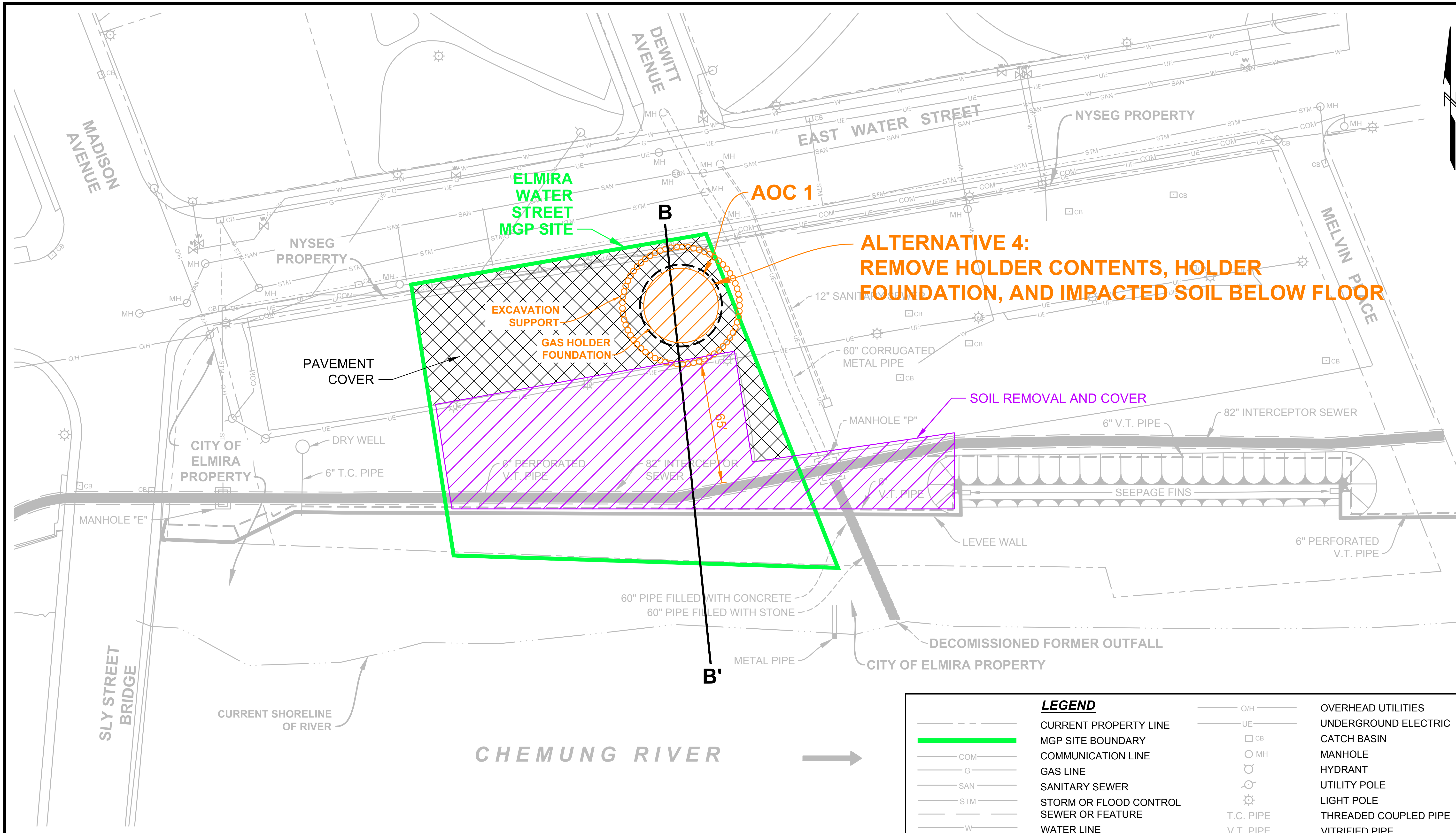

SOURCES:

1. 5/30/13 KEYSTONE ASSOCIATES PLS, SURVEY.
2. *ELMIRA, NY SECTION NO. 2, CHEMUNG RIVER, LEFT BANK, PLAN AND PROFILE,* PREPARED BY: ARMY CORPS OF ENGINEERS, 1" = 50', DATE: 1/10/1944.

0 50' 100'
SCALE: 1" = 50'

Feasibility Study Report Elmira Water Street MGP Site Elmira, New York	GEI Consultants	ALTERNATIVE 4: AOC 1 - EXCAVATION
NYSEG Binghamton, New York	Project 116120	November 2015 Fig. 11

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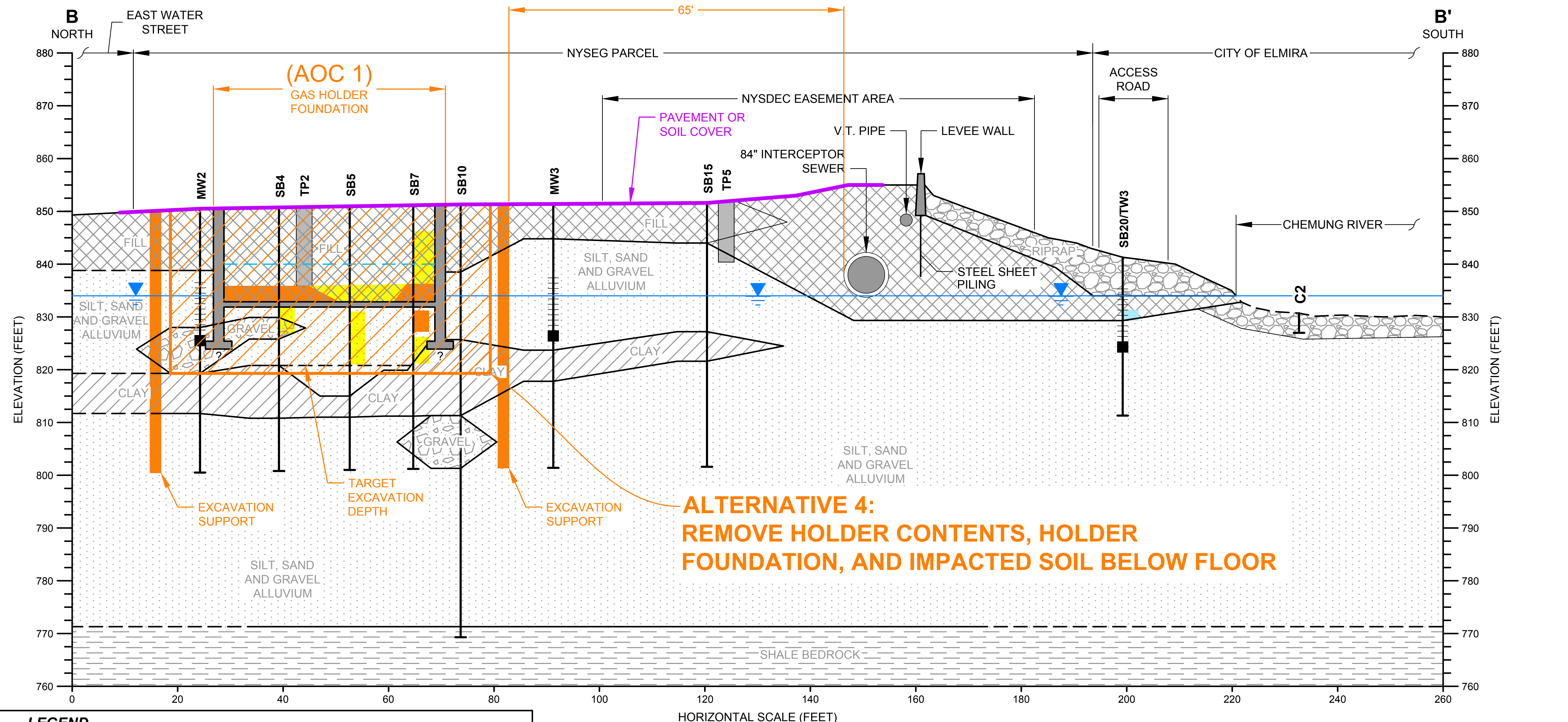


LEGEND

- WATER LEVEL IN GAS HOLDER FOUNDATION
- GROUNDWATER TABLE (JUNE 18, 2013)
- CONTACT
- INFERRED CONTACT
- MW1 — SOIL BORING/WELL IDENTIFICATION
- SCREEN INTERVAL
- DNAPL SUMP
- BOTTOM OF BORING
- GP2 — GEOPROBE BORING / GROUNDWATER SAMPLE
- V.T. PIPE — VITRIFIED PIPE
- TP2 — TEST PIT
- FILL
- SILT, SAND AND GRAVEL ALLUVIUM
- CLAY
- GRAVEL
- SHALE BEDROCK
- HYDROCARBON STAIN OR ODOR
- BLEBS, GLOBS OR SHEEN
- PETROLEUM IMPACTS STAINING AND ODOR

HORIZONTAL SCALE: 1" = 20'

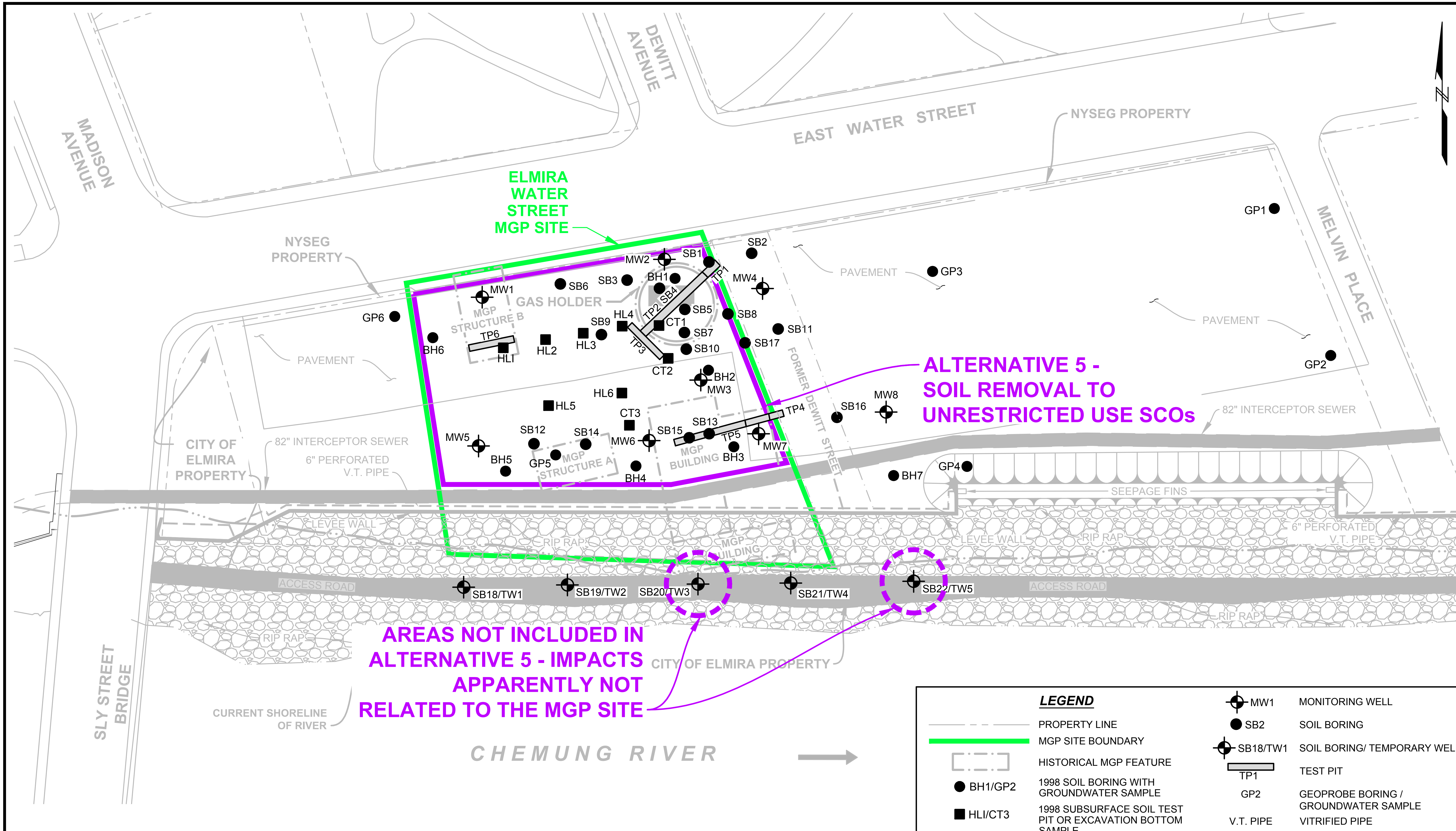
0 20' 40'

0 20' 40'

VERTICAL SCALE: 20'

NOTE: 1x VERTICAL EXAGGERATION

Feasibility Study Report Elmira Water Street MGP Site Elmira, New York	GEI Consultants	ALTERNATIVE 4: CROSS SECTION B-B'
NYSEG Binghamton, New York	Project 116120	November 2015 Fig. 12



SOURCES

1. 5/30/13 KEYSTONE ASSOCIATES PLS, SURVEY.
2. *ELMIRA, NY SECTION NO. 2, CHEMUNG RIVER, LEFT BANK, PLAN AND PROFILE,* PREPARED BY: ARMY CORPS OF ENGINEERS, 1" = 50', DATE: 1/10/1944.

Feasibility Study Report Elmira Water Street MGP Site Elmira, New York	GEI Consultants	ALTERNATIVE 5: REMOVAL OF SOIL TO UNRESTRICTED USE SCOs
NYSEG Binghamton, New York	Project 116120	November 2015 Fig. 13

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Appendix A

Remedial Alternative Cost Estimates

Table A-1
Cost Evaluation - Alternatives Summary
Elmira Water Street MGP Site FS

Alternative	Description	Total Cost (2015 $)
Alternative 1	No Action	No Cost
Alternative 2	1ft soil removal and re-grading for cover, maintain asphalt cover, groundwater monitoring, IC/ECs	$530,000
Alternative 3	Excavation of soil in ISS footprint (0-5 ft), auger ISS soil within and below holder foundation (5-30 ft), repair asphalt cover, 1ft soil removal and re-grading for cover, groundwater monitoring, IC/ECs	$1,490,000
Alternative 4	Excavation of holder foundation and soil below holder to 30 ft using excavation support, repair asphalt cover, 1ft soil removal and re-grading for cover, groundwater monitoring, IC/ECs	$3,220,000
Alternative 5	Protection of flood control features, excavation of soil to Unrestricted Use SCOs, backfill and site restoration	$6,420,000

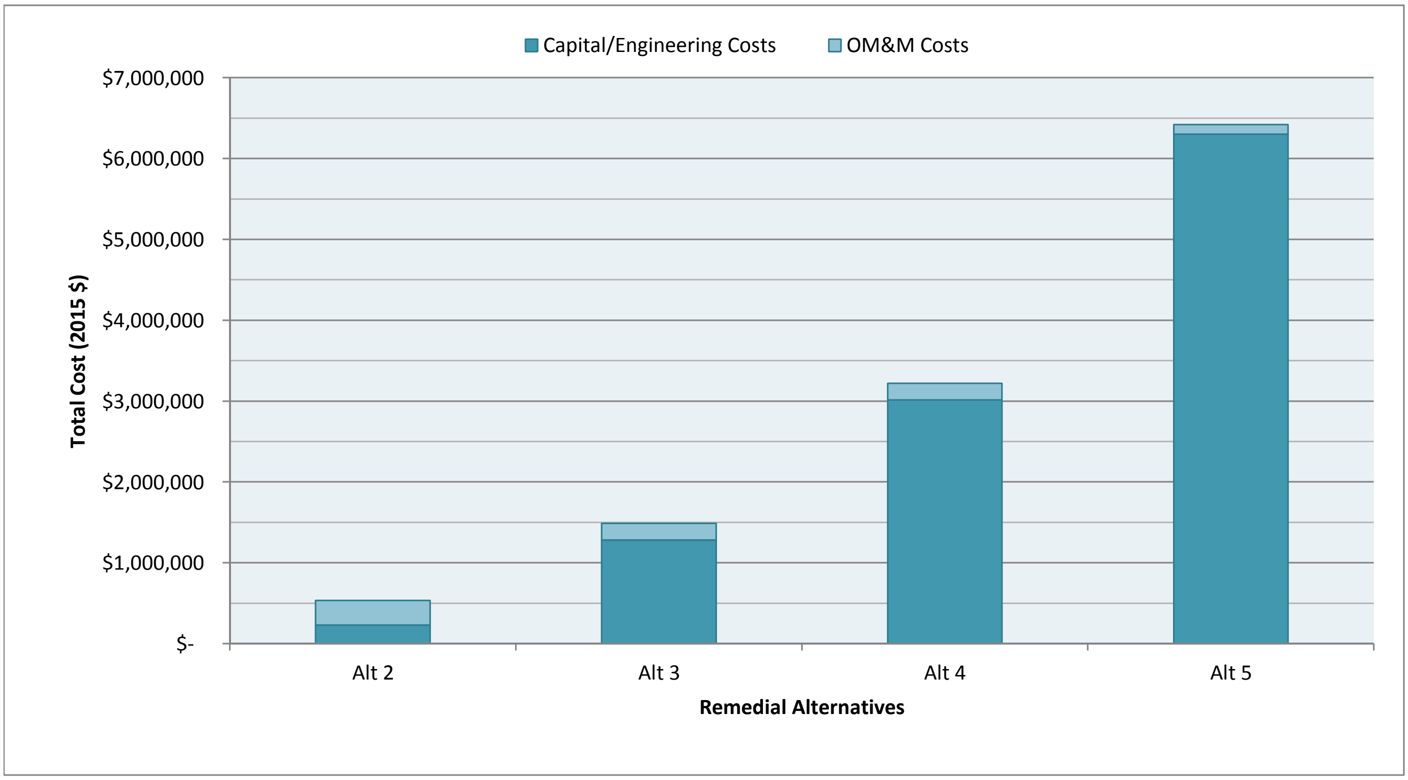

Table A-2 - Alternative 2
Cost Evaluation - Alternatives Summary
Elmira Water Street MGP Site FS

Remedial Component	Unit	Unit Price	Quantity	Total Cost (2015 $) Total Cost
COMMON COST COMPONENTS				
100 ENGINEERING				
101 Engineering Design, Contract Drawings	Lump Sum	$15,000	1	$15,000
102 Draft Work Plan for NYSDEC Review	Lump Sum	$20,000	1	$20,000
103 Draft of Completion Report	Lump Sum	$20,000	1	$20,000
			Subtotal	$55,000
			% Total Costs	10%
		TOTAL ENGINEERING COSTS		**$55,000**
200 CONSTRUCTION MANAGEMENT				
201 Construction Oversight (including CAMP oversight)	Day	$1,015	10	$10,150
203 CAMP Equipment Rental	Week	$1,050	2	$2,100
204 Pre-characterization sampling	Each	$425	10	$4,250
206 Project Management (including OM&M period)	Lump Sum	$27,500	1	$27,500
			Subtotal	$44,000
			% Total Costs	8%
300 REMEDIAL COMPONENTS				
307 Excavation	Cubic Yard	$20	375	$7,500
316 Disposal - Soil - Landfill	Ton	$60	563	$33,750
Soil Cover				
324 Borrow, compaction, grading, and seeding for 1-ft cover	Cubic Yard	$40	375	$15,000
Institutional Controls / Engineering Controls				
326 Environmental Easement, Groundwater Restrictions	Lump Sum	$10,000	1	$10,000
327 Site Management Plan	Lump Sum	$25,000	1	$25,000
			Subtotal	$91,250
			% Total Costs	17%
		TOTAL CAPITAL COSTS		**$135,250**
400 OPERATION AND MAINTENANCE				
First 5 Years Post Remediation				
402 Sample Collection	Semi-Annual	$4,832	2	$9,664
403 Lab Costs	Semi-Annual	$2,280	2	$4,560
404 Validation	Semi-Annual	$792	2	$1,584
405 Reports	Semi-Annual	$5,000	2	$10,000
406 EC Inspection	Annual	$1,100	1	$1,100
			Annual Subtotal	$26,908
Subsequent 25 Years				
402 Sample Collection	Annual	$4,832	1	$4,832
403 Lab Costs	Annual	$760	1	$760
404 Validation	Annual	$792	1	$792
405 Reports	Annual	$5,000	1	$5,000
406 EC Inspection	Annual	$1,100	1	$1,100
			Annual Subtotal	$12,484
			Present Worth Given a 30 Year Period with 5% Effective Rate	$ 254,358.05
			% Total Costs	48%
		TOTAL O&M COSTS		**$254,358**
REMEDIAL COST SUMMARY				
Total Engineering Costs				$55,000
Total Capital Costs				$135,250
Total Operation and Maintenance Costs				$254,358
		Total Capital, O&M, and Engineering Costs		**$444,608**
500 CONTINGENCY				
501 Allowance for Undefined Costs Associated with Utilities, Subsurface Structures, and Extent of Impacts.			20%	$88,921.61
			TOTAL COST	**$ 533,530**
		ROUNDED COST		**$530,000**

Table A-3 - Alternative 3
Cost Evaluation - Alternatives Summary
Elmira Water Street MGP Site FS

Total Cost (2015 $)

Remedial Component	Unit	Unit Price	Quantity	Total Cost
COMMON COST COMPONENTS				
100 ENGINEERING				
101 Engineering Design, Contract Drawings	Lump Sum	$130,000	1	$130,000
102 Draft Work Plan for NYSDEC Review	Lump Sum	$30,000	1	$30,000
103 Draft of Completion Report	Lump Sum	$45,000	1	$45,000
			Subtotal	$205,000
			% Total Costs	14%
		TOTAL ENGINEERING COSTS		**$205,000**
200 CONSTRUCTION MANAGEMENT				
201 Construction Oversight	Month	$22,330	1.5	$33,495
202 CAMP Technician	Month	$14,300	1.5	$21,450
203 CAMP Equipment Rental	Month	$6,875	1.5	$10,313
204 Pre-design investigation/pre-characterization/confirmation sampling	Each	$425	120	$51,000
205 ISS Bench Scale Study	Each	$20,000	1	$20,000
206 Project Management (including OM&M period)	Lump Sum	$71,000	1	$71,000
			Subtotal	$207,258
			% Total Costs	14%
300 REMEDIAL COMPONENTS				
302 Mobilization / Demobilization	Lump Sum	$50,000	1	$50,000
303 Survey and Layout Work	Acre	$3,882	2	$7,763
305 Temporary Facilities	Month	$1,539.94	1.5	$2,310
306 Temporary Fence	Linear Foot	$27.65	500	$13,825
Earthwork				
307 Pre-excavation of gas holder fill / soil	Cubic Yard	$25	605	$15,125
308 Excavation of ISS swell within frost zone	Cubic Yard	$25	300	$7,500
310 Odor Control - Odor suppressant foam	Month	$20,000	1.5	$30,000
315 Disposal - Soil - Thermal Desorption	Ton	$100	795	$79,500
316 Disposal - Soil - Landfill	Ton	$40	563	$22,500
317 Backfill	Cubic Yard	$25	230	$5,750
In-Situ Solidification (ISS)				
320 ISS equipment and Batch Plant Mobilization	Lump Sum	$300,000	1	$300,000
321 Water for ISS mix	Gal	$0.05	27000	$1,350
322 Auger ISS	Cubic Yard	$50.00	1170	$58,500
Soil Cover and Asphalt Restoration				
324 Borrow, compaction, grading, and seeding for 1-ft cover	Cubic Yard	$40	375	$15,000
325 Asphalt parking lot (1.5 inches thick)	Ton	$99	131	$12,969
Institutional Controls / Engineering Controls				
326 Environmental Easement, Groundwater Restrictions	Lump Sum	$10,000	1	$10,000
327 Site Management Plan	Lump Sum	$25,000	1	$25,000
			Subtotal	$657,092
			% Total Costs	44%
		TOTAL CAPITAL COSTS		**$864,350**
400 OPERATION AND MAINTENANCE				
First 5 Years Post Remediation				
401 Sample Collection	Semi-Annual	$4,832	2	$9,664
402 Lab Costs	Semi-Annual	$760	2	$1,520
403 Validation	Semi-Annual	$792	2	$1,584
404 Reports	Semi-Annual	$5,000	2	$10,000
405 EC Inspection	Annual	$1,100	1	$1,100
			Annual Subtotal	$23,868
Subsequent 25 Years				
404 Reports	Annual	$5,000	1	$5,000
405 EC Inspection	Annual	$1,100	1	$1,100
			Annual Subtotal	$6,100
Present Worth Given a 30 Year Period with 5% Effective Rate				$ 170,698.09
			% Total Costs	11%
		TOTAL O&M COSTS		**$170,698**
REMEDIAL COST SUMMARY				
Total Engineering Costs				$205,000
Total Capital Costs				$864,350
Total Operation and Maintenance Costs				$170,698
Total Capital, O&M, and Engineering Costs				**$1,240,048**
500 CONTINGENCY				
501 Allowance for Undefined Costs Associated with Utilities, Subsurface Structures, and Extent of Impacts			20%	$248,009.56
			TOTAL COST	**$ 1,488,057**
		ROUNDED COST		**$1,490,000**

Table A-4 - Alternative 4
Cost Evaluation - Alternatives Summary
Elmira Water Street MGP Site FS

Total Cost (2015 $)

Remedial Component	Unit	Unit Price	Quantity	Total Cost
COMMON COST COMPONENTS				
100 ENGINEERING				
101 Engineering Design, Contract Drawings	Lump Sum	$175,000	1	$175,000
102 Draft Work Plan for NYSDEC Review	Lump Sum	$30,000	1	$30,000
103 Draft of Completion Report	Lump Sum	$30,000	1	$30,000
104 Strategic planning and permitting with regulators	Lump Sum	$25,000	1	$25,000
			Subtotal	$260,000
			% Total Costs	8%
		TOTAL ENGINEERING COSTS		**$260,000**
200 CONSTRUCTION MANAGEMENT				
201 Construction Oversight	Month	$22,330	2	$44,660
202 CAMP Technician	Month	$14,300	2	$28,600
203 CAMP Equipment Rental	Month	$6,875	2	$13,750
204 Pre-design investigation (including utility recon)/pre-characterization	Each	$425	240	$102,000
206 Project Management	Lump Sum	$98,282	1	$98,282
			Subtotal	$287,292
			% Total Costs	9%
300 REMEDIAL COMPONENTS				
302 Mobilization / Demobilization	Lump Sum	$150,000	1	$150,000
303 Survey and Layout Work	Acre	$3,882	2	$7,763
305 Temporary Facilities	Month	$1,539.94	2	$3,080
306 Temporary Fence	Linear Foot	$27.65	500	$13,825
Excavation				
307 Excavation	Cubic Yard	$30	3815	$114,450
309 Excavation Support for deep foundation and soil removal - Sheet Pile	Square Foot	$45	5910	
309a Excavation Support for deep foundation and soil removal - Secant Pile	Vertical Lin FT	$250	3060	$765,000
310 Odor Control - Odor suppressant foam	Month	$20,000	2	$40,000
313 Dewatering Equipment - Local	Month	$20,000	2	$40,000
314 Disposal - Water pre-treatment and disposal at POTW facility	gal	$0.1	1500000	$150,000
315 Disposal - Soil - Thermal Desorption	Ton	$100	5160	$516,000
316 Disposal - Soil - Landfill	Ton	$60	563	$33,750
317 Backfill	Cubic Yard	$20	3440	$68,800
Soil Cover (or Gravel Cover)				
324 Borrow, compaction, grading, and seeding for 1-ft cover	Cubic Yard	$40	375	$15,000
325 Asphalt parking lot (1.5 inches thick)	Ton	$99	131	$12,969
Institutional Controls / Engineering Controls				
326 Environmental Easement, Groundwater Restrictions	Lump Sum	$10,000	1	$10,000
327 Site Management Plan	Lump Sum	$25,000	1	$25,000
			Subtotal	$1,965,637
			% Total Costs	61%
		TOTAL CAPITAL COSTS		**$2,252,929**
400 OPERATION AND MAINTENANCE				
First 5 Years Post Remediation				
401 Sample Collection	Semi-Annual	$4,832	2	$9,664
402 Lab Costs	Semi-Annual	$760	2	$1,520
403 Validation	Semi-Annual	$792	2	$1,584
404 Reports	Semi-Annual	$5,000	2	$10,000
405 EC Inspection	Annual	$1,100	1	$1,100
			Annual Subtotal	$23,868
Subsequent 25 Years				
404 Reports	Annual	$5,000	1	$5,000
405 EC Inspection	Annual	$1,100	1	$1,100
			Annual Subtotal	$6,100
			Present Worth Given a 30 Year Period with 5% Effective Rate	$ 170,698.09
			% Total Costs	5%
		TOTAL O&M COSTS		**$170,698**
REMEDIAL COST SUMMARY				
Total Engineering Costs				$260,000
Total Capital Costs				$2,252,929
Total Operation and Maintenance Costs				$170,698
			Total Capital, O&M, and Engineering Costs	**$2,683,627**
500 CONTINGENCY				
501 Allowance for Undefined Costs Associated with Utilities, Subsurface Structures, and Extent of Impacts.			20%	$536,725.42
			TOTAL COST	**$ 3,220,353**
		ROUNDED COST		**$3,220,000**

Table A-5 - Alternative 5
Cost Evaluation - Alternatives Summary
Elmira Water Street MGP Site FS

				Total Cost (2015 $)
Remedial Component	**Unit**	**Unit Price**	**Quantity**	**Total Cost**
COMMON COST COMPONENTS				
100 ENGINEERING				
101 Engineering Design, Contract Drawings	Lump Sum	$175,000	1	$175,000
102 Draft Work Plan for NYSDEC Review	Lump Sum	$45,000	1	$45,000
103 Draft of Completion Report	Lump Sum	$60,000	1	$60,000
104 Strategic planning and permitting with regulators	Lump Sum	$40,000	1	$40,000
			Subtotal	$320,000
			% Total Costs	5%
	TOTAL ENGINEERING COSTS			**$320,000**
200 CONSTRUCTION MANAGEMENT				
201 Construction Oversight	Month	$22,330	4	$89,320
202 CAMP Technician	Month	$14,300	4	$57,200
203 CAMP Equipment Rental	Month	$6,875	4	$27,500
204 Pre-design investigation (including utility recon)/pre-characterization	Each	$425	240	$102,000
206 Project Management	Lump Sum	$221,699	1	$221,699
			Subtotal	$497,719
			% Total Costs	8%
300 REMEDIAL COMPONENTS				
302 Mobilization / Demobilization	Lump Sum	$150,000	1	$150,000
303 Survey and Layout Work	Acre	$3,882	2	$7,763
305 Temporary Facilities	Month	$1,539.94	4	$6,160
306 Temporary Fence	Linear Foot	$27.65	1200	$33,180
Excavation				
307 Excavation	Cubic Yard	$30	12800	$384,000
309 Excavation Support for deep foundation and soil removal - Sheet Pile	Square Foot	$45	13105	
309a Excavation Support for deep foundation and soil removal - Secant Pile	Vertical Lin FT	$250	6550	$1,637,500
310 Odor Control - Odor suppressant foam	Month	$20,000	4	$80,000
313 Dewatering Equipment - Local	Month	$20,000	4	$80,000
314 Disposal - Water pre-treatment and disposal at POTW facility	gal	$0.1	3750000	$375,000
315 Disposal - Soil - Thermal Desorption	Ton	$100	5760	$576,000
316 Disposal - Soil - Landfill	Ton	$60	13440	$806,400
317 Backfill	Cubic Yard	$20	12800	$256,000
Surface Soil (outside excavation limits) and Asphalt Restoration				
324 Borrow, compaction, grading, and seeding for (1ft thick)	Cubic Yard	$40	100	$4,000
325 Asphalt parking lot (1.5 inches thick)	Ton	$99	131	$12,969
Institutional Controls / Engineering Controls				
326 Environmental Easement, Groundwater Restrictions	Lump Sum	$10,000	1	$10,000
327 Site Management Plan	Lump Sum	$15,000	1	$15,000
			Subtotal	$4,433,972
			% Total Costs	69%
		TOTAL CAPITAL COSTS		**$4,931,691**
400 OPERATION AND MAINTENANCE				
5 Years Post Remediation				
401 Sample Collection	Semi-Annual	$4,832	2	$9,664
402 Lab Costs	Semi-Annual	$760	2	$1,520
403 Validation	Semi-Annual	$792	2	$1,584
404 Reports	Semi-Annual	$5,000	2	$10,000
			Annual Subtotal	$22,768
	Present Worth Given a 5 Year Period with 5% Effective Rate			$ 98,573.52
			% Total Costs	2%
		TOTAL O&M COSTS		**$98,574**
REMEDIAL COST SUMMARY				
Total Engineering Costs				$320,000
Total Capital Costs				$4,931,691
Total Operation and Maintenance Costs				$98,574
	Total Capital, O&M, and Engineering Costs			**$5,350,264**
500 CONTINGENCY				
501 Allowance for Undefined Costs Associated with Utilities, Subsurface Structures, and Extent of Impacts.			20%	$1,070,052.83
			TOTAL COST	**$ 6,420,317**
		ROUNDED COST		**$6,420,000**

Table A-6
Cost Evaluation - Alternatives Summary Notes
Elmira Water Street MGP Site FS

Detailed Cost Estimate Notes - Alternatives 2,3,4,5		Total Cost (2015 $)
Elmira Water Street MGP Site		
Elmira, New York		
100	ENGINEERING	
101	Engineering Design, Contract Drawings	GEI Project Experience
102	Draft Work Plan for NYSDEC Review	GEI Project Experience
103	Draft of Completion Report	GEI Project Experience
104	Strategic planning and permitting with regulators	GEI Project Experience
200	CONSTRUCTION MANAGEMENT	
201	Construction Oversight	Assume 1 Grade 3 Project Engineer, vehicle and supplies, no per diem
202	CAMP Technician	Assume 1 Grade 1 Staff Engineer, no per diem
203	CAMP Equipment Rental	Cost basis obtained from recent rental pricing. Cost assumes 4 CAMP stations (2 upwind, 2 downwind) with remote monitoring, 1 weather station, 1 work zone PID
204	Confirmation Sampling	Cost basis obtained from recent lab pricing. Assuming sampling for metals, semi-volatile and volatile organic compounds.
205	ISS Bench Scale Study	Recent contractor pricing.
206	Project Management	5% of total cost
300	REMEDIAL COMPONENTS	
302	Mobilization/Demobilization	GEI Project Experience
303	Survey and Layout Work	RS Means estimate, quantity increased to account for multiple rounds of surveying to document work
304	Pre-clear/Grub	RS Means estimate
305	Trailers and Chemical Toilets	RS Means estimate, assuming 2 trailers with supplies and utilities, and 2 chemical toilets per month.
306	Temporary Fence	RS Means, assuming an 8 ft fence height
	Excavate and Backfill Materials	
307	Excavations to Remove Soils	Recent contractor pricing
308	Excavation of ISS ground swell within frost zone	Recent contractor pricing, assume final ISS mass cannot exist in 4-foot frost zone
309	Excavation Support for deep foundation removal and ISS/deep soil removal	Recent contractor pricing, cost in price per area of exposed sheeting
310	Odor Control - Odor suppressant foam	Recent contractor pricing.
311	Odor Control - Temporary Structure Mobilization/Demobilization	Recent contractor pricing.
312	Odor Control - Maintain/Operate Temporary Structure	Recent contractor pricing.
313	Dewatering Equipment - local	Recent contractor pricing, assuming the use of sumps and trash pumps for localized dewatering.
314	Disposal - Water pre-treatment and disposal at POTW facility	Recent contractor pricing
315	Disposal - Soil - Thermal Desorption	Recent contractor pricing, incl. transportation,
316	Disposal - Soil - Landfill	Recent contractor pricing, incl. transportation
317	Backfill	Recent contractor pricing, cost includes borrow, compaction, grading, and seeding
	In-Situ Solidification	
320	ISS Equipment and Batch Plant Mobilization	Recent contractor pricing
321	Water for ISS mix	
322	Bucket-mix ISS	Recent contractor pricing, incl. geotech testing, assuming water and electricity are readily available
323	Auger ISS	Recent contractor pricing, incl. geotech testing, assuming water and electricity are readily available
	Soil Cover	
324	Borrow, compaction, grading, and seeding for 1-ft cover	Recent contractor pricing, assume 6" topsoil
325	Asphalt parking lot (1.5" thick)	Recent contractor pricing, includes tackcoat
	Institutional Controls / Engineering Controls	
326	Groundwater Restrictions	GEI Project Experience
327	Site Management Plan	GEI Project Experience
400	OPERATION AND MAINTENANCE	For Alts 2,3,4,5 assume a semi-annual 5-year OMM period. For Alts 2,3,4 assume subsequent annual 25-year OMM period (Alts 3,4: EC inspection only). 4 wells in the monitoring program. 2 sampling events per year for 5 years, 1 sampling event per year for subsequent 25 years. 3 QA/QC samples
	Groundwater Monitoring	
401	Sample Collection	GEI Project Experience
402	Lab Costs	Recent lab pricing
403	Validation	GEI Project Experience
404	Reports	GEI Project Experience
405	EC Inspection	GEI Project Experience
REMEDIAL COST SUMMARY		
	Total Engineering Costs	Includes Sections 100
	Total Capital Costs	Includes Section 200,300
	Total Operation and Maintenance Costs	Includes Section 400. Present Cost given a 30 year period and 5% effective rate. 5 year period for Alt 5.
500	CONTINGENCY	
501	Allowance for Undefined Costs Associated with Utilities, Subsurface Structures, and Extent of Impacts. Applied to Total Cost.	

Appendix B

Volume Estimates

Table B-1
Volume Estimates
Elmira Water Street MGP Site FS

Volume of MGP-Impacted Soil Exceeding the Unrestricted Use SCOs					
Area ID	Area (sf)	SCO	Avg Depth (ft)	Volume CY	
Unrestricted Use (west)	9,900	Unrestricted	8	2,933	
Unrestricted Use (east)	10,625	Unrestricted	25	9,838	
Rounded Total Volume				**13,000**	**CY**
Volume of Surface Soil with COC Exceeding Individual Commercial SCOs in the Identified Area					
Area ID	Area (sf)	SCO	Depth (ft)	Volume CY	
Identified Area	10,100	Commercial-Individual COC	1	374	
Rounded Total Volume				**380**	**CY**
Volume of MGP-Impacted Fill and Soil Exceeding TPAH 500 ppm in Gas Holder Foundation (0-17 ft)					
Area ID	Area (sf)	SCO	Avg Depth (ft)	Volume CY	
AOC 1	1,256	Commercial	17	791	
Rounded Total Volume				**800**	**CY**
Volume of MGP-Impacted Soil Below the Gas Holder Foundation Floor					
Area ID	Area (sf)	SCO	Interval Thickness (ft)	Volume CY	
AOC 1	1,256	N/A	13	605	
Rounded Total Volume				**600**	**CY**
Volume of Supported Excavation of Gas Holder Foundation (10-foot set back)					
Area ID	Area (sf)	SCO	Depth (ft)	Volume CY	
Excavation	3,096	N/A	30	3,440	
Rounded Total Volume				**3,500**	**CY**
Volume of Vessel Water Contained in Gas Holder Foundation					
Groundwater Type	Area (sf)	Void ratio[1] (e)	Saturation (S)	Thickness (ft)	Volume gal
Perched (wet zone)	1,256	0.67	0.3	10	11,308
Perched (saturated zone)	1,256	0.67	1	7	26,384
Rounded Total Volume of Vessel Water in Gas Holder Foundation				**38,000**	**gal**

[1] Coduto, Donald P. *Geotechnical Engineering* . Upper Saddle River: Prentice-Hall, 1999.