Environmental Consultants
and Contractors

2830 Dairy Drive
Madison, WI 53718-6751

608 224-2830
FAX 608 224-2839
www.scsengineers.com

SCS ENGINEERS

January 30, 2015
File No. 25214107

Mr. Jeffrey D. Jeep
Jeep and Blazer, LLC
24 Hillside Avenue
Hillside, IL 60162

Subject: Opinion on the Source of the Occurrence of Petroleum and Gas In Monitor Wells and Borings in the James Park Area

Dear Mr. Jeep:

This letter transmits SCS's report titled, "Opinion on the Source of the Occurrence of Petroleum and Gas In Monitor Wells and Borings in the James Park Area," as a searchable pdf file.

The document consists of text, figures, tables, references and appendices. Please call if you have any questions or concerns regarding the document.

Sincerely,

David M. Hendron, PE
Senior Project Manager
SCS ENGINEERS

DH/peh/TLC_lmh

Enclosure

I:\25214107\Reports\150130_Text - Opinion Cause_James Park Report_FINAL.doc

SCS ENGINEERS

Opinion on the Source of the Occurrence of Petroleum and Gas in Monitor Wells and Borings in the James Park Area

Prepared for:

Jeep and Blazer, LLC
24 Hillside Avenue
Hillside, Illinois 60162

Prepared by:

SCS ENGINEERS
2830 Dairy Drive
Madison, Wisconsin 53718-6751
(608) 224-2830

January 2015
File No. 25214107

Offices Nationwide
www.scsengineers.com

Opinion on the Source of the Occurrence of Petroleum and Gas in Monitor Wells and Borings in the James Park Area

Prepared for:

Jeep and Blazer, LLC
24 Hillside Avenue
Hillside, Illinois 60162

Prepared by:

SCS ENGINEERS
2830 Dairy Drive
Madison, Wisconsin 53718-6751
(608) 224-2830

January 2015
File No. 25214107

Table of Contents

Section **Page**

1.0 Introduction 1
2.0 History of the Occurrence of Petroleum and Gas in the James Park Area 1
2.1 Original Finding of Petroleum and Gas in Borings and Monitor Wells 1
2.2 Review of Tetra Tech Report and Notification of Illinois Environmental Protection Agency 2
3.0 SCS Investigations 2
3.1 Initial Identification of Potential Sources of the Occurrence 2
3.2 Scope of the Additional Site, Laboratory and Literature Investigations Conducted by SCS 3
4.0 Results of SCS Site Investigations 4
4.1 Field Investigations 4
4.1.1 Borings, Geoprobes, and Gas Monitor Wells 4
4.1.2 Crust Sample From Water Pipe Excavation at Dodge Street and Mulford 5
4.1.3 Water Sample From GMP-19S 6
4.1.4 Locations of Natural Gas Pipelines In the James Park Area 6
4.1.5 Locations of Other Pipelines in the James Park Area 7
5.0 Laboratory Investigations 7
5.1 Geotechnical 8
5.2 Analytical Chemistry Testing 8
5.2.1 GC-MS, and GC-FID Fingerprinting Data 8
5.2.2 VOC and SVOCs 8
6.0 Literature Investigations 8
7.0 Assessment of Each of the Potential Sources of the Occurrence 9
7.1 General 9
7.2 James Park Landfill 9
7.2.1 Basis for Consideration as a Source 9
7.2.2 Outline of the Relevant Information in Support of Basis 9
7.2.3 Summary of Our Analyses of the Relevant Data for Determination of the Viability of the Landfill at James Park to be a Potential Source of the Occurrence 10
7.2.4 Conclusion Whether the Landfill at James Park Remains in Consideration as the Potential Source of the Occurrence 12
7.3 Former MGP Site Operations and Infrastructure 12
7.3.1 Basis for Consideration 12
7.3.2 Outline of the Relevant Information in Support of Basis 13
7.3.3 Summary of our Analyses of the Relevant Data for Determination of the Viability of the MGP site as a Source of the Occurrence 13
7.3.4 Conclusion Whether the MGP Site Remains in Consideration as the Potential Source of the Occurrence 18
7.4 The Former Operation of the Large Oil Storage Tanks at the MWRD Site 18
7.4.1 Basis for Consideration 18
7.4.2 Outline of the Relevant Information in Support of Basis 18

Contents (Continued)

List of Figures (continued)

15 Core Photographs from James Park Site Boring GMP-19
16 Core Photographs from James Park Site Boring GMP-21
17 Location of Glacial Drift Gas in Illinois
18 Plan View and Cross Section of Evanston Tributary Tunnel

Appendices

A-1 Data Summary Tables for the GMP Borings and Gas Probes installed at James Park
Summary Table 1: GMP Construction Details, Water Levels, Pressure Readings, and Gas Screening Data (GEM 5000 4-gas meter) for GMPs 1 through 21
Table 1A: Average Maximum Pressure Calculation for Waste GMPs Compared to Perimeter GMPs
Summary Table 2: Geotechnical Data for GMP borings 14 through 21 Installed by SCS Engineers
Summary Table 3: Gas Screening Data for GMP Borings 14 through 21 Installed by SCS Engineers (includes FID, PID and 4-gas meter readings)
A-2 SCS's Boring Logs for Geoprobe Borings GMP 14, 14A, 14B, 16, 16A, 17, 17A, 18, 18A, and 20
A-3 SCS's Boring Logs for Auger Borings GMP 15, 19, and 21 (bedrock borings)
A-4 SCS's Well Completion Reports for Gas Monitoring Probes Installed in the Glacial Deposits (GMP 14, 15A, 16, 19S, 20, 21A), Waste (GMP 17 and 18) and Bedrock (GMP 15, 19, and 21)
B-1 Analytical Data Summary Tables
Summary Table 1: Summary Gas VOC Data James Park (GMPs 1, 10, 11, 17, 18 and 19A) and the Wastewater Treatment Plant (MW B-11)
Summary Table 1-A: Halogenated Compounds in Waste GMPs Compared to Perimeter GMPs
Summary Table 2: Summary of Gas Isotopic Data for James Park GMPs 1, 10, 11, 17, 18 and 19A
Summary Table 3: Summary of Gas Composition Data for James Park GMPs 1, 10, 11, 17, 18 and 19A
Table 3-A: Calculation of Average Methane Concentrations in Waste GMPs Compared to Perimeter GMPs
B-2 GC/MS and GC/FID Chemical Fingerprinting Data – ZymaX Forensics – Liquid and Solid Media
B-3 VOC and SVOC Data – Test America - Gas, Liquid, and Solid Media
B-4 Mercaptan and Hydrogen Sulfide Data – Schneider Laboratories - Gas Media Only
B-5 Gas Isotopic and Composition Data – Isotech Laboratories – Gas Media Only
B-6 References Used to Document That the Halocarbons Listed in Appendix B-1, Table 1-A, Are Not Naturally Occurring Compounds

I:\25214107\Reports\150130_Text - Opinion Cause_James Park Report_FINAL.doc

Contents (Continued)

List of Figures (continued)

15 Core Photographs from James Park Site Boring GMP-19
16 Core Photographs from James Park Site Boring GMP-21
17 Location of Glacial Drift Gas in Illinois
18 Plan View and Cross Section of Evanston Tributary Tunnel

Appendices

A-1 Data Summary Tables for the GMP Borings and Gas Probes installed at James Park
Summary Table 1: GMP Construction Details, Water Levels, Pressure Readings, and Gas Screening Data (GEM 5000 4-gas meter) for GMPs 1 through 21
Table 1A: Average Maximum Pressure Calculation for Waste GMPs Compared to Perimeter GMPs
Summary Table 2: Geotechnical Data for GMP borings 14 through 21 Installed by SCS Engineers
Summary Table 3: Gas Screening Data for GMP Borings 14 through 21 Installed by SCS Engineers (includes FID, PID and 4-gas meter readings)
A-2 SCS's Boring Logs for Geoprobe Borings GMP 14, 14A, 14B, 16, 16A, 17, 17A, 18, 18A, and 20
A-3 SCS's Boring Logs for Auger Borings GMP 15, 19, and 21 (bedrock borings)
A-4 SCS's Well Completion Reports for Gas Monitoring Probes Installed in the Glacial Deposits (GMP 14, 15A, 16, 19S, 20, 21A), Waste (GMP 17 and 18) and Bedrock (GMP 15, 19, and 21)
B-1 Analytical Data Summary Tables
Summary Table 1: Summary Gas VOC Data James Park (GMPs 1, 10, 11, 17, 18 and 19A) and the Wastewater Treatment Plant (MW B-11)
Summary Table 1-A: Halogenated Compounds in Waste GMPs Compared to Perimeter GMPs
Summary Table 2: Summary of Gas Isotopic Data for James Park GMPs 1, 10, 11, 17, 18 and 19A
Summary Table 3: Summary of Gas Composition Data for James Park GMPs 1, 10, 11, 17, 18 and 19A
Table 3-A: Calculation of Average Methane Concentrations in Waste GMPs Compared to Perimeter GMPs
B-2 GC/MS and GC/FID Chemical Fingerprinting Data – ZymaX Forensics – Liquid and Solid Media
B-3 VOC and SVOC Data – Test America - Gas, Liquid, and Solid Media
B-4 Mercaptan and Hydrogen Sulfide Data – Schneider Laboratories - Gas Media Only
B-5 Gas Isotopic and Composition Data – Isotech Laboratories – Gas Media Only
B-6 References Used to Document That the Halocarbons Listed in Appendix B-1, Table 1-A, Are Not Naturally Occurring Compounds

I:\25214107\Reports\150130_Text - Opinion Cause_James Park Report_FINAL.doc

1.0 INTRODUCTION

At the request of Messrs. Jeffery D. Jeep and Michael Blazer of Jeep and Blazer, LLC, the author, Mr. David M. Hendron, PE of SCS Engineers (SCS), prepared this report to provide his opinion on the source(s) (hereinafter referred to as source) of the occurrence of petroleum and gas in monitor wells and borings (occurrence) in the James Park area in Evanston, Illinois. The location of James Park is shown on **Figure 1**. The report is organized into the following sections:

1.0 Introduction
2.0 History of the Occurrence of Petroleum and Gas in the James Park area
3.0 SCS Investigations
4.0 Results of SCS Site Investigations
5.0 Results of SCS Laboratory Investigations
6.0 Results of SCS Literature Investigations
7.0 Assessment of Each of the Potential Sources of the Occurrence
8.0 Opinion on the Potential Sources of the Occurrence
9.0 References

2.0 HISTORY OF THE OCCURRENCE OF PETROLEUM AND GAS IN THE JAMES PARK AREA

2.1 ORIGINAL FINDING OF PETROLEUM AND GAS IN BORINGS AND MONITOR WELLS

In November 2012, a Tetra Tech Report (**Reference 1**) of an investigation conducted by them for the Metropolitan Water Reclamation District of Greater Chicago (MWRD) at the MWRD O'Brien water treatment plant located at the corner of McCormick Boulevard and Howard Street indicated that soil and gas samples from their borings encountered both petroleum and gas constituents. **Figure 2** shows the location of the MWRD plant and the approximate location of borings and monitor wells that encountered petroleum and gas constituents.

Tetra Tech made an assessment of the cause of the gas in their borings and monitor wells that included the following potential sources:

1. Two large (est. at 500,000 gallons for each tank) concrete underground oil storage tanks on the MWRD property
2. Current and historic oil and gas pipelines north of the MWRD site
3. Former Manufactured Gas Plant (MGP) north of the site
4. A landfill formerly operated in the area now occupied by James Park

As a conclusion, as a result of analyses made by them, Tetra Tech stated in their report:

> *Presence of landfill gas on the northeast side of the site could be attributed to landfill-type gas and leachate that may be mobilized by the gas in a confined groundwater*

system. Based on samples collected during this investigation, the gas contains several compounds above EPA RSLs for the indoor inhalation exposure route, the groundwater contains oily material that contains PAHs above Class I and Class II drinking water standards, and the bedrock contains possible landfill-derived oil.

And:

Tetra Tech recommends that the District notify the City of Evanston of its concerns, and also notify the Illinois Environmental Protection Agency of contamination and a potentially hazardous condition in the bedrock that may be associated with the nearby historical landfill.

2.2 REVIEW OF TETRA TECH REPORT AND NOTIFICATION OF ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

The City of Evanston commissioned a review of the Tetra Tech Report and an investigation of James Park by Mr. Craig Rawlinson of CS Geologic, LLC (CSG) in 2013. Mr. Rawlinson completed his review and responded to the Illinois Environmental Protection Agency (IEPA) with a letter report dated March 29, 2013 (**Reference 2**). In summary, CSG concluded that the landfill at James Park was not the source of either the petroleum or gas occurring in the borings and monitor wells at the MWRD property.

Following submittal of this report, CSG made investigations around the perimeter of the James Park property. These investigations included the drilling of 3 borings and 10 cone penetrometer probes, installation of 14 Gas Monitoring Probes (GMPs) in the borings and probes, performance of gas pressure and gas flow analyses and VOC and isotopic analyses of samples from these GMPs. The locations of borings and GMPs installed during the CSG investigation is shown on **Figure 3**. Following the completion of these additional investigations, SCS was retained by J&B to make an assessment of the source of the petroleum and gas in monitor wells and borings in the James Park area. The following sections of this report present the results of SCS's work including data from the CSG investigations.

3.0 SCS INVESTIGATIONS

3.1 INITIAL IDENTIFICATION OF POTENTIAL SOURCES OF THE OCCURRENCE

Following completion of the investigations by CSG, SCS was retained by Jeep and Blazer, LLC, to review the project files and provide a preliminary assessment of the work and recommendations for any further investigations necessary to assess the potential source of the occurrence of petroleum and gas in monitor wells and borings in the James Park area.

Based on SCS's review of the data from site investigations made in the James Park area, available reports, relevant technical literature and information, and available information on infrastructure in the area of James Park, SCS identified the following potential sources of the occurrence. These include:

1. James Park Landfill;
2. Former Manufactured Gas Plant (MGP) site, and specifically its on-site and off-site operations including gas transmission through pipelines in and around the James Park area;
3. The former operation of the large oil storage tanks at the MWRD site;
4. Releases from existing high and low pressure natural gas pipelines on the perimeter of James Park; and
5. Natural petroleum and gas occurring in the local geology of the James Park area.

Each of the above-mentioned potential sources were assessed separately using the information and data obtained during investigations of the areas in the vicinity of James Park. The major investigations that have been made include: 1) James Park investigations by CSG and SCS; 2) available literature describing studies and investigations relevant to the natural occurring petroleum and methane in the upper bedrock deposit in the area of Northern Illinois that pertains to the James Park area; 3) available literature describing studies and investigations relevant to the naturally occurring methane in the glacial tills in the area of Northern Illinois that pertain to the James Park area; 4) MWRD property investigations; 5) MGP investigations and site remediation activities; and 6) Nicor pipeline decommissioning activities.

3.2 SCOPE OF THE ADDITIONAL SITE, LABORATORY AND LITERATURE INVESTIGATIONS CONDUCTED BY SCS

The general scope of the additional investigations conducted by SCS, following the initial review activities of project files, consisted of the following activities:

1. Additional site investigations, including the drilling of 3 borings, 5 Geoprobes™ (geoprobes); installation of 12 additional GMPs; sampling of encrusted material on a water pipeline at the corner of Dodge and Mulford Street, and sampling water and sediment from GMP-19s. The locations of the additional investigations are shown on **Figure 3**.

2. Soil samples were taken in all borings and geoprobes; 10 feet of NX-sized rock core was obtained from all 3 bedrock borings.

3. Gas phase samples and gas pressure measurements were attempted in all GMPs installed in the SCS and those installed previously in the CSG investigations.

4. Geotechnical testing of soil and rock samples from the borings and probes.

5. Analytical testing of Gas Samples for volatile organic compound (VOC) and semi volatile organic compound (SVOC) constituents.

6. Analytical testing of Gas samples for determination of Isotope concentrations.

7. Analytical testing of Gas samples for determination of Carbon 14 concentrations.

8. Analytical testing of one encrustation sample for determination of VOC and SVOC constituents and GC-MS fingerprinting.

9. Meeting and discussions with Nicor staff on two occasions.

10. Research into the locations of former and existing pipelines in the James Park area.

11. Review of Freedom of Information Act (FOIA) material (**Reference 3**) on the MGP site obtained from IEPA.

12. Observance of Nicor's pipeline excavation activities to decommission a section of pipeline in the area along Dodge Avenue just north of Oakton Street and along Asbury Street just south of Oakton Street.

13. Discussions with Evanston Department of Public Works staff regarding the occurrence of black, encrusted material (crust) on the main water supply line along Dodge Street in the vicinity of James Park, and the occurrence of a pipeline of unknown origin encountered along Dodge Street.

4.0 RESULTS OF SCS SITE INVESTIGATIONS

4.1 FIELD INVESTIGATIONS

The data pertaining to the field investigations conducted by SCS Engineers at James Park can be found in the following appendices:

- Appendix A-1: Summary Data Tables
  - Summary Table 1: GMP Construction Details, Water Levels, Pressure Readings, and Gas Screening Data for GMP 1 Through 21
    - Table 1-A: Average Maximum Pressure Calculation for Waste and Perimeter GMPs
  - Summary Table 2: Geotech Data for GMP Borings 14 Through 21
  - Summary Table 3: Gas Screening Data for Soil Samples from GMP Borings 14 through 21
- Appendix A-2: SCS Boring Logs for Geoprobe® Borings GMP 14, 14A, 14B, 16, 16A, 17, 17A, 18, 18A, and 20
- Appendix A-3, SCS Boring Logs for Auger Borings GMP 15, 19, and 21
- Appendix A-4, SCS Well Completion Reports for GMP 14 to 21

4.1.1 Borings, Geoprobes, and Gas Monitor Wells

The locations of all of the geoprobes, borings, and GMPs installed by SCS are shown on **Figure 3**. A summary of the results is given in the tables in **Appendix A-1**.

Geoprobes - Generally, the geoprobes were pushed through the upper softer glacial soils material until refusal in the hard glacial till at a depth of about 45 to 55 feet below ground

surface (bgs). Continuous soil samples were attempted using this method. Soil samples recovered were field classified, jar samples of each 4-foot push were taken, and the remaining sample was photographed, wrapped in plastic film and stored in boxes. Flameionization detector (FID) and photoionization (PID) measurements were made of each core sample obtained. Logs of the geoprobes are shown in **Appendix A-2**. The FID meter was a Photovac, MicroFID-IS with a maximum reading of 50,000 ppm. The PID meter was a Rae Systems, MiniRAE Lite, with a 10.6 eV gas discharge lamp with a maximum reading of 5,000 ppm.

Borings - Borings were drilled at three corners of the James Park Property using hollow stem auger drilling methods. Prior to the SCS investigation, CSG drilled a boring at the southwest corner of the property. At each location, soil samples were taken at 5-foot intervals using Standard Penetration Test (SPT) methods. These samples were field classified, jarred, and sent to the geotechnical laboratory. Index property tests were performed on selected representative samples. FID and PID measurements were made on each SPT sample. Upon reaching bedrock at about 67 to 75 ft. depth in these borings, the borings were advanced 10-ft into the bedrock using rock coring methods. SCS visually classified the rock core and sent representative rock samples to ZymaX Forensics for GC-MS and GC-FID fingerprint testing (one rock sample from each rock core).

Logs of all of the auger borings are shown in **Appendix A-3**.

Gas Monitor Wells - Gas monitor wells (GMP's) were installed in all of the borings and geoprobes around the perimeter of James Park. The gas monitor wells consisted of a 10-foot-long, 1-inch-diameter slotted PVC pipe section installed at specific depths in each of the borings to capture any gas phase occurring in a specific geologic unit at the location.

Generally, GMPs were installed in the borings in the contact area between the soft and hard glacial till units and in the upper bedrock unit at each location. GMPs were installed in the geoprobes only in the contact area between the soft and hard glacial till units. An exception to this general rule occurred at location 19 in the parking lot of Dawe's School. At this location an additional GMP (GMP-19S) was installed in the center of the soft glacial till unit to determine whether a gas phase existed at that level.

Gas concentration and pressure measurements were made on quick connections installed on each of the GMPs using a GEM 5000 landfill gas meter. These measurements were also made on GMPs installed during CSG investigations. It was not possible to make gas concentration and pressure measurements on some of the wells because the GMP installed did not encounter a gas phase and the GMP was flooded with water. The field gas concentrations, water levels, screened zones and pressure measurements are shown in **Appendix A-1, Summary Table 1**.

The logs of the GMP's are shown in **Appendices A-2 and A-3**.

4.1.2 Crust Sample From Water Pipe Excavation at Dodge Street and Mulford

The City of Evanston Department of Public Works (EDPW) was repairing a water main at the time the borings and probes were being drilled. SCS observed that the work was being done and

discussed the activities with Mr. Tim Bartus, Director of Public Works. A photograph of the work is shown on **Figure 4**.

Several pieces of dark brown to black crust were extracted from a water pipe at the corner of Dodge Street and Mulford Avenue during the investigation. The water line was at a depth of about 12 feet bgs at the point the repair was occurring. This depth was about 5 to 8 feet below the invert of other electrical and gas utility lines in the area and was estimated to be 5 or more feet above the crown of sanitary and storm sewers in the area.

Mr. Bartus indicated that the water line along Dodge Street is encrusted with a relatively thick layer of dark brown to black material that has to be removed to allow for repair of the water line. This crust material is shown in the photograph on **Figure 5**. The thickness of the crust material on the pipe is typically varies from about 2 to 4 inches along Dodge Street. SCS took a sample of the crust material for analytical testing (see laboratory reports in **Appendices B-2 and B-3**).

4.1.3 Water Sample From GMP-19S

The GMP installed in GMP-19S did not encounter a gas phase. The GMP was found to be filled to a depth of about 15 feet bgs with water. During an attempt to remove the water from GMP-19S to stimulate a gas phase if one were present, a dark brown to black liquid phase was observed in the liquid being removed. The liquid is shown on the water's surface in the photograph on **Figure 6**. The liquid in GMP-19S was sampled twice, and the samples were sent to laboratories for analytical testing using qualitative GC-MS and GC-FID fingerprinting methods and quantitative SVOC and VOC analyses.

4.1.4 Locations of Natural Gas Pipelines In the James Park Area

Based on our review of public information, SCS did identify that there are substantial natural gas pipeline infrastructure elements in the general vicinity of James Park area. These include a major terminal for Kinder Morgan, major trunk lines for Nicor and Peoples Gas Company that tap their supply from the Kinder Morgan terminal. The location of the Kinder Morgan terminal is shown on **Figure 1.**

Based on information SCS received from Mr. Greg Stiglic of Nicor on May 21, 2014, SCS was able to identify the general locations of existing natural gas pipelines in the area of James Park. **Figure 7** shows the locations of existing gas pipelines in the specific area of James Park. This information was provided in the e-mail referenced above. These pipelines are located on the North, East and south sides of James Park. The existing pipelines were installed from 1929 to 1971. We understand that the operational pressures in the pipelines shown range from 0.25 pounds per square inch (psi) to 60 psi.

In November 2014, Nicor excavated and decommissioned a portion of their existing system in the area immediately north of James Park. We understand from correspondence from Nicor that this work was done to remove a portion of the system containing cast iron pipe because this portion was known to be prone to leakage (**Reference 4**). SCS observed excavations made on Dodge Street just north of Oakton Street and on Asbury Street just South of Oakton Street. The photographs on **Figure 8** shows the pipe exposed in these excavations and the visual condition of

the interior and exterior of the pipe after excavation and removal from the excavation. SCS requested to take samples of coating observed on the interior of pipeline materials during this work but this request was denied by Nicor.

4.1.5 Locations of Other Pipelines in the James Park Area

SCS identified the locations of three other pipelines in the James Park area. These locations include the following:

1. Known location of a 24-inch diameter pipeline that extended from the former MGP plant under the North Branch of the Chicago River and extends along (**Reference 5**);
2. An abandoned 12-inch diameter pipeline of unknown origin that the EPWD encounters along Dodge Street during their work in that area (**Reference 6**);
3. An existing 48-inch diameter pipeline (abandoned) located near the southwest corner of James Park. This pipeline is identified on drawing 5221D – RS26 R1 prepared by Harza Engineering Services and dated 12/93 (**Reference** 7).

5.0 LABORATORY INVESTIGATIONS

The analytical test results are presented in **Appendices B-1** through **B-6**. **Appendix B-1** provides summary tables of the VOC, Isotopic and Gas Composition Data for the GMPs installed by SCS. **Appendices B-2** through **B-6** provides the laboratory analytical reports.

Appendix B contains the following information:

- Appendix B-1: Analytical Data Summary Tables
  - Summary Table 1: Summary Gas VOC Data for James Park and the MWRD.
    - Table 1-A: Halogenated Compounds in Waste GMPs Compared to Perimeter GMPs
  - Summary Table 2: Summary of Gas Isotropic Data for James Park GMPs 1, 10, 11, 17, 18 and 19A
  - Summary Table 3: Summary of Gas Composition Data for James Park GMPs 1, 10, 11, 17, 18 and 19A
    - Table 3-A: Calculation of Average Methane Concentrations in Waste and Perimeter GMPs
- Appendix B-2: GC-MS and GC-FID Fingerprinting Data for Liquid and Solid Media
- Appendix B-3: VOC and SVOC Data for Gas, Liquid and Solid Media
- Appendix B-4: Mercaptan and Hydrogen Sulfide Data for Gas Media
- Appendix B-5: Isotopic Data for Gas Media
- Appendix B-6: References Used to Document That the Halocarbons Listed in Appendix B-1, Table 1-A, Are Not Naturally-Occurring Compounds

5.1 GEOTECHNICAL

SCS performed various index property testing on selected representative samples from the borings and geoprobes. The results of the geotechnical testing are shown on the boring logs shown in **Appendix A-2** and **Appendix A-3** and in **Appendix A-1**, **Summary Table 2**.

5.2 ANALYTICAL CHEMISTRY TESTING

5.2.1 GC-MS, and GC-FID Fingerprinting Data

SCS performed a GC-MS fingerprint test on the liquid sample taken from GMP-19S and on the solid crust sample taken from the water line. Results of the GC-MS and GC-FID fingerprint testing on all the liquid, and solid samples are given in **Appendix B-2**.

5.2.2 VOC and SVOCs

SCS performed seven VOC GC-MS tests on Suma-Canister samples taken from GMPs installed in the vicinity of James Park. Of these samples, five samples were taken from GMPs installed by SCS and CSG around the perimeter of the landfilled portion of James Park, and two of the samples were taken from GMPs installed by SCS in the landfilled portion of James Park. The locations of the GMPs on the interior of James Park were selected to be in the closest proximity possible to the areas where perimeter GMPs showed the largest concentrations of gasses and the highest gas pressures. These were near GMP-1 in the southwest corner of James Park, and near GMP-19, GMP-10, and GMP-11 in the northeast corner of James Park and the Dawes Elementary School.

SCS performed a total of eight VOC and eight SVOC tests on air, liquid, and solid samples as described in **Section 5.2.1**. Results of the VOC and SVOC testing are given in **Appendix B-3**.

6.0 LITERATURE INVESTIGATIONS

SCS made literature searches to obtain reasonably available technical information relevant to the objectives of the assessment of the potential source of the occurrence of petroleum and gas in the James Park area. The principal references used for the assessments are listed in **Section 9.0** of this report.

7.0 ASSESSMENT OF EACH OF THE POTENTIAL SOURCES OF THE OCCURRENCE

7.1 GENERAL

The list of potential sources of the occurrence of petroleum and gas in the James Park area includes the following:

1. James Park Landfill;
2. Former MGP site, and specifically its operations including gas transmission through pipelines in and around the perimeter of James Park;
3. The former operation of the large oil storage tanks at the MWRD site;
4. Releases from existing high and low pressure natural gas pipelines in and around the perimeter of James Park; or
5. Natural petroleum and gas occurring in the local geology of the area.

Our assessment of each of these potential sources, using the data obtained from the work performed during this investigation, is presented in the sections that follow. The assessment generally includes:

1) A focused summary of the basis for the inclusion of each as a potential source;
2) An outline of the relevant information that was considered;
3) A summary of our analyses of the relevant data with respect to determination of the viability of the specific potential source as the cause of the occurrence; and
4) Our conclusion whether the potential source being evaluated remains in consideration as a potential source of the occurrence of petroleum and gas in the James Park area.

7.2 JAMES PARK LANDFILL

7.2.1 Basis for Consideration as a Source

The James Park Landfill was identified as the sole source of the petroleum and gas encountered in the borings drilled and sampled by Tetra Tech at the MWRD site. Specifically, on page 9, the Tetra Tech Report states:

> *Presence of landfill gas on the northeast side of the site could be attributed to landfill-type gas and leachate that may be mobilized by the gas in a confined groundwater system.*

The Tetra Tech report did not implicate any other potential source for the petroleum and gas found on the MWRD site.

7.2.2 Outline of the Relevant Information in Support of Basis

The Tetra Tech report had limited scientific information and analyses to support the conclusion in their report. The primary data that Tetra Tech relied on was an aerial photo of the clay borrow area filled as part of the landfill operations at James Park in the 1940's and 1950's. The aerial

photos showed the proximity of the clay borrow area to the general area at the MWRD property where the petroleum and gas were encountered. There was no scale on the photograph. The Tetra Tech report did not propose a distance that these constituents would have to travel to be present at the MWRD site nor did Tetra Tech make any form of analysis to determine that the constituents would be able to travel that distance and occur at the concentrations and pressures found at the MWRD site.

7.2.3 Summary of Our Analyses of the Relevant Data for Determination of the Viability of the Landfill at James Park to be a Potential Source of the Occurrence

Tetra Tech Report - The Tetra Tech report does not offer any relevant data to associate the petroleum and gas found in the borings and probes drilled at the MWRD site with the former landfill in the area of James Park. The actual distance from the project area where the petroleum and gas was encountered at the MWRD site and the closest point at James Park is approximately 1000 feet. More importantly, the Tetra Tech report contained no data on the nature and occurrence of either petroleum or gas constituents in the former landfill at James Park in comparison with the constituents found at the MWRD site.

An evaluation of the history of the landfill operations shows that the landfill was only permitted to receive inert waste materials that did not contain petroleum or substantial amounts of putrescible organic materials. Additionally, the landfill ceased receiving waste more than 50 years ago, so the concentration of gas in the landfill and the pressure of these gasses would be expected to be very low even if the landfill had received organic waste materials. The Tetra Tech report did not explore these investigations or lines of logic.

It is our conclusion that the Tetra Tech report stating that the former landfill at James Park is the source of petroleum and gas in the vicinity does not present a scientifically sound basis for their conclusion and should be disregarded for this purpose.

CSG Report - Mr. Craig Rawlinson of CSG prepared a report (**Reference 2**) presenting his review of the Tetra Tech Phase II Report. The conclusion reached by Mr. Rawlinson regarding his opinion on the viability of the landfill at James Park being the source of petroleum and gas at the MWRD site is stated as follows:

> *It is the opinion of CS Geologic that no definitive evidence has been presented to suggest that the Water Reclamation Plant Facility has in any way been impacted by a leachate or landfill gas release from landfilled areas of James Park. It is recommended that the preceding review be forwarded to the IEPA so that they are apprised of this alternate explanation for the conditions described in the TetraTech report.*

SCS agrees with this opinion regarding the impact of the landfilled areas of James Park on the MWRD site. Mr. Rawlinson proposed an alternate explanation for the petroleum and gas in the James Park area that was based on his opinion that the petroleum and gas encountered at the MWRD site was a result of the natural occurrence of petroleum in the upper Silurian bedrock

deposits in the Chicago area. SCS does not agree with Mr. Rawlinson's alternate explanation for the occurrence of petroleum and gas in the James Park area. Our assessment of Mr. Rawlinson's alternate explanation is given in **Section 7.6** of this report.

SCS Analyses of Landfill at James Park as a source of petroleum and gas in the James Park area – SCS made a detailed analysis of all of the available data from the investigations conducted at the MWRD site, the MGP site, and the James Park area in the assessment of whether the landfill at James Park is a source of petroleum and gas in the vicinity of these three sites. **Table 1** presents a tabular summary of the key data relevant to our assessment. The data and calculations used to prepare this table are shown in **Appendix A-1, Table 1-A** (average maximum pressure calculations) and **Appendix B-1, Table 3-A** (Average methane calculations).

Our conclusion is that the landfill at James Park is not a source of either the petroleum or any measureable portion of the gas being observed even in the GMPs installed on the perimeter of James Park. SCS has similarly concluded that the James Park Landfill is also not the source of any petroleum or gas observed in borings made at the MWRD site. These SCS conclusions are based on the following major facts that are supported by the data we reviewed:

1. The landfill ceased receiving waste materials more than 50 years ago. Given this age, the landfill would not be expected to have much methane production even if significant organic materials had been placed in the landfill.

2. The average methane concentration in two gas probes installed in the landfill in close proximity to the perimeter areas was 3.6 percent compared to a methane concentration of an average of 85.26 percent in areas where methane was observed on the perimeter of the landfill. It is possible that some of the methane that is being detected inside the landfill is a result of migration from methane on the perimeter of the landfill into the landfill area. It is not possible to explain the high levels of methane on the perimeter of the landfill by migration of methane from within the landfill.

3. The gas pressures measured in the two gas probes installed in the landfill are zero psi. The gas pressures measured in gas probes installed on the perimeter of the landfill where gasses were present (GMP-1, GMP-10, GMP-11 and GMP 19A) averaged 11 psi. The significantly-higher gas pressures measured in the perimeter GMPs cannot be a result of gasses migrating from the landfill to the natural soils on the perimeter of the landfill where GMP-1, GMP-10, GMP-11 and GMP 19A are located.

4. The Carbon 14 concentration of the gasses in perimeter wells around the landfill at James Park range from 2.1 to 2.9 percent Modern Carbon (pMC). This results in an age from about 29,000 to 31,000 years before present. In actuality, the age could be substantially older than this as a result in the limitations of the sampling methods we used for this project. Generally, the upper age of the use of Carbon 14 is about 40,000 years unless very advanced protocols are used to obtain and test the samples.

   In comparison, the Carbon 14 concentration of the gasses in GMP'sinstalled in the landfill (GMP 17 and GMP 18) was 81.3 to 85.1 pMC. This translates to an age of about 1,600 years before present. This calculated age is somewhat greater than would be

expected. However, the great disparity between ages calculated using the two sets of Carbon 14 measurements is an indication that the gasses in the perimeter wells outside the landfill could not have resulted from migration from gasses within the landfill. On the contrary, these data are indicative that the gasses within the landfill may be a result of older age gasses from outside the perimeter of the landfill migrating into the landfill and mixing with much younger and much more limited quantities of the much younger landfill gas.

5. Given that SCS has concluded that gas migration is not occurring from the landfill at James Park, SCS similarly concludes that the landfill at James Park is also not the source of any of the gasses that were detected in the borings and probes drilled and installed at the MWRD property in 2012.

6. The borings drilled in the landfill at James Park by SCS did not encounter any significant evidence of the presence of organic waste materials, active gas emission or free product or significant other petroleum phase liquids. The review of records related to the waste streams that were to be allowed into the landfill is consistent with these findings. These findings are also consistent with the conclusion that the landfill at James Park cannot be and is not the source of petroleum and gas constituents found in borings, probes, and monitor wells in the vicinity of James Park or at the MWRD site.

7.2.4 Conclusion Whether the Landfill at James Park Remains in Consideration as the Potential Source of the Occurrence

Based on the assessment described in this section, SCS concludes that the former landfill at James Park cannot be and is not a potential source of petroleum and gasses found in borings, probes, and monitor wells installed at any of the three sites in the James Park area. These sites include the MWRD site, the MGP site, and areas outside the actual limits of the landfill at James Park.

7.3 FORMER MGP SITE OPERATIONS AND INFRASTRUCTURE

7.3.1 Basis for Consideration

The former MGP Site was identified as a potential source of the petroleum and gas encountered in the borings drilled and sampled by Tetra Tech at the MWRD site. Specifically, on page 2, the Tetra Tech report states:

> *In addition to on-site evaluations, the following potential off-site sources of the oily material (in bedrock) were noted: ... the former Skokie manufactured gas plant (MGP) north of the pipeline corridor,*

The Tetra Tech report states the following:

> *The MGP site was investigated by Burns and McDonnell in 2010 and is undergoing cleanup under the Site Remediation Program; no indication that contamination extends into the bedrock has been found.*

SCS concludes that the Tetra Tech analyses of the MGP site as a potential source of the occurrence of petroleum and gas in the vicinity of James Park is deficient in two significant respects. First, it eliminates the MGP site as a source on a scientifically unsound basis as defined in the following section of this report, and second, it does not include any assessment of an important part of the site operations and distribution system infrastructure that extends into the James Park area.

7.3.2 Outline of the Relevant Information in Support of Basis

In the first citation above, Tetra Tech eliminated the MGP site as a potential source without any backup for the conclusion, including presentation of data showing results of investigations at the MGP site itself. In fact, SCS could find no borings or other such information in any data reviewed in the Burns and McDonald (B&M) report that indicated any attempt to get soil or bedrock information from the MGP site below a depth of about 25 feet. Our review of the B&M report indicated that petroleum contamination extended to the depth of their investigation – about 25 feet bgs and there were no direct data such as boring or probes that penetrated to and into the bedrock to indicate whether the contamination extended into the bedrock formation. Therefore, the conclusion eliminating the MGP site in the Tetra Tech report is a result of the absence of data. The conclusion is not a result of data showing an absence of contamination extending into bedrock. The B&M report did show one photograph of waste tar found near soil boring SB-170. This photograph is shown on **Figure 9.** The tar appears to be in a dark brown to black, low to moderately viscous liquid. There were no analyses in the B&M report to characterize the species and concentrations of constituents in the tar material.

The conclusion in the Tetra Tech report does not specifically include the infrastructure such as pipelines and other distribution system extending from the MGP operations into the James Park area. The SCS evaluation includes this element because the distribution system (e.g., pipelines, condensate traps, meters, valves, and vaults) extended throughout the James Park area and beyond. The gas from MGP facilities using the same process used at the MGP facility in Skokie is known to have included minor component amounts and remnants of the raw and processed materials (coal tar, fuel oil and fuel oil tar) used to create the gas at the plant. SCS was able to determine that two, 24-inch diameter pipelines extended from the MGP plant under the channel and towards the James Park area. Drawings showing this infrastructure element are shown in **Reference 5**. These two pipelines were abandoned and replaced with subsequent distribution infrastructure. The details of the abandonment procedure were not available. There were no data or other types of information about the nature and extent of the MGP distribution system beyond that shown on drawings in **Reference 5**.

7.3.3 Summary of our Analyses of the Relevant Data for Determination of the Viability of the MGP site as a Source of the Occurrence

Tetra Tech Report - The Tetra Tech report did not include information from the Site Investigation Reports (SIR) prepared by B&M documenting the investigation work at the MGP site. Consequently, SCS concludes that the Tetra Tech's elimination of the MGP from consideration as a potential source does not have a scientifically sound basis.

Burns & McDonald SIR Report on MGP Site - B&M prepared numerous reports on their activities at the MGP site north of the MWRD site. One report, the SIR dated November 2008 (**Reference 3**), describes investigative activities and presents findings for the Site. SCS reviewed the B&M SIR report and concludes the following with respect to the data and information that the report provides.

1. The depth of the investigation of the MGP site by B&M was limited to about 25 feet bgs. Most of the investigation was at depths much less than this. There were no data from bedrock (depth of about 60 to 70 ft bgs) at the MGP site. The only bedrock core samples that were obtained from borings were from the Tetra Tech investigation of the MWRD site and from the CSG and SCS investigations around the entire perimeter of the James Park area.

2. The results of the investigations of the MGP site indicated the prevalence of contamination with constituents similar to those found in samples tested from the James Park area – primarily polyaromatic hydrocarbon (PAH) SVOC and the VOC compounds benzene, ethylbenzene, toluene, and xylene (BETX) found by others to be associated with releases from MGP operations.

3. The B&M SIR did not consider the impact of the extension of contamination from the MGP operations site by pathways created by the distribution system to the customers of the product created at the site.

4. The B&M SIR did not characterize any of the important elements of the site operations including such factors as the process(es) used to manufacture the gas, the raw materials used in the operation, system efficiency and the nature and extent of the distribution system.

5. The Tetra Tech analyses did not consider the above factors in their assessment that the MGP site as a potential source of the occurrence of petroleum and gas at the MWRD and other sites in the vicinity of the MGP site.

SCS Analyses of the MGP site as a potential source of petroleum and gas in the area - SCS analyzed the available data from the investigations conducted at the MWRD site, the MGP site, and the James Park area in the assessment of whether the MGP site remains as a potential source of petroleum and gas in the vicinity of the James Park area. **Table 2** presents a tabular summary of the data relevant to our assessment.

Additionally, SCS investigated readily-available information sources regarding the history of the MGP site to determine the types of process(es) that were used to manufacture the gas, the types of raw materials used in these process, and the typical properties of tars, condensates and residues resulting from the MGP processes identified. A key source of information was the Brown's Directory of American Gas Companies. (Brown's) (**Reference 8**). **Figure 10** presents a page from the 1918 Edition of Brown's describing the information available for the MGP site.

Specifically, the 1918 Brown's identifies that the "process manufacture" is "Lowe's (Williamson)." This process was also known as the "carbureted water gas" Process.

The Lowes process used "oil" in conjunction with water-gas to enhance the caloric value of the gas produced. SCS reviewed information showing the layout of facilities at the Skokie MGP. **Figure 11** shows two views of the site in about 1950. **Figure 11A** is a plan view of the site purported to be from 1950, **Figure 11B** is an aerial photo of the site purported to be from 1952. Both show the location of a significant number of tanks. These tanks are physically identified in the 1950 plan to be oil tanks, fuel oil tanks and tar tanks.

SCS also identified a relevant paper by Dr. Brian Murphy (**Reference 9**) that provided data and analyses of the characteristics of tar and condensate that result from the production of manufactured gas using various processes including the carbureted water-gas processes. In summary, the paper shows:

1. **From Slide 11** – The paper states:

   "In former days it was a common custom to put all these tar tanks, settling tanks, etc. in the ground and to build them of wood. In time these became leaky and the contents would ooze out. Similarly, metal tanks would rust out and leak, and brick tanks would become more or less permeable. The present tendency is toward the use of better tanks, in order to avoid losses of valuable substances and in order to prevent pollution. The **wastes from water gas plants are more troublesome in this respect than the waste from the coal-gas plants.** ...Often the floor of the tanks is built of concrete or brick and there is danger of leakage from such holders, as their area is considerable." (Whipple 1908)

2. **From Slide 14**

Tar Viscosity at Time of Manufacture

	Water gas tar #1	Water gas tar #2	Light water gas tar	Low temperature coal tar	Coke oven coal tar	Pacific Coast oil gas tar
Dynamic Viscosity (cP)	9.1	9.9	12	60	1,470	119

Note: Viscosity converted from degrees Engler, T = 104° F = 40° C

3. **From Slide 16**

How "Tarry" is MGP Tar: Comparison with Common Fluids

Fluid	Viscosity (cps)	Tar	Viscosity
Water (65°F)	1		
Milk	3	Water gas tar #1	9.1
Blood	10	Water gas Tar #2	9.9
Gasoline	11	Light water gas tar	11
Beer	18	#7	32.0
Cream	20	#11	34.7
Vegetable oil	40	Low temperature coal tar	60
SAE 10	88–206	#9	51.0
		#10	62.6

4. **From Slide 27**

Tar Properties

Site/Sample	1B	2B	4	7	9	10
Density (g/cm^3)	1.066	1.104	1.062	1.076	1.054	1.062
Dynamic viscosity (cP)	63.6	425.3	144.6	32.0	51.0	62.9
Surface tension (dynes/cm)	33.75	26.67	34.35	34.17	23.44	33.63
Interfacial Tension (dynes/cm)	26.70	27.83	22.55	25.79	22.37	24.43
α_t (cm^3/cm^3)	0.159	0.226	0.131	0.156	0.192	0.077
θ (degrees)	15.8	22.4	26.8	17.4	19.3	21.6

Source: EPRI (2004); Kong (2004). θ is the average at pH 4.7 and 7.1.

5. **From Slide 31**

How long does the tar take to move 100 m in the saturated zone?

- Generally a few years
- Worst case about two decades
  - High viscosity
  - Low conductivity
  - Near neutral buoyancy
- Requires a large initial input of tar from 7.7 to 22.6 m thick to go 100 m
- Much faster in the vadose zone

SCS's assessment of the information in this paper indicates that the tar created by the process used at the MGP site has favorable density and viscosity properties for migration through the local geologic materials into the upper bedrock formation. Small amounts of the raw materials used in the process would also be expected to travel along with the gas in the distribution lines and collect as tars in condensate traps provided for that purpose at regular intervals along the entire distribution system. The tars would also be expected to collect in sags and other lower parts of the distribution lines. Releases from the distribution system were known to occur and this resulted in migration of the tars into the surrounding geologic materials.

A review of the information in the Brown's shows that 8 percent of the gas was "unaccounted for" in 1918. This line item provided in the Brown's directory is an overall index of the amount of loss and leakage of materials from the operational and distribution system for the preceding year. This volume of loss is a significant amount in the evaluation of the potential for the MGP to be a source of the occurrence.

Table 2 presents a summary of the comparison of VOC and SVOC testing of samples taken at the Skokie MGP and the crust sample taken in the SCS investigations. **Table 2** also shows the typical constituents found in MGP waste materials by the New York State Department of Environmental Conservation (NYSDEC) and the USEPA. It is clear that the constituents found in the crust sample are the same as those found at MGPs in general and in the Skokie MGP samples in particular.

The SCS conclusion is that the MGP site, including the distribution system used to transport the gas to customers, is a potential source of the petroleum and the gas being observed in the GMPs installed on the perimeter of James Park. This conclusion is based on the following major facts that are supported by the data reviewed:

1. The VOC constituents of concern found in the crust sample from the water pipe at the southeast corner of James Park are similar to the constituents of concern found in the

results of analytical testing of numerous samples obtained from borings and probes drilled and installed at the MGP site. The constituents of concern found at the MGP and at James Park are almost identical to those expected for MGP waste materials based on the literature study done by SCS.

2. The process used at the MGP site (Lowe carbureted water-gas) created tars with a very low viscosity and a reasonably high density (greater than water). These tars have a high potential to migrate through saturated soils like those in the MGP and James Park area (**Reference 9**).

3. The tars produced at the MGP site are known to migrate along with the gas in the distribution system. In systems like this one, it was typical to have condensate traps to collect these tars and liquids at intervals along the distribution system. It is known that a portion of the tars and liquids also typically were reported to accumulate in the piping for the distribution system between the condensate traps and would leak through defective or damaged joints before entering the condensate trap.

4. There was a high potential for releases of tars in the operational and infrastructure system of MGP's like the MGP site in the James Park area.

7.3.4 Conclusion Whether the MGP Site Remains in Consideration as the Potential Source of the Occurrence

Based on the assessment described in this section, SCS concludes that the MGP site and its distribution system are a potential source of petroleum and gasses found in borings, probes, and monitor wells installed in the three sites in the James Park area. These sites include the MWRD site, the MGP site, and the perimeter area of James Park outside the actual limits of the landfill at James Park.

7.4 THE FORMER OPERATION OF THE LARGE OIL STORAGE TANKS AT THE MWRD SITE

7.4.1 Basis for Consideration

The large oil storage tanks at the MWRD site were identified as a potential source of the petroleum and gas encountered in the borings drilled and sampled by Tetra Tech at the MWRD site.

7.4.2 Outline of the Relevant Information in Support of Basis

With regard to the presence of petroleum and gas at the MWRD site, the basis for Tetra Tech's consideration of the large oil storage tanks at the MWRD as a source of the petroleum and gas at the MWRD site was valid and feasible. However, the Tetra Tech report (**Reference 1**) concluded that the presence of petroleum and gas at the MWRD site was not a result of these tanks but was a result of migration of these constituents from the landfill at James Park.

7.4.3 Summary of our Analyses of the Relevant Data for Determination of the Viability of the Former Operation of the Large Oil Storage Tanks at the MWRD Site as a Cause of the Occurrence at James Park Area

Tetra Tech Report - With regard to the consideration of the large oil storage tanks as a source of petroleum and gas at the James Park site, the Tetra Tech report actually concluded the opposite relationship between the two sites. The Tetra Tech report concluded that the presence of petroleum and gas at their site was a result of migration of these constituents from the landfill at James Park. The SCS analysis of this conclusion is presented in **Section 7.2** of this report.

The SCS Analyses - Given the results of the Phase I and Phase II studies of the MWRD site area, SCS concludes that it is unlikely that the former operation of the large oil storage tanks at the MWRD site are a source of petroleum and gas in the vicinity of James Park area. Given that the specific gravity of the oils stored in these tanks is generally less than 1.0, it is not likely that vertically downward migration of the oil occurred even if the tanks leaked. Additionally, even if there were to be some vertically downward migration of the oils from tanks at the MWRD site, it is not possible to envision a pathway or a time frame by which the petroleum and gas could migrate from the tanks to the James Park area.

7.4.4 Conclusion Whether the MGP Site Remains in Consideration as the Cause of the Occurrence

Based on the assessment described in this section, SCS concludes that the former operation of the large oil storage tanks at the MWRD site are not a potential source of the occurrence of petroleum and gasses found in borings, probes, and monitor wells installed in the vicinity of James Park.

7.5 RELEASES OF GAS FROM EXISTING HIGH AND LOW PRESSURE NATURAL GAS PIPELINES IN AND AROUND THE PERIMETER OF JAMES PARK

7.5.1 Basis for Consideration

The Tetra Tech report initially identified the existing natural gas pipelines in the vicinity of the MWRD site as potential sources of gas found in borings drilled on the MWRD site. Additionally, SCS identified releases from existing high and low pressure natural gas pipelines in and around the James Park area as a potential source of gas in the GMPs installed on the perimeter area of James Park.

7.5.2 Outline of the Relevant Information in Support of Basis

Table 1 shows the methane and pressure measurements made in the GMPs installed around James Park. In general, the methane concentrations measurements have shown 82 percent to 87 percent based on laboratory data, and 83 percent to 99 percent based on field data, and maximum pressures have ranged from 4.2 psi to 13.8 psi. These concentrations and pressures

are consistent with the operational parameters for concentrations and pressures used in the natural gas pipe lines in the James Park area.

7.5.3 Summary of Our Analyses of the Relevant Data for Determination of the Viability of the Natural Gas Pipelines as a Source of the Occurrence

Tetra Tech Report - The Tetra Tech report did identify that the gas from borings at the MWRD site were tested for index chemicals as discussed below:

> *When the locking well cap was removed, gas under pressure was released from the well head at B-11. After the measurements of methane, the caps were placed back on the well heads at MW-1 and B-11.Nicor was initially notified on October 3, 2012 of the presence of a methane release, based on concerns that the methane might possibly be related to a nearby gas pipeline on October 3, 2012. A Nicor representative arrived at the site at about 14:30 on October 3, 2012, and measured methane at 100 percent in B-11 and 75 percent at MW-2. Nicor left the site at about 15:30 after not identifying any potential nearby Nicor source and suggesting that Tetra Tech contact Peoples Gas, which operates a nearby pipeline. Representatives of Peoples Gas and two pipeline companies (American National Pipeline and Kinder Morgan) arrived at the site on October 4, 2012. Peoples Gas collected gas samples for analysis and provided verbal results later in the day. Peoples Gas verbally indicated that the sampling results did not indicate a mercaptan signature representative of gas conveyed by its nearby pipelines.*

There was no attempt reported to measure the pressure that existed in the borings where gas was encountered.

The absence of mercaptan in the sample taken and tested by the utility was the only parameter reported in the Tetra Tech report to have been considered in the decision about whether the pipelines are a source of the gas. The very high concentration levels of methane reported in the Tetra Tech report (100 percent in SB-2) were apparently not considered to be significant in the source assessment presented in their report. SCS does not agree that the absence of mercaptan is definitive or sufficient to exclude leakage from the nearby natural gas pipelines from consideration given the extremely high concentrations of methane measured. The fact is that mercaptans are known to disappear quickly in soils due to adsorbtion so their absence is not sufficient to rule out natural gas pipelines as a source of the methane (**Reference 10**). The Tetra Tech report did not provide any other basis for their exclusion of the pipelines as potential sources of gas in the borings at MWRD site.

The SCS Analyses of the existing natural gas pipelines in the area as a source of petroleum and gas in the area - Table 1 shows the methane and pressure measurements made in the GMPs installed around James Park. In general, the methane concentrations measurements have shown 82 percent to 87 percent methane based on laboratory data, and 83 percent to 99 percent based on field data, and pressures have ranged from 4.2 psi to 13.8 psi. These concentrations and pressures are consistent with the operational parameters for concentrations and pressures used in the natural gas pipelines in the James Park area. SCS did not detect any evidence of mercaptan in the tests performed on any of the samples taken in this investigation. However, SCS does not

consider the absence of mercaptan to be dispositive that the natural gas pipelines in the area do not contribute to the gas occurring in the GMPs installed in the area of James Park because such compound can disappear quickly from leaked natural gas due to soil adsorption processes.

7.5.4 Conclusion Whether the Natural Gas Pipelines in the Area of James Park Remain in Consideration as the Cause of the Occurrence

Based on the assessment described in this section, SCS concludes that the natural gas pipelines in the area of James Park remain a potential source of gasses found in GMPs installed on the perimeter of James Park.

7.6 NATURAL PETROLEUM AND GAS OCCURRING IN THE LOCAL GEOLOGY OF THE AREA

7.6.1 Basis for Consideration

CSG Report - On page 3 of the CSG report, the following statement is made:

> *Similar petroleum materials were found at each rock cored boring at the water reclamation plant (note that in addition to borings SB-1 and B-11, boring B-8 and B-10 also reported similar petroleum materials). In addition ATEC boring B-16 completed in 1974 on behalf of the MWRDGC (Main Street Tunnel and Shaft Project) also reported similar black staining of the rock core obtained from the area of the drop shaft at Mulford St. The fact that so many rock cored borings in the area completed at different times suggest that the petroleum is spread over a wide area and it is likely to have been there for an appreciable time. It should be noted that similar asphaltic type residues have long been reported in the limestone pores at the Thornton Quarry in Southern Cook County (Alden 1902). Similar petroleum residues are also reported to have been detected in closer proximity to the site.*

No boring information was provided to document the above statement. The CSG report did not contend that there was any natural occurrence of gas that accompanied the presence of the alleged petroleum or asphaltic materials found in the upper bedrock in the James Park area.

SCS Investigation - The SCS Investigation has identified that there are no indications that there is naturally occurring petroleum in the upper Silurian bedrock deposits anywhere in the Chicago area including the James Park area. SCS performed GC-MS fingerprint testing of bedrock and water samples obtained from the perimeter of James Park. These results are given in **Appendix B-2.**

The SCS literature investigation did identify one paper presenting data showing the potential of naturally occurring gasses accumulating in the glacial drift materials in Illinois and in the Chicago area (**Reference 11**). This potential source had not been considered previously by CSG

or Tetra Tech. SCS has evaluated glacial drift gas as a separate potential source of gasses in the James Park area.

7.6.2 Outline of the Relevant Information in Support of Basis

Naturally occurring petroleum in the upper Silurian bedrock - The CSG report provides the only information in support of this alleged potential source in the vicinity of James Park. On pages 3 and 4 of the CSG report, Mr. Rawlinson states:

> William Alden (1902) writes:
>
> > *"The presence of petroleum, apparently saturating the rock in places, led, in 1864, to an attempt to procure a flow of oil. A well was sunk at the corner of Chicago and Western Avenues. While a small amount of petroleum was found the well failed to disclose the presence of oil in sufficient quantities to be of any value, and the attempt was abandoned."*
>
> Carl Anderson (1919) p. 185 describes similar petroleum materials in the Niagaran Dolomite in the Lake Forest area:
>
> > *"In drilling a 261 ft well on the same property (Armour Estate), the well driller reported finding in the drillings from the Niagaran Limestone gobs of a dark-colored substances resembling crude oil which would burn when thrown on the fire. The Niagaran Limestone in other localities, as in the Chicago area, shows dark colored, bituminous blotches. The presence of this substances may account for the noticeable content of hydrogen sulfide in the Niagaran limeston waters."*
>
> These references indicate that it is not uncommon to find minor amounts of crude petroleum and/or asphaltic petroleum residues in the Niagaran Silurian age bedrock. Because the rock consists largely of a biologic rich reef complex, it is not surprising that the limestone contains petroleum derived from decay of organic matter. Most of the petroleum was likely lost millions of years ago since the reef was not overlain by an impermeable cap rock (necessary for accumulation of an oil reservoir). Most of the petroleum is likely to have either undergone weathering, biodegradation, and was washed away by groundwater. However, if groundwater circulation was poor or restricted, it is likely that heavier phase higher carbon chain petroleum compounds would remain in the pores of the limestone. The lighter phase compounds would be more likely removed by biodegradation and by groundwater flow over millions of years.

The naturally occurring biogenic petroleum provides an explanation which is more consistent with the asphaltic type product characterization. the distribution of such a viscous product in widely spaced cored holes (holes where petroleum and/or staining was reported}, and the fact that the petroleum is found in the pores of the rock which would be largely inaccessible to an anthropogenic (i.e., man-made) release of a viscous product.

Naturally occurring gas in the glacial drift in the Chicago Area - SCS researched the potential for the accumulation of gasses in the glacial drift in the Illinois area. The primary paper that identified the occurrence of methane in the glacial drift deposits in Illinois was prepared by Meents 1960 (**Reference 11**). This paper was updated by Meents in 1981. Additionally, SCS contacted Mr. Steve Brown of the Illinois Geologic Survey (**Reference 12**).

7.6.3 Summary of Our Analyses of the Relevant Data for Determination of the Viability of the Naturally Occurring Petroleum and Gas in Geologic Deposits as a Cause of the Occurrence

Naturally occurring petroleum in the upper Silurian bedrock - Mr. Rawlinson contended in his March 29, 2013 letter report to the IEPA that biodegradation of naturally-occurring asphaltic petroleum residues in the bedrock at the Wastewater Treatment Plant was the probable source of the methane gas found at the bedrock-till interface at the Plant. SCS concludes that natural asphaltic petroleum residues are absent from the site vicinity and therefore cannot be the source of the methane gas.

SCS Analysis

- Mr. Rawlinson concluded that the naturally-occurring asphalt residue in the Silurian dolomite can exist as both an immobile solid phase and as a mobile liquid phase in the Chicago area. SCS agrees that solid-phase asphalt residues are reported in the Chicago area, but that liquid-phase, indigenous petroleum is not.

- The only reference provided by Mr. Rawlinson to document the purported liquid-phase petroleum was an 1866 document titled, "History of the Chicago Artesian Well, A Demonstration of the Truth of the Spiritual Philosophy, With an Essay on the Origin and Uses of Petroleum," by Geo. A. Shufeldt, Jr (**Reference 13**). According to the text of the document, the boring location for this well was selected during a séance with a spiritual medium. Additionally, a driller's boring log was presented as an attachment to this paper and it did not identify any petroleum or asphalt at the level that Mr. Shufeldt says that oil was observed. In SCS's opinion, this source lacks scientific credibility.

- If liquid petroleum were present in the Greater Chicago Area, it would have undoubtedly been encountered and reported in some of the thousands of water wells completed in the Silurian dolomite aquifer, in some of the thousands of geotechnical borings drilled to, or into, the Silurian bedrock, and in some of the hundreds of miles of tunnels bored into the Silurian bedrock in the Chicago area. SCS's review of the

historical literature did not reveal any mention of liquid petroleum in the Silurian bedrock besides the unscientific "Artesian Well" reference mentioned by Mr. Rawlinson.

- Mr. Rawlinson incorrectly assumed that the "free product phase" detected in the Silurian bedrock at the wastewater treatment plant by Tetra Tech and Greeley and Hanson was a naturally-occurring asphalt residue like the solid asphalt residues that are reported within the Silurian-age rocks of the Greater Chicago Area. Such asphaltic residues are typically black, solid, tar-like materials at aquifer temperatures (55 degrees Fahrenheit) but no such residues were reported in the Tetra Tech or Greeley and Hanson core logs from the MWRD site. These logs used the terms: "petroleum staining and odors" (one boring), "petroleum impregnated" (three borings), and "petroleum odor" (three borings). The word "petroleum" implies a liquid phase as opposed to a solid, asphalt phase.

- Tetra Tech cored one boring into bedrock (see SB-1 on **Figure 2**) and took photos of the cores. **Figure 12** is a photo of this core showing large pores in the bedrock and a brown stain on the walls of the pores. The pores are **not** filled with black asphaltic material as asserted by Mr. Rawlinson. A review of the core recovered from SB-1 shows alternating porous layers of brown, petroleum-stained dolomite, alternating with light-colored dolomite with less staining. Furthermore, Tetra Tech reported, "entrained oily material," in a water sample bailed from bedrock monitoring well MW-1, which was installed in Tetra Tech boring SB-1. This well was installed in the same bedrock interval that Tetra Tech had described as "Dolomite with petroleum staining and odors," and "oil stain on bedrock surface" (see **Figure 12**). Since the petroleum in the rock was able to flow into the well, it was clearly a liquid, mobile-phase as opposed to an immobile asphalt residuum.

- Subsequent to writing his critique of the Tetra Tech report in March 2013, Mr. Rawlinson oversaw bedrock coring operations in GMP-1 in the southwest corner of James Park. Mr. Rawlinson reported "non-liquid petroleum asphaltum in vugs and larger pores" in bedrock boring GMP-1 at James Park from 68.5 to 71.7 feet. Immediately below, however, he reported "petroleum oozing from pores." This description directly conflicts with statements in his report that the asphalt residuum is viscous and immobile.

- SCS obtained the GMP-1 core described by Mr. Rawlinson and carefully examined it. A photograph of the core obtained from GMP-1 is shown in **Figure 13**. The "vugs and larger pores" referred to by Rawlinson were empty and no "non-liquid petroleum asphaltum" was present. Rather, the rock was stained dark brown by a low viscosity petroleum, or petroleum distillate, with a strong fuel-oil type odor. The walls of the pores and vugs were similarly stained. One vug contained remnants of a dark brown hydrocarbon liquid that in no way resembled solid asphalt (see **Figure 13-b**).

- The most recent drilling program at James Park was completed by SCS in August 2014. Three bedrock borings were cored 10 feet into the bedrock (GMP-15, GMP-19, and GMP-21). Photographs of the cores from these borings are shown on

Figures 14, 15, and **16**. At GMP-15 and GMP-19, SCS encountered a low-viscosity, dark brown, translucent, non-sticky, free-product phase oozing from the rock that looked nothing like asphalt. All of the pores and vugs were empty, except for a brown staining on the walls of the pores. The cores from GMP-15 and GMP-19 exhibited a strong fuel-oil-like hydrocarbon odor and the more porous layers were stained brown. There was no evidence of hydrocarbon staining or petroleum odor in the cores obtained from GMP-2 or GMP-21. This sharp demarcation from stained rock at GMPs 1, 15 and 19 to unstained rock at GMP-2 and GMP-21 is not what would be expected if the hydrocarbons were natural to the geology of the area. This variation is consistent with a manmade release of hydrocarbon materials from local facilities and infrastructure.

- The SCS cores obtained in GMP-1, GMP-15 and GMP-19 looked very similar to the core obtained from SB-1 by Tetra Tech at the Wastewater Treatment plant). In both cases, the more porous layers in the rock were stained brown, and the vugs were empty, not filled with asphalt. This evidence is consistent with a manmade hydrocarbon spill of fuel-oil-type material that Mr. Rawlinson incorrectly identified in his report as natural asphalt.

- SCS performed GC-MS and GC-FID fingerprint tests on samples of rock core from GMP-15, GMP-19 and GMP-21. The results of the tests performed are given in **Appendix B-2**. In summary, the results of tests on GMP-21 showed no evidence of petroleum or hydrocarbon contamination. This is consistent with the visual examination of the core samples. The results of tests on GMP-15 and GMP-19 showed that the brown staining on the rock core is a hydrocarbon material consistent with a carbon chemistry of fuel-oil or residual or weathered crude oil product (carbon number of 14 to 37). In either case, SCS concludes that the hydrocarbon material is not natural to the geology of the Chicago or James Park areas.

SCS concludes that the liquid petroleum hydrocarbon materials found by SCS in some of the bedrock cores taken from borings made at James Park, and in bedrock cores taken in a boring made by Tetra Tech at the MWRD site, is the result of a release of a petroleum product that is not natural to the James Park area. SCS concludes, based on information and data from the James Park area that the source of the product found in borings in the James Park area is from a release consistent with operations and infrastructure at the MGP plant. The SCS investigation did not identify other sources such as industrial operations, pipelines, or large petroleum storage facilities in the James Park area that had the potential to cause the occurrence of petroleum and gas found in the borings in the James Park area.

Gaseous Phase Contamination and Pressure

Three borings completed in, or on top of, the Silurian bedrock by Tetra Tech (SB-11, MW-1, and MW-2) at the MWRD site encountered methane gas at the bedrock-till interface. The gas was reportedly under pressure, but no pressure measurements were made. Subsequently, pressurized methane gas was found in three additional gas probes at James Park at the contact between the soft and hard tills. This interface is located about 10 to 20 ft. above the bedrock-till interface.

Mr. Rawlinson concluded in the section of the report titled, "Gaseous Phase Contamination and Pressure," that the source of the methane gas was bacterial biodegradation of naturally-occurring asphaltic residues left over from millions of years of biodegradation.

SCS Response

- As previously discussed, there was no evidence of naturally-occurring asphalt residue in the borings made at the MWRD site or the James Park area. For this reason, SCS concludes that Mr. Rawlinson's theory does not explain the occurrence of methane gas in the site area.

- Mr. Rawlinson described the asphalt he reportedly encountered in GMP-1 as highly degraded residue that is resistant to further biodegradation. Such material, even if present, would be highly resistant to further biodegradation, and hence could not be responsible for the methane gas detected in the site vicinity.

- It may be possible for a spill of liquid hydrocarbon, such as fuel oil or refined crude oil residue to undergo biodegradation and thereby generate methane gas. However, to the extent that this process is active at the James Park area, SCS concludes that it is occurring as a result of the release of hydrocarbons from the MGP operations and infrastructure.

Naturally occurring gas in the glacial drift in the Chicago Area - SCS analyzed available geologic literature describing:

- The nature and extent of glacial drift gas in Illinois,
- Age dating of gas samples obtained from GMPs on the perimeter of James Park in comparison with age dating of comparable drift gasses in the available literature,
- Analyses of the gas chemistry in the samples taken from the GMPs,
- Experience with tunnel projects in similar geology in proximity to James Park, and
- Discussions with Quaternary Geologists with the Illinois State Geological Survey (ISGS) familiar with the occurrence of glacial drift gasses in the vicinity of James Park.

A summary of each of the elements of these analyses follow.

Literature Assessment - Figure 17 shows the location of glacial drift gas in Illinois. This map was copied from Meents (1960) (**Reference 11**). The approximate location of James Park is also shown on **Figure 17**. There were no documented wells with glacial drift gas known to occur in the glacial setting of James Park as of 1960. Meents updated this paper in 1981 and he made no change to the map shown in the 1960 paper in the Chicago area.

Age Dating the gasses found in the GMPs installed on the perimeter of James Park - SCS determined the age of the gas in GMPs around the perimeter of James Park using Carbon 14 methods. The results of the tests performed by SCS and by others are given in **Table 3**. The range of results shows a Carbon 14 from 3.2 to 1.9 pMC with the average of all measurements being 2.5 pMC. Using the generally accepted half-life for Carbon 14 of 5,730 years, the range

of age of the gasses sampled in the GMPs installed around the perimeter of James Park is from 28,500 to 32,800 years before present. This range of age is approximately twice the age of gas that would be expected to occur in the Wisconsin Age glacial drift deposits present in the James Park area. Hackley, for example, showed that gas in Wisconsin age glacial drift deposits in the Lake Calumet area had an age of about 16,000 years before present (Reference 14a). Coleman also describes gas in Wisconsin age glaicial drift with an age of 16,000 years before present (Reference 14b). This difference in age is significant. The conclusion based on these measurements is that the gasses in the GMPs are not glacial drift gas.

Analysis of the chemistry of the gas in the GMPs – Appendix B-1, Summary Table 1 presents a summary of all of the VOC testing performed on samples of gas from the GMPs by CSG and SCS and on MW-B11 at the MWRD site by Tetra Tech. Analyses of these data indicate that the methane concentrations in the GMPs range from about 82 to 87 percent for all of the laboratory measurements made.

The excerpt shown below is taken from Meents (1960) and shows results of chemistry testing done on drift gas sampled in Cook County and adjacent counties in Illinois.

Table 2. - Analyses of Glacial-Drift Gas in Illinois

	Location	Methane CH_4	Ethane C_2H_6	Illum.	CO_2	CO	O_2	Nitrogen N_2	H_2	Btu/cu ft at 760mm; 60°F Gross	Net	Specific gravity Calculated	Determined
						Cook County							
Giertz	SE SE NE 33-41N-9E	78.9	0.0	0.0	0.0	0.0	0.2	20.9	0.0	799	719	.64	.61
						Kane County							
Sykes	SW SE NW 16-42N-8E	80.2	0.0	0.0	0.0	0.5	0.4	18.5	0.4	814	733	.63	.65
						Lake County							
Natzke	SW NE NE 23-45N-11E	79.7	0.0	0.1	0.1	0.7	0.3	18.7	0.4	812	731	.63	.61

The data obtained from GMP's in the James Park area indicates somewhat higher methane concentration in the drift gas data compared with data in the Meents report, and the drift gas data in the Cook County wells sampled in the Meents investigation did not show any ethane concentration. The GMP borings had ethane concentrations ranging from 62,000 to 200,000 ug/m^3. Based on the comparison of the two data sets, SCS concludes that the methane in the GMPs is not from naturally occurring glacial drift gas.

Experience with tunnel projects in the area - There has been substantial activity on tunnel projects in the area of James Park that have vertically and horizontally traversed through the same geology where the petroleum and gas are being encountered in the borings, probes, and wells around the perimeter of James Park. These projects included vertical drop shafts for the Tunnel and Reservoir Plan (TARP) and one horizontal tributary channel connected to the main TARP tunnel that was drilled along Noyes Street in Evanston.

SCS reviewed a PhD thesis (**Reference 15**) prepared by Dr. Tanate Srisirirojanakorn of the University of Illinois concerning instrumentation installed during the construction of this tributary tunnel. **Figure 18** shows a plan view and geologic cross section of the tunnel. This tributary tunnel was constructed at almost the exact geologic boundary that gas is being encountered in the GMPs at James Park.

Dr. Srisirirojanakorn's thesis discussed the tunnel construction including the fact that there was no mention that the tunnel encountered any gas during its construction. SCS also discussed this thesis with Dr. Srisirirojanakorn's thesis advisor, Dr. Edward Cording. This thesis did not describe encountering any foreign gasses during construction of the tunnel. Additionally, Dr. Cording confirmed that, to his knowledge there were no methane or other such naturally occurring hazardous gasses encountered during the construction of the tributary tunnel.

Based our investigation of recent experiences with tunnel projects in the area of James Park, SCS concludes that the gasses in the GMPs around the perimeter of James Park are not a result of naturally-occurring glacial drift gasses.

Discussions with Quaternary Geologists with the ISGS - SCS learned that the ISGS recently completed an intensive study of the nature and extent of glacial deposits in Lake County, Illinois (**Reference 16**). SCS discussed this study with Mr. Steve Brown of the ISGS. Mr. Brown has participated in the study and is familiar with the occurrence of drift gas in this area. Mr. Brown directed SCS to the parts of the study closest to the James Park area. SCS reviewed the results of the borings and wells drilled closest to the James Park site and then contacted Mr. Brown to further discuss extension of the study to the James Park area. Following these discussions, Mr. Brown stated the following in an email sent to Mr. Hendron:

> *Dave, this note is a follow-up to our conversation about evidence for drift gas in glacial and post glacial deposits near Lake Michigan. We have been conducting geologic mapping in Lake County and have drilled a number of test borings during the mapping projects. We have not encountered deposits above the bedrock surface in easternmost Lake County that would be sources of drift gas.*
>
> *Please don't hesitate to contact me if you have any other questions.*
>
> *Sincerely,*
> *Steve*
>
> Steven E. Brown, M.S., L.P.G.
> Interim Chief Scientist
> Head, Quaternary and Engineering Geology Section
> Illinois State Geological Survey
> Prairie Research Institute

Based our discussions with Mr. Brown, we conclude that the gasses in the GMPs around the perimeter of James Park are not a result of naturally occurring glacial drift gasses.

Summary of Analyses that gasses in the glacial drift in the vicinity of James Park are glacial drift gasses - Based on our investigation, SCS concludes that the gasses in the glacial drift in the vicinity of James Park are not a result of naturally-occurring glacial drift gasses.

8.0 Opinion on the Potential Sources of the Occurrence

Based on the investigations and analyses performed by SCS and described in this report, it is SCS's opinion that two sources remain viable potential sources of the petroleum and gas found in the GMP's and borings around the perimeter of James Park. These two sources include:

1. Leakage of natural gas from existing and abandoned natural gas pipelines in the vicinity of James Park
2. Leakage of petroleum materials from the operational facilities at, and from the maintenance and operation of the pipeline infrastructure systems associated with the former Skokie MGP.

Further, based on the investigations and analyses performed by SCS and described in this report, it is SCS's opinion that four potential sources evaluated are not viable sources of the petroleum and gas found in the GMP's and borings in the James Park area. These four sources include:

1. James Park Landfill
2. Oil Storage tanks at the MWRD site
3. Natural petroleum in the geology in the James Park area.
4. Natural gasses in the geology in the James Park area

The conclusions and opinions presented in this report are based on the data and information described in this report. If and when additional relevant data are obtained, the conclusions and opinions will be reviewed and modified as appropriate to consider the additional data.