B.9 Chemical, physical and bacteriological characterizations of the waste stream before and after treatment and/or filtration. Include a characterization of the compatibility of the injectate with the injection zone and the fluid in the injection zone along with a characterization of the potential for multiple waste streams to react in the well bore or in the injection zone.

Injectate Characteristics

Wells IW-1 and IW-2 will inject non-hazardous fluids generated on-site from the landfill leachate and gas condensate collection systems. As necessary, fluids derived from or necessary for injection well operation and maintenance may also be injected. Fluids will be comingled prior to injection. Landfill leachate is anticipated to constitute the majority of the total fluid volume to be managed in the Class I wells.

Landfill leachate is generated when precipitation contacts the solid waste in the landfill's active disposal area. As this precipitation migrates downward through the waste mass, it dissolves soluble materials (or leaches) and mixes with other liquids contained within the waste or generated as part of the degradation process. Landfill leachate is comprised of approximately 98% water, along with relatively low concentrations of dissolved salts (sodium, chloride, bicarbonate, and potassium), organics, and other nutrients (Ammonia, BOD). Naturally occurring bacteria consume organic components of solid waste, generating landfill gas composed of methane and carbon dioxide. Gas is sent to treatment in an open flare and condensate from this system is diverted to the leachate management system. The landfill gas condensate comingled within leachate in the collection system.

Under the Ottawa County Farms Landfill Operating License, total leachate volume is recorded on a monthly basis and water quality on a quarterly basis. Fluid to be injected is collected at the leachate collection sumps in each cell, then is transferred to the leachate holding tank. In addition to water from the leachate collection system, liquids will also be collected from the landfill gas condensate collection system. A single sample is collected from the composite stream on a quarterly basis, and analyzed for the parameters per the Landfill Operating License requirements.

Leachate is currently being transported by truck for disposal at a commercial facility. Ottawa County Landfill, Inc. has an agreement with a Commercial Waste Facility located in Grand Rapids, Michigan, for both transport and disposal of leachate. The Commercial Waste Facility discharges their combined waste volume to the City of Grand Rapids POTW. Approximately 790,000 gallons are hauled offsite weekly. Additionally, leachate is permitted for recirculation and dust control per an approved Leachate Recirculation Plan, although company policy does not allow with recycle or reuse. Leachate analyses performed from 2002 to 2019 is summarized in Tables B.9-1 and B.9-2; Appendix B9 includes detailed tabulations of leachate analytical data. These analyses show that these leachate samples contain very few detected organic compounds. TDS values from leachate sampling data from 2017 to 2018 varied from

5,700 mg/L to 10,000 mg/L. Table B.9-3 presents a summary of the most recent leachate analyses collected in May, 2020. The most recent sample results are generally consistent with historical data, and the sample exhibited a TDS value of 8,400 mg/l.

Compatibility and plugging problems encountered due to injection of non-hazardous landfill leachate and gas condensate are possible due to particulate matter, which could cause decreased flow capacity. Screens or filters may be used to condition fluids if needed. Due to the composition of the fluid to be injected and landfill origin, periodic biocide treatments may be instituted as needed to prevent the establishment of bacterial plugging issues. Also, it is possible that leachate components could lead to precipitation issues within tubing, pipe, or the injection formation, so implementation of a system to prevent plugging or treat injectate may be required. Such solids, compatibility, or bacterial problems, if they do occur, would not be a containment issue, but would be an operations issue. If plugging occurred and was not remedied, Ottawa County Farms may choose to reduce injection rates so that maximum pressure limits are not exceeded. To sustain rates if such a situation develops, periodic stimulations may be required, but would be accomplished within regulatory requirements. Only relatively low suspended solids fluids derived from the Ottawa County Farms Landfill operations will be injected in the well.

TABLE B.9-1 LEACHATE ANALYSES, SELECT ORGANIC PARAMETERS, 2002-2019

Analyte,ug/L	Max	Min	Average	Detections	Non Detects
Carbon tetrachloride	0	0		0	72
Acetone	8600	30	1775	59	2
Chloroform	0	0		0	72
Benzene	8.2	1.9	5	18	54
1,1,1-Trichloroethane	0	0		0	72
Bromomethane	0	0		0	72
Chloromethane	0	0		0	72
Methyl Iodide	110	110	110	1	71
Dibromomethane	0	0		0	72
Bromochloromethane	0	0		0	61
Chloroethane	0	0		0	72
Vinyl Chloride	0	0		0	72
Methylene Chloride	8.4	5.3	7	2	70
Carbon Disulfide	130	6	32	11	50
Bromoform	0	0		0	72
Bromodichloromethane	0	0		0	72
1,1-Dichloroethane	0	0		0	72
Trichlorofluoromethane	0	0		0	72
1,2-Dichloropropane	0	0		0	72
2-Butanone	5000	45.1	1058	56	5
1,1,2-Trichloroethane	0	0		0	72
Trichloroethene	21	21	21	1	71
1,1,2,2-Tetrachloroethane	0	0		0	72
1,2-Dichlorobenzene	0	0		0	72
1,2-Dibromo-3-Chloropropane	0	0		0	61

Analyte,ug/L	Max	Min	Average	Detections	Non Detects
1,2,3-Trichloropropane	0	0		0	72
Ethylbenzene	65	6.8	19	46	26
Styrene	41	1.2	6	9	63
1,4-Dichlorobenzene	6.9	1.2	3	14	58
1,2-Dichloroethane	0	0		0	72
Acrylonitrile	0	0		0	61
Vinyl acetate	0	0		0	61
4-Methyl-2-Pentanone	190	7.4	66	20	41
Toluene	110	4.2	33	63	9
Chlorobenzene	1.7	1	1	5	67
Trans-1,4-Dichloro-2-Butene	0	0		0	61
Dibromochloromethane	0	0		0	72
Tetrachloroethene	0	0		0	72
cis-1,2-Dichloroethene	1.1	1	1	3	69
trans-1,2-Dichloroethene	0	0		0	72
2-Hexanone	540	540	540	1	60
1,1,1,2-Tetrachloroethane	0	0		0	72
Xylenes, Total	370	12	60	55	17
cis-1,3-Dichloropropene	0	0		0	72
trans-1,3-Dichloropropene	0	0		0	72

TABLE B.9-2 LEACHATE ANALYSES, SELECT INORGANIC PARAMETERS, 2002-2019

Analyte,ug/L	Max	Min	Average	Detections	Non Detects
Alkalinity to pH 4.5,Total	7440000	7440000	7440000	1	0
Alkalinity, Bicarbonate	8520000	8520000	8520000	1	0
Alkalinity, Carbonate	ND	ND	ND	0	3
Arsenic, Total	160	39	87	19	0
Boron, Total	36700	33600	35667	3	0
Barium, Total	510	270	395	19	0
Beryllium, Total	ND	ND	ND	0	3
Biochemical Oxygen Demand, 5-Day,mg/L	672	370	521	2	0
Calcium, Total	113000	43400	68533	3	0
Cadmium, Total	2.4	0.31	1	3	0
Chloride,mg/L	2900	529	2010	72	0
Cyanide, Total	16.4	6.4	10	3	0
Cobalt, Total	50.1	40.9	46	2	1
Chemical Oxygen Demand,mg/L	6500	11	3231	19	0
Chromium, Total	411	385	396	3	0
Copper, Total	42.5	10.5	25	3	0
Iron, Total	140000	1040	12863	72	0
Bicarbonate	7440000	3120000	5280000	2	0
Potassium, Total	583000	469000	545000	3	0
Magnesium, Total	156000	91200	115667	3	0
Manganese, Total	681	99	325	3	0
Nitrogen, Kjeldahl	1160000	1160000	1160000	1	0
Nitrogen, Ammonia,mg/L	1740	152	1094	72	0
Nitrogen, Nitrate & Nitrite,mg/L	0.062	0.062	0	1	2
Sodium, Total	2850000	2340000	2603333	3	0
Nickel, Total	432	287	342	3	0
Lead, Total	10.5	5.4	8	3	0

Analyte,ug/L	Max	Min	Average	Detections	Non Detects
pH, Field,Std Units	8.87	6.43	8	28	0
Phenols, Total Recoverable	4570	1140	3170	3	0
Antimony, Total	15.8	8.3	12	3	0
Selenium, Total	164	79.5	122	2	1
Conductance Field,umhos/cm	10100	10100	10100	1	0
Sulfate	207000	5000	110725	4	9
Solids, Total Dissolved	10000000	5700000	8101538	13	0
Temperature,°C	15.3	15.3	15	1	0
Temperature, Field, °C	17.1	17.1	17	1	0
Total Inorganic Nitrogen	1740000	1380000	1510000	3	0
Thallium, Total	ND	ND	ND	0	3
Total Organic Carbon,mg/L	3200	380	1101	19	0
Solids, Total Suspended	31000	31000	31000	1	0
Vanadium, Total	73.9	41.2	55	3	0
Zinc, Total	1100	36	212	19	0

TABLE B.9-3 LEACHATE ANALYSES, MAY 2020

Analyte	Results	Units
Calcium	90700	ug/l
Iron	7600	ug/l
Magnesium	111000	ug/l
Potassium	450000	ug/l
Sodium	2330000	ug/l
Acetone	955	ug/l
Acrylonitrile	<50.0	ug/l
Benzene	<10.0	ug/l
Bromochloromethane	<10.0	ug/l
Bromodichloromethane	<10.0	ug/l
Bromoform	<10.0	ug/l
2-Butanone (MEK)	<50.0	ug/l
Carbon disulfide	<10.0	ug/l
Carbon tetrachloride	<10.0	ug/l
Chlorobenzene	<10.0	ug/l
Chloroethane	<50.0	ug/l
Chloroform	<10.0	ug/l
Chloromethane	<50.0	ug/l
1,2-Dibromo-3-chloropropane	<50.0	ug/l
1,2-Dibromomethane (EDB)	<10.0	ug/l
Dibromomethane	<10.0	ug/l
1,2-Dichlorobenzene	<10.0	ug/l
1,4-Dichlorobenzene	<10.0	ug/l
Trans-1,4-Dichloro-2-butene	<50.0	ug/l
1,1-Dichloroethane	<10.0	ug/l
1,2-Dichloroethane	<10.0	ug/l
1,1-Dichloroethene	<10.0	ug/l
Cis 1,2-Dichloroethene	<10.0	ug/l
Trans 1,2-Dichloroethene	<10.0	ug/l
1,2-Dichloropropane	<10.0	ug/l
Cis-1.3 Dichloropropene	<10.0	ug/l
trans- 1,3-Dichloropropene	<10.0	ug/l
Ethylbenzene	12.1	ug/l
2-Hexanone	<50.0	ug/l

Analyte	Results	Units
Iodomethane	<10.0	ug/l
Methylene Chloride	<50.0	ug/l
4-Methyl-2-pentanon (MIBK)	<50.0	ug/l
Styrene	<10.0	ug/l
1,1,2,2-Tetrachloroethane	<10.0	ug/l
Tetrachlorethene	<10.0	ug/l
Toluene	61.7	ug/l
1,1,1-Trichloroethane	<10.0	ug/l
1.1.2-Trichloroethane	<10.0	ug/l
Trichloroethene	<10.0	ug/l
Trichlorofluoromethane	<10.0	ug/l
1,2,3- Trichloropropane	<10.0	ug/l
Vinyl acetate	<50.0	ug/l
Vinyl chloride	<10.0	ug/l
Xylene	38.4	ug/l
Flashpoint	>200	ug/l
Alkalinity, Total as CaCO3	7940	ug/l
Alkalinity, Bicarbonate (CaCO3)	7940	ug/l
Alkalinity, Carbonate (CaCO3)	<10.0	ug/l
Total Dissolved Solids	8400000	ug/l
Total Suspended Solids	39000	ug/l
Sulfide, Reactive	<50.0	ug/l
Sulfate	<500000	ug/l
Chloride	2090000	ug/l
Nitrogen, Ammonia	1260000	ug/l
Total Organic Carbon	769000	ug/l
Reactive Cyanide	<25.0	mg/kg

B.10 Information to characterize the proposed injection zone, including:

- **A. The geological name of the stratum or strata making up the injection zone and the top and bottom depths of the injection zone.**
- **B. An isopach map showing thickness and areal extent of the injection zone**
- **C. Lithology, grain mineralogy and matrix cementing of the injection zone.**
- **D. Effective porosity of the injection zone including the method of determination.**
- **E. Vertical and horizontal permeability of the injection zone and the method used to determine permeability. Horizontal and vertical variations in permeability expected within the area of influence.**
- **F. The occurrence and extent of natural fractures and/or solution features within the area of influence.**
- **G. Chemical and physical characteristics of the fluids contained in the injection zone and fluid saturations.**
- **H. The anticipated bottom hole temperature and pressure of the injection zone and whether these quantities have been affected by past fluid injection or withdrawal.**
- **I. Formation fracture pressure, the method used to determine fracture pressure and the expected direction of fracture propagation.**
- **J. The vertical distance between the top of the injection zone from the base of the lowest fresh water strata.**
- **K. Other information the applicant believes will characterize the injection zone.**

Items A-C are detailed in Section B.8. Items D-K will be verified during drilling and testing of IW-1. Literature data available to characterize formations has been cited in previous sections. Available data are summarized below.

A. The geological name of the stratum or strata making up the injection zone and the top and bottom depths of the injection zone.

The proposed injection zone includes the interval from (deepest to shallowest) the base of the Mt. Simon Sandstone to the top of the Trenton/Black River. Ottawa County Landfill, Inc. intends to complete the base of the Mt. Simon to the top of the Trempealeau Formation as the injection interval. The table below (Table B.10-1_provides estimated top/bottom depths in feet below ground level (BGL) and feet below mean sea level (BSL) for this formation.

TABLE B.10-1 ESTIMATED FORMATION TOPS AT THE PROPOSED OTTAWA COUNTY FARMS LANDFILL IW-1 AND IW-2 LOCATIONS

Formation	IW-1 and IW-2 Est. Depth to Top, from GL (ft)	IW-1 and IW-2 Est. Elevation Relative to Sea Level
Ground Level (feet ASL)	0	676
Glacial Drift	0	676
Marshall Sandstone	200	476
Coldwater Shale	466	210
Ellsworth Shale	770	-94
Antrim Shale	1665	-989
Traverse Group	1,900	-1,224
Dundee Limestone	2,160	-1,484
Detroit River Group	2,600	-1,924
Bass Island Group	2,700	-2,024
Salina Group	2,840	-2,164
Niagara Group	3,110	-2,434
Clinton Group	3,720	-3,044
Undifferentiated Upper Cincinnatian	3,870	-3,194
Utica Shale	4,270	-3,594
Trenton	4,490	-3,814
Black River	4,790	-4,114
Prairie du Chien Group	4,970	-4,294
Trempealeau Formation	5,420	-4,744
Franconia Formation	5,595	-4,919
Dresbach Formation	5,830	-5,154
Eau Claire Formation	6,165	-5,489
Mt Simon Sandstone	6,295	-5,619
Precambrian Granite Wash	7,440	-6,764
Precambrian	7,465	-6,789

B. An isopach map showing thickness and areal extent of the injection zone

Figures B.8-8 and B.8-27 are regional and local isopachs of the Mt. Simon Sandstone, respectively. Figures B.8-10 and B.8-29 are regional and local isopachs of the Eau Claire, respectively. Figures B .8-12 and B.8-31 are regional and local isopachs of the

the Galesville (Dresbach) Formation, respectively. Figure B.8-33 presents a local isopach of the Franconia Formation. Figures B.8-13 and B.8-35 are regional and local isopachs of the Trempealeau Formation, respectively. Figures B.8-14 and B.8-36 present regional and local isopachs of the Prairie du Chien Group. An isopach map for the Trenton-Black River is presented in Cohee (1945) and indicates a total thickness of 400-500 feet, which compares well to the total thickness of 485 feet projected locally for these formations presented in the table above. In total, the injection zone from the base of the Mt. Simon to the base of the Utica Shale is laterally pervasive and is approximately 2,700 feet thick in the Ottawa County Farms Landfill area.

C. Lithology, grain mineralogy and matrix cementing of the injection zone.

See Section B.8 for detailed lithologic information concerning the Injection Zone formations.

D. Effective porosity of the injection zone including the method of determination.

See Section B.8 for detailed information concerning the effective porosity of the injection zone formations and method of determination. Core data available for the formations in the injection zone are presented in Section B.8.

The proposed injection zone includes the Mt. Simon, Eau Claire, Dresbach/Galesville, Franconia, Trempealeau, Prairie du Chien, St. Peter/Glenwood and Black River/Trenton formations. The Mt. Simon to top of Trempealeau is the injection interval that will be completed, open hole, and into which injection will take place. The overlying formations constitute the remainder of the injection zone, and these formations offer arrestment capabilities. The following summarizes porosity information pertaining to the Formations of the Munising Group and Trempealeau Formation, noting that the Mt. Simon information is also included in Section B.8. Information pertaining to the Prairie du Chien Group and St. Peter/Glenwood Formations is presented in Section B.8.

<u>Injection Interval: Mt. Simon Porosity Range</u>

As indicated in Section B.8.2.2.2, the Mt. Simon injection interval is well characterized by core data that were tested to derive porosity information. Cores were taken from the Mt. Simon in the Warner-Lambert No. 5 well at Holland from 5,200-5,231 ft BGL and BASF Well No. 1 from 5,300-5,335 and 5,516-5,576 ft BGL. These wells are located south of the Site area. Mt. Simon porosity information obtained from the Warner-Lambert No. 5 core indicates the horizontal plug porosity varies from 14-19% in a 30 ft interval of the Mt. Simon, which is generally representative of the upper range for anticipated porosity at the proposed site wells. Formation test results for the BASF well at Holland show an effective porosity of 12.2%, which is lower but generally consistent with that obtained by core at the Warner Lambert No. 5 well. Additional burial depth at the Ottawa County Farms site is likely to make these core data represent the higher end of potential values for the proposed wells.

Injection Interval: Eau Claire, Dresbach/Galesville, Franconia, and Trempealeau Formations Porosity Ranges

The following information addressed porosity of formations above the Mt. Simon, and is based on wireline log data from the Consumers Energy Generating Station (Mirant) well IW-1.

Eau Claire Porosity Range: Wireline data from the Mirant IW-1 was evaluated for the 180 foot thick Eau Claire Formation. Based on the high gamma ray readings throughout the entire thickness of this interval, the Eau Claire is composed of almost entirely shale and therefore would be expected to have very little effective porosity. The average gamma ray values for the entire interval average approximately 155 gamma units, defined by the American Petroleum Institute (GAPI).

The average neutron porosity in the Eau Claire is approximately 19%, though apparent neutron porosity readings in shale are always significantly higher than actual formation porosity. This is due to the fact that shales contain clays that have a significant amount of bound water which increases the hydrogen index of the formation. Because the neutron tool is sensitive to the amount of hydrogen atoms in a formation, this results in higher neutron porosity data due to the shale effect or bound-water effect. Therefore, there is likely to be little effective porosity in the Eau Claire Formation. As such, while included in the Injection Zone, the Eau Claire serves as an arrestment interval above the Mt. Simon and would impede vertical fluid flow.

Additional information from core data is presented in Section B.8 in Tables B.8.6a and B.8.6b.

Dresbach/Galesville Porosity Range: Wireline data from the Mirant IW-1 was evaluated for the 120 foot thick Dresbach/Galesville interval. The Dresbach/Galesville is primarily described as a silica cemented sandstone with occasional shale lamination (Sections B.8.1.3.2 and B.8.2.2.2). Utilizing a gamma ray cutoff of 60 GAPI to evaluate relatively clean sandstone intervals, there is approximately 67 feet of sand with an average neutron porosity of 17.5% at Zeeland, though the potential presence of glauconite (which yields higher gamma ray readings) may impact this cutoff thickness.

Additional information from core data is presented in Section B.8 in Tables B.8.7a and B.8.7b.

Franconia Porosity Range: Wireline data from the Mirant IW-1 was evaluated for the 118 foot thick Franconia Formation. Average neutron porosity across this interval is approximately 17.5%. Additional information for the Franconia is presented in Section B.8.

Trempealeau Porosity Range: Wireline data from the Mirant IW-1 was evaluated for the 199 foot thick Trempealeau Formation. Based on the neutron porosity data, there are 168 feet, 86 feet, and 43 feet of thickness at 8%, 12%, and 15% respectively. Additional information for the Trempealeau is presented in Section B.8.

Injection Zone: Trenton/Black River

Trenton/Black River Porosity Range: Core plug data from the Warner-Lambert Well No. 5 at Holland indicates that within a core collected from a 20 foot interval exhibits horizontal plug porosity from 0.005%-0.04%. Limited effective porosity-thickness is anticipated for the Trenton/Black River. Additional information for the Trenton is presented in Section B.8.

E. Vertical and horizontal permeability of the injection zone and the method used to determine permeability. Horizontal and vertical variations in permeability expected within the area of influence.

Permeability data for the formations in the injection zone are provided in various tables in Section B.8. Permeability-thickness will be evaluated in the first Ottawa County Farms Landfill well drilled at the site to confirm formation permeability.

F. The occurrence and extent of natural fractures and/or solution features within the area of influence.

No solution features such as paleokarst are documented in the proposed injection zone at the proposed well location. See B.8 for additional information about injection zone lithologies and structural geology.

G. Chemical and physical characteristics of the fluids contained in the injection zone and fluid saturations.

Fluid samples were obtained during drilling from the IW-1 and IW-2 wells at the Consumers Energy Zeeland Generating Station site. Reported Mt. Simon TDS values for wells IW-1 and IW-2 were 190,000 mg/L and 220,000 mg/L, respectively. Fluid samples will be taken from the injection zone at the first Ottawa County Farms Landfill well drilled at the site to confirm formation fluid quality and TDS.

Additional information is provided in Sections B.7, B.8.2.2.2 and B.8.2.2.3.

H. The anticipated bottom hole temperature and pressure of the injection zone and whether these quantities have been affected by past fluid injection or withdrawal.

The nearest active injection wells that penetrate through the Mt. Simon Sandstone are the Consumers Energy Generating Station wells IW-1 and IW-2 (Mirant wells). Maximum recorded bottomhole temperature from wireline log data was 106° F at a depth of 6,670 ft RKB (6,657 ft BGL) and 122° F at a depth of 6,630 ft RKB (6,618 ft BGL) for the Mirant wells IW-1 and IW-2, respectively.

Reservoir pressure in the Mt. Simon Sandstone is estimated based on data from the Mirant IW-2 well, where an original measured pressure of 2,429.5 psi was recorded at a depth of 5,280 ft RKB (5,267 ft BGL). This is equivalent to a reservoir pressure gradient of approximately 0.46 psi/ft, which is consistent with regional data for the Mt. Simon in this portion of Michigan. Based on an estimated total depth of 7,440 ft BGL and a reservoir pressure gradient of 0.46 psi/ft in the Mt. Simon, estimated bottom hole pressure is estimated to be 3,422 psi. Similar reservoir gradients have been projected for the shallower formations of the injection interval. Static pressure measurements will be obtained from the injection zone at the first Ottawa County Farms Landfill well drilled at the site to confirm original formation pressure.

I. Formation fracture pressure, the method used to determine fracture pressure and the expected direction of fracture propagation.

The Ottawa County Farms wells will be installed based on the plans for operation under positive pressure. Wellhead pressure will be supplied by using an injection pump or pumps. Although no site specific data are available, the US EPA Region 5 permits issued in 2013 for the Consumers Energy IW-1 and IW-2 used an EPA assigned value of 0.725 psi/ft for the fracture gradient of the Mt. Simon injection interval, therefore this value will be used for the Ottawa County Farms Landfill wells. If injection fluid is assumed to be comprised of a brine with a maximum specific gravity of 1.1 (maximum anticipated average specific gravity of 1.05 plus 0.05 safety margin) that fills the tubing from the surface to a maximum depth of 4,490 feet (estimated top of the injection zone), a maximum wellhead injection pressure of 1,102 psi is calculated based on this Region 5 assigned gradient and the previously approved formula presented in the Consumers Energy permits where a value of 14.7 psi is subtracted from the calculated value (4,490 * (0.725-(0.433*1.1))-14.7). The value is conservative since no allowances for tubing friction are included in this calculation. Average injection pressure is expected to be approximately 600 to 800 psi.

Note that the average specific gravity is expected to be in the 1.00 to 1.05 range. The maximum pressure exerted by injectate of a 1.1 specific gravity (that includes the 0.05 safety margin) at the top of the injection zone (estimated to be 4,490 feet BGL) is not expected to exceed 2,041 psi, and when adding the requested wellhead injection pressure of 1,102 psi yields a total downhole pressure of 3,143 psi, which is still below the calculated fracture pressure of 3,255 psi (4,490 ft * 0.725 psi/ft) with friction losses neglected, thus offering a safety margin.

J. The vertical distance between the top of the injection zone from the base of the lowest fresh water strata.

As shown in the tables presented in the previous sections, the top of the Trenton/base of the Utica Shale (top of the injection zone) is more than 4,000 feet below the base of the Glacial Drift/Marshall Sandstone which has been conservatively assigned as the base of the USDW.

K. Other information the applicant believes will characterize the injection zone.

See Section B.8 for additional information and a comprehensive characterization of the injection zone. Projected characteristics are to be confirmed upon installation of the first well by collecting geophysical logs, fluid samples and conducting reservoir pressure tests. These data will be submitted to the EGLE as required in a drilling and completion report.

B.11 Information to characterize the proposed confining zone, including:

- **A. The geological name of the stratum or strata making up the confining zone and the top and bottom depths of the confining zone.**
- **B. An isopach map showing thickness and areal extent of the confining zone**
- **C. Lithology, grain mineralogy and matrix cementing of the confining zone.**
- **D. Effective porosity of the confining zone including the method of determination.**
- **E. Vertical and horizontal permeability of the confining zone and the method used to determine permeability. Horizontal and vertical variations in permeability expected within the area of influence.**
- **F. The occurrence and extent of natural fractures and/or solution features within the area of influence.**
- **G. Chemical and physical characteristics of the fluids contained in the confining zone and fluid saturations.**
- **H. Formation fracture pressure, the method used to determine fracture pressure and the expected direction of fracture propagation.**
- **I. The vertical distance between the top of the confining zone from the base of the lowest fresh water strata.**
- **J. Other information the applicant believes will characterize the confining zone.**

Items A-C are detailed in Section B.8. Items D-J will be verified during drilling and testing of the IW-1 well. Literature data available to characterize formations has been cited in previous sections. Available data are summarized below.

A. The geological name of the stratum or strata making up the confining zone and the top and bottom depths of the confining zone.

The proposed confining zone is the Utica Shale. The table below provides estimated top/bottom depths in feet below GL and feet below mean sea level (BSL) for this formation (Table B.11-1).

TABLE B.11-1 ESTIMATED FORMATION TOPS AT THE PROPOSED OTTAWA COUNTY FARMS LANDFILL IW-1 AND IW-2 LOCATIONS

Formation	IW-1 and IW-2 Est. Depth to Top, from GL (ft)	IW-1 and IW-2 Est. Elevation Relative to Sea Level
Ground Level (feet ASL)	0	676
Glacial Drift	0	676
Marshall Sandstone	200	476
Coldwater Shale	466	210
Ellsworth Shale	770	-94
Antrim Shale	1665	-989
Traverse Group	1,900	-1,224
Dundee Limestone	2,160	-1,484
Detroit River Group	2,600	-1,924
Bass Island Group	2,700	-2,024
Salina Group	2,840	-2,164
Niagara Group	3,110	-2,434
Clinton Group	3,720	-3,044
Undifferentiated Upper Cincinnatian	3,870	-3,194
Utica Shale	4,270	-3,594
Trenton	4,490	-3,814
Black River	4,790	-4,114
Prairie du Chien Group	4,970	-4,294
Trempealeau Formation	5,420	-4,744
Franconia Formation	5,595	-4,919
Dresbach Formation	5,830	-5,154
Eau Claire Formation	6,165	-5,489
Mt Simon Sandstone	6,295	-5,619
Precambrian Granite Wash	7,440	-6,764
Precambrian	7,465	-6,789

B. An isopach map showing thickness and areal extent of the confining zone

Figure B.8-16 is a regional isopach and Figure B.8-40 is a local isopach of the Utica Shale. Based on these data, the estimated thickness of the Utica Shale is projected to be at least 190 feet and the interval is aerially extensive across the state. The 480 foot thick Trenton/Black River below the Utica is not projected to be permeable and provides a secondary arrestment interval below the confining zone.

C. Lithology, grain mineralogy and matrix cementing of the confining zone.

See Section B.8 for detailed lithologic information concerning the Confining Zone formation.

D. Effective porosity of the confining zone including the method of determination.

The Utica Shale is composed primarily of silty claystone deposited in a marine environment (Sattler, 2015). Western Michigan University (WMU,1981) reported porosity from cores collected and evaluated for the Consumers Power Company (Mirant Zeeland) Brine Disposal Well No 139 T4N, R15E, as being 1.5-4%; note that the Utica Shale is the confining zone for other Class I wells in southwestern Michigan. The effective porosities for Utica core collected elsewhere in the Michigan Basin indicate that porosity varies from 0.77-5.93% (Sattler, 2015). The Black River/Trenton occurs immediately below the Utica Shale, and core data obtained from the Warner Lambert Well No. 5 at Holland for this interval showed a core porosity ranging from 0.5 to 5%. Therefore, core data are available for the Utica Shale and underlying units, that show limited porosity.

E. Vertical and horizontal permeability of the confining zone and the method used to determine permeability. Horizontal and vertical variations in permeability expected within the area of influence.

As indicated under item B.11-D above, limited core data for the Utica Shale are available at various locations throughout the state (Briggs, 1968, Stattler, 2015). These data indicate that Utica Shale permeabilities of less than 0.5-2.5 md were reported for the “a location in southeastern Michigan” while Utica Shale permeabilities varied from 0.003-89.42 md elsewhere in the state. Note that WMU (1981) indicates that the core described by Briggs is actually the Consumers Energy (Mirant Zeeland) well No. 139 located in T 4N R15E. The Trenton Group at the Warner-Lambert Well No. 5 in Holland exhibited a horizontal brine permeability as low as 5.166×10^{-6} md and vertical core plug permeability to injectate as low as 5.2×10^{-6} md. These data suggest that Utica Shale permeability can be highly variable, but is typically low. Additional information regarding the suitability of the Utica as a confining zone are presented in B.8 and B.11-D of this document.

F. The occurrence and extent of natural fractures and/or solution features within the area of influence.

No solution features such as paleokarst are documented in the confining zone at the proposed well location. See B.8 for additional information about confining zone lithologies and characteristics.

G. Chemical and physical characteristics of the fluids contained in the confining zone and fluid saturations.

Data specific to confining zone water quality are not available in the vicinity of the Ottawa County Farms Landfill area. This is not unexpected since the Utica is typically a confining layer or aquiclude and does not commonly have effective porosity or permeability. A search of the USGS Produced Waters Geochemical Database (USGS 2018) yielded no water quality samples from the Utica Shale, although 13 water quality samples were available for the underlying Trenton Formation. All Trenton samples were greater than 29,900 mg/l TDS, with the majority in excess of 100,000 mg/l TDS. Two samples from the overlying Guelph/Lockport exhibited water quality in excess of 300,000 mg/l TDS. Note that WMU (1981) states that the Utica Shale is not an aquifer, due to lower permeability and porosity.

H. Formation fracture pressure, the method used to determine fracture pressure and the expected direction of fracture propagation.

The Ottawa County Farms Landfill wells will be installed based on the plans for operation under positive pressure. Wellhead pressure will be supplied by using an injection pump or pumps. Although no site specific data are available at the Ottawa County Fams Landfill site, the US EPA Region 5 permits issued in 2013 for the Consumers Energy IW-1 and IW-2 used an EPA assigned value of 0.725 psi/ft for the fracture gradient of the Mt. Simon injection interval, therefore this value will be used for the Ottawa County Farms Landfill wells. If injection fluid is assumed to be comprised of a brine with a maximum specific gravity of 1.1 (maximum anticipated average specific gravity of 1.05 plus 0.05 safety margin) that fills the tubing from the surface to a maximum depth of 4,490 feet (estimated top of the injection zone), a maximum wellhead injection pressure of 1,102 psi is calculated based on this Region 5 assigned gradient and the previously approved formula presented in the Consumers Energy permits where a value of 14.7 psi is subtracted from the calculated value (4,490 * (0.725-(0.433*1.1))-14.7). The value is conservative since no allowances for tubing friction are included in this calculation. Average injection pressure is expected to be approximately 600 to 800 psi.

Note that the average specific gravity is expected to be in the 1.00 to 1.05 range. The maximum pressure exerted by injectate of a 1.1 specific gravity (that includes the 0.05 safety margin) at the top of the injection zone (estimated to be 4,490 ft BGL) is not expected to exceed 2,041 psi, and when adding the requested wellhead injection pressure of 1,102 psi yields a total downhole pressure of 3,143 psi, which is still below the calculated fracture pressure of 3,255 psi (4,490 ft * 0.725 psi/ft) with friction losses neglected, thus offering a safety margin.

I. The vertical distance between the top of the confining zone from the base of the lowest fresh water strata.

As shown in the table above, the top of the Utica Shale (top of the confining zone) is projected to be more than 4,000 feet below the base of the Glacial Drift/Marshall Sandstone which has been conservatively assigned as the base of the lowermost USDW.

J. Other information the applicant believes will characterize the confining zone.

See Section B.8 for additional information.

B.12 Information demonstrating injection of liquids into the proposed zone will not exceed the fracture pressure gradient and information showing injection into the proposed geological strata will not initiate fractures through the confining zone. Information showing the anticipated dispersion, diffusion and/or displacement of injected fluids and behavior of transient pressure gradients in the injection zone during and following injection.

Maximum Injection Pressure

The Ottawa County Farms Landfill wells will be installed based on the plans for operation under positive pressure. Wellhead pressure will be supplied by using an injection pump or pumps. Although no site specific data are available, the US EPA Region 5 permits issued in 2013 for the Consumers Energy IW-1 and IW-2 used an EPA assigned value of 0.725 psi/ft for the fracture gradient of the Mt. Simon injection interval, therefore this value will be used for the Ottawa County Farms Landfill wells. If injection fluid is assumed to be comprised of a brine with a maximum specific gravity of 1.1 (maximum anticipated average specific gravity of 1.05 plus 0.05 safety margin) that fills the tubing from the surface to a maximum depth of 4,490 feet (estimated top of the injection zone), a maximum wellhead injection pressure of 1,102 psi is calculated based on this Region 5 assigned gradient and the previously approved formula presented in the Consumers Energy permits where a value of 14.7 psi is subtracted from the calculated value (4,490 * (0.725-(0.433*1.1))-14.7). The value is conservative since no allowances for tubing friction are included in this calculation. Average injection pressure is expected to be approximately 600 to 800 psi.

Note that the average specific gravity is expected to be in the 1.00 to 1.05 range. The maximum pressure exerted by injectate of a 1.05 specific gravity at the top of the injection interval (estimated to be 4,490 ft BGL) is not likely to exceed 2,041 psi, and when adding the requested wellhead injection pressure of 1,102 psi yields a total downhole pressure of 3,143 psi, which is still below the calculated fracture pressure of 3,255 psi (4,490 ft * 0.725 psi/ft) with friction losses neglected, thus offering a safety margin.

Average Rates, Volumes and Pressures

The range of injection rates and pressures is expected to fluctuate depending on the demands of the system along with variables related to the well and reservoir conditions. Operational injection rates are expected to average a combined rate of 125 gpm, with a maximum combined rate of 180 gpm. The estimated annual volume is not expected to exceed 65,700,000 gallons/year, with an average daily volume of 180,000 gallons (125 gpm) and maximum expected daily volume of 259,200gallons (180 gpm). Table B.12-1 presents representative historic leachate generation information that reflects anticipated injectate volumes.

TABLE B.12-1 ANNUAL LEACHATE VOLUMES, 2015 TO 2019

Year	Volume (gallons)
2015	23,121,000
2016	27,930,500
2017	32,181,000
2018	30,148,600
2019	41,022,500

The well is to be operated, and operating data will be reported, according to the requirements presented in Table B.12-2.

TABLE B 12-2 OPERATING, MONITORING, AND REPORTING REQUIREMENTS, OTTAWA COUNTY FARMS LANDFILL WELLS IW-1 and IW-2

Characteristic	Value	Minimum Monitoring Frequency [2]	Minimum Reporting Frequency
Injection Rate (Maximum)	180 (total)	Continuous	Monthly
Injection Rate (Average)	125	Continuous	Monthly
Cumulative Estimated Annual Volume	65,700,000 gallons/year	Continuous	Monthly
Injection Pressure (maximum)	1,102 psig	Continuous	Monthly
Injection Pressure (average)	500 psig	Continuous	Monthly
Annulus Pressure	100 psig min.	Continuous	Monthly
Annulus/Tubing Pressure Differential	100 psig min.	Continuous	Monthly
Sight Glass Level	Visible	Daily, when operated	monthly
Annulus Fluid Addition Or Removal	None	Monthly	Monthly
Chemical Composition of Injected Fluids[1]	None	Monthly	Monthly
Physical Characteristics of Injected Fluids[1]	Non-hazardous	Monthly	Monthly

[1] As specified in the Waste Analysis Plan, see Attachment C (CD-ROM)
[2] Continuous is to be defined as a value recorded not less than once every five (5) minutes

Impact of Injection

No well penetrates the confining zone into the uppermost injection zone within the 2-mile AOR. The nearest active Class I injection wells that penetrate the injection zone and injection interval are the two Class I non-hazardous wells at the Consumers Energy Generating Station in Zeeland, MI, located over 15-miles to the southwest of Ottawa County Farms Landfill.

The injection interval will be tested to verify capacity upon well installation. Until data are obtained during installation of the wells, conservative estimates of formation properties have been assigned based on regional data associated with the closest Class I well to the proposed injection zone being the Consumers Energy wells in Zeeland (Permit Nos. MI-139-1I-004 and 005), and projected operational parameters, to generate an estimate of the fluid front for the IW-1 and IW-2 wells. Standard equations for the volume of a porous cylinder can be used with the following parameters to generate an estimate for a simplistic piston-like displacement fluid front radius. Based on parameters determined at Consumers Energy Well No. 1, the following conservative formation characteristics and injectate volumes were assumed:

- 800 foot net injection zone thickness, conservatively assumed from approximate 2,000 ft total thickness of this interval
- 1,893,456,,000 gallons of injectate estimated based on twenty years of continuous injection at a rate of 94,672,800 gallons per year (180 gpm)

The following formula was used to estimate plume dimensions:

$$\text{Radius} = (\text{volume} / \pi * \Phi * h)^{1/2}$$
$$= [(1{,}893{,}456{,}000 \text{ gal} * ft^3/7.48 \text{ gal}) / \pi * 0.09 * 800]^{1/2}$$
$$= 1{,}058 \text{ ft}$$

As an estimate for illustrative purposes, this calculation yields a piston-like, 100 percent injected fluid front radial distance of approximately 1,058 feet from a well assuming that injection is constant at a rate of 180 gpm for 20 years. Although dispersion will play a role in spreading this plume over a slightly larger area, even a relatively large dispersivity combined with a low cut-off boundary concentration would likely yield a plume that reaches a radial distance of less than ¼-mile from the well. This is much smaller than the 2-mile mile AOR radius for which artificial penetrations were identified and evaluated. As previously noted, there are no wells located within the AOR that penetrate the injection or confining zones. Additional evaluation of dispersion, diffusion and/or displacement of injected fluids and behavior of transient pressure gradients in the injection zone during and following injection will be conducted upon site-specific information becoming available from testing the well.

Compatibility problems encountered due to injection of non-hazardous landfill leachate and gas condensate are possible due to injection of particulate matter that could cause decreased flow capacity. Screens or filters may be used to condition fluids if needed. Due to the composition of the fluid to be injected and landfill origin, periodic biocide treatments may be instituted as needed to prevent the establishment of bacterial plugging issues. Also, it is possible that the concentration of iron within injectate could lead to precipitation issues within tubing, pipe, or the formation, so implementation of a system to prevent plugging or treat iron may be required. Such solids, compatibility, or bacterial problems, if they do occur, would not be a containment issue, but would be an operations issue. If plugging occurred and was not remedied, the operator could reduce injection rates so that maximum pressure limits are not exceeded. To sustain rates if such a situation develops, periodic stimulations may be required, but would be accomplished within regulatory requirements. At this time, only relatively low suspended solids fluids from the Ottawa County Farms Landfill will be injected in the well.

B.13 Proposed operating data including all of the following data:
A. The anticipated daily injection rates and pressures.
B. The types of fluids to be injected.
C. A plan for conducting mechanical integrity tests.

A and B. As noted in Section B.12, continuous injection at an average combined rate of 125 gpm (180,000 gallons per day) is projected. This is equivalent to an injection volume of approximately 65,700,000 gallons per year. At the maximum permitted injection rate of 180 gpm, injection volume is equivalent to not more than approximately 94,608,000 gallons per year. As noted on Table B.12-2, average injection pressure is estimated to be approximately 600 to 800 psig with a maximum injection pressure of not more than 1,102 psig. The injectate will be non-hazardous fluids generated on-site from landfill leachate and gas condensate collection systems. As necessary, storm water, surface water run-off, and/or fluids derived from or necessary for wells IW-1 and IW-2 operation and maintenance may also be injected. See Item B.9 and B.12 for additional information pertaining to daily injection rates/pressure and the types of fluids to be injected.

C. Annual Part I mechanical integrity testing for IW-1 and IW-2 will include reservoir monitoring as specified by permit requirements in addition to static annulus pressure testing. Ottawa County Farms Landfill will provide the agency a minimum of 30 days notice prior to annual testing. Although test procedures or methods may be changed based on approval by EGLE staff, the following procedure will be used for the first such testing performed:

Mechanical integrity and ambient reservoir monitoring will be conducted after well construction activities are complete. Annual Part I mechanical integrity testing (MIT) for the IW-1 and IW-2 wells and 5-year Part II MIT procedures are detailed below. Although test procedures or methods may be changed based on approval by EGLE staff, the following procedure will be used for the testing:

7. Conduct Wellsite Safety Meeting
    a. Prior to commencement of field activities, conduct safety meeting with contractors and personnel to be involved with field services and MIT testing. Ensure that all safety procedures are understood and review days' work activities.

8. Conduct Reservoir (Fall-Off or Static) Pressure Test
    a. For fall-off, record data regarding test well injection at typical operating conditions (constant rate). Rate versus time data will be recorded during the injection period. Cumulative injection volume will also be recorded. Continue injection for a minimum of approximately 8 hours. Note that significant rate variations may require more complicated analysis techniques.

   b. Rig-up pressure gauge and run in well to a depth likely not to exceed approximately 5,460 feet or other depth approved by EGLE.
   c. For pressure transient fall-off, obtain final stabilized injection pressure for a minimum of 1 hour. For static test, collect a minimum of two pressure/temperature readings at depth. Ensure that the gauge temperature readings have also stabilized.
   d. After gauge recordings are stable, cease injection and monitor pressure fall-off. Continue monitoring pressure for a minimum of 8 hours or until a valid observation of fall-off curve is observed. For a static gradient survey, the well will be shut-in for a minimum of 48 hours before testing. Wellbore pressure gradients will be obtained to establish fluid gradient and bottomhole pressure data will be collected for a minimum of 4 hours for static testing.
   e. Stop test data acquisition, rig-down and release equipment.

9. Annulus Pressure Test
   a. Stabilize well pressure and temperature for a target period of 12-hours.
   b. As practical, arrangements will be made for a representative from the EGLE to be present to witness testing.
   c. Install ball valve or similar type “bleed” valve on annulus gate valve. Pressurize annulus to a minimum of 100 psig above maximum permitted operating pressure and shut-in valve. Install certified gauge on “bleed” type valve. The annulus may need to be pressurized and bled off several times to ensure an absence of air.
   d. Monitor and record pressure for 1 hour. Pressure may not fluctuate more than 3% during the one-hour test.
   e. Lower the annulus pressure to normal operating pressure at the end of the test.

The Part II external mechanical integrity demonstration for the well will be accomplished via a minimum of one approved logging method such as temperature log, or radioactive tracer survey, or noise log, or oxygen activation log.
Although Ottawa County Farms Landfill may utilize any acceptable method per EGLE procedure approval, at this time it is proposed that temperature logging be utilized for 5-year Part II mechanical integrity testing. Static temperature logging is to be conducted as follows:

3. Conduct Temperature Log
   a. Shut-in well for stabilization (minimum of 36 hours, or as required by USEPA/EGLE) prior to running base temperature log.
   b. Rig-up temperature log and run base log from surface to total depth. Pull tool to surface and shut-in master valve.
   c. Rig-down equipment and return the well to normal operations.

Future annual or 5-year testing will be conducted using these procedures unless alternative procedures are approved by EGLE in advance. Future periodic MIT testing will be conducted after Ottawa County Landfill provides the agency with a minimum of a 30-day notice of testing, as practical, to allow the agency an opportunity to witness data collection activities.

Part II mechanical integrity testing to be conducted every 5 years, as required by EGLE, is detailed in Sections A.11 and A.14 and is not repeated herein.

B.14 For a proposed disposal well to dispose of waste products into a zone that would likely constitute a producing oil or gas pool or natural brine pool, a list of all offset operators and certification that the person making application for a well has notified all offset operators of the person's intention by certified mail. If within 21 days after the mailing date an offset operator files a substantive objection with the supervisor, then the application shall not be granted without a hearing pursuant to part 12 of these rules. A hearing may also be scheduled by the supervisor to determine the need or desirability of granting permission for the proposed well.

Production from the injection interval (Trempealeau through Mt. Simon) has not been identified in the vicinity of the proposed disposal wells. There are also no deep wells within the vicinity of the Ottawa County Farms Landfill that penetrate to or produce from zones below the Utica Shale, which is the proposed upper confining zone. Therefore, a list of offset operators is not required.

B.15 A proposed plugging and abandonment plan

The following is the proposed plan for plugging and abandonment of the proposed IW-1 well:

<u>OTTAWA COUNTY FARMS LANDFILL IW-1 AND IW-2 PLUGGING AND ABANDONMENT PLAN</u>

1. Notify regulatory agencies a minimum of 30 days prior to commencement of plugging operations.
2. Prepare well and location for plugging. Move in and rig up well servicing rig, pipe racks and tanks.
3. Install a test gauge on the annulus to perform a static annulus pressure test. Ensure that the annulus is fluid filled and that the well has been shut-in for a minimum of 24 hours. Pressurize annulus and isolate from the annulus system. Monitor annular pressure for one hour.
4. Displace tubing with kill brine as needed to control wellhead pressure. Dismantle wellhead and install blow-out preventer. Displace annulus with kill brine as needed to control pressure. Fluid compatibility with cement to be used will be verified.
5. Remove injection tubing and packer. If packer will not unseat, proceed with fishing operations as needed to remove packer from hole or obtain approval to set retainer above packer and pump cement through retainer and abandoned packer.
6. Make up mechanical retainer on work string and trip in hole. Set cement retainer at top of injection interval just above historical packer setting depth. Test cement retainer to 500 psig.
7. Move in cement and cementing equipment.
8. Displace hole below retainer with Class "A" cement. Unsting from retainer and spot 50 additional sacks (sx) on top of retainer. Cement volume has been calculated based on the following volumes:
    - 6-3/4" hole from 5,460 ft GL to 7,440 feet GL, at 0.2485 ft^3/ft = 492 ft^3
    - 7-5/8" casing from surface to 5,460 feet GL, at 0.2649 ft^3/ft = 1,446 ft^3
    - 50 additional sacks with a yield of 1.18 $ft^3/sack$ = 59 ft^3

   The total volume of the plugs is estimated to be 1,997 ft^3, which is equivalent to 1,692 sx of Class "A" cement with a yield of 1.18 $ft^3/sack$. If wellbore fill is present, this volume may have to be reduced or squeezed into the openhole of the injection interval or approval obtained to reduce cement volume based on open hole conditions.
9. Once cement has been tagged on top of the retainer, spot successive, continuous balanced cement plugs in 500' intervals from top of cement retainer to surface (6 intervals required). Cement to be API Class 'A' with not more than 4% bentonite. If neat Class 'A' cement is pumped it will have the following slurry properties.
    - Water ratio – 5.2 gallons per sack

- Slurry weight – 15.6 pounds per gallon
- Slurry volume – 1.18 ft^3/sack

An estimated 1,203 sacks, or 1,419 cubic feet, of slurry will be required above retainer.

10. Remove BOP and wellhead equipment
11. Cut off wellhead approximately 4 ft BGS and weld cap with permanent marker on casing.
12. Rig down and move out all equipment.
13. Prepare and file USEPA and EGLE Plugging Reports.

The steel plate will be inscribed with the disposal well identification information and the date of plugging. Federal and State representatives will have been invited to witness the plugging and sign the plug and abandonment form.

B.16 Identify the source or sources of proposed injected fluids. Identify if injected fluids will be considered hazardous or non-hazardous as defined by Part 111, Hazardous Waste Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA)

See Section B.9 for information about waste sources and waste chemistry. As stated in Section B.9, the injected fluids are non-hazardous as defined by Part 111, Hazardous Waste Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA). The fluids are to primarily be comprised of non-hazardous landfill leachate and gas condensate along with other fluids associated with well operations.. Injection of fluids generated on-site will provide an environmentally safe management option that does not require off-site transport with associated traffic, potential for fluid spillage, and other issues. Ottawa County Landfill,Inc. believes Class I authorization will provide the most environmentally safe option for management of on-site generated fluids into formations isolated from overlying USDWs. This will safely, cost effectively, and efficiently manage non-hazardous fluids via injection while minimizing the risks and environmental footprint associated with transporting such wastes substantial distances to utilize other fluid management methods.

B.17 Whether the well is to be a multisource commercial hazardous waste disposal well.

This well permit application request is for two single non-hazardous wells, not for commercial hazardous waste disposal wells.

B.18 Additional information required for an application for a permit to drill and operate a storage well or to convert a previously drilled well to such a well:

For an application to drill storage well or to convert a previously drilled well to a storage well, also submit the following information in addition to that submitted in the previous section for a disposal well. In the previous sections instructions, replace the term 'disposal' with 'storage' and 'waste' with 'stored product.'

1. **The name and chemical formula of the product to be stored, and a characterization of the physical, chemical, and hazardous or toxic properties of the product.**
2. **The anticipated vertical and horizontal dimensions and volume of the completed underground storage cavity.**
3. **The anticipated operating life of the underground storage cavity.**
4. **The method to be used to create the underground storage cavity.**
5. **The name of the geological stratum in which the underground storage cavity will be created.**
6. **A schematic diagram of the well bore showing the proposed arrangement and specifications of the down hole well equipment.**
7. **If the underground storage cavity is to be formed by solution mining bedded salt, then all of the following information shall be included:**
8. **The plan for disposal of brine produced during solution mining of the underground storage cavity and for the operating life of the underground storage cavity.**
9. **The expected starting and ending dates of the solution mining.**
10. **The range of anticipated operating pressures of the underground storage cavity.**
11. **The anticipated range of operating injection pressure.**
12. **The proposed method of displacing stored product.**
13. **A plan for testing the mechanical integrity of the underground storage cavity as provided in R 299.2392 and R 299.2393.**

N/A. This application is not being submitted for a permit to drill and operate a storage well or to convert a previously drilled well to such a well.

B.19 Additional information required for an application for a permit to drill and operate a well for the production of artificial brine or to convert a previously drilled well to such a well:

For an application to drill and operate a brine well for production of artificial brine or to convert a previously drilled well to a well for production of artificial brine, submit in addition to the information in the first section, all of the following proposed information:

1. **If the well will be drilled into an existing cavern, the number of wells in the cavern, the present extent of the cavern, and the purpose of the proposed well.**
2. **The name of the geological stratum or strata to be mined, the top and bottom depths of the mined zone, the gross and net mineable thickness, and the mineral or minerals to be recovered by solution mining.**
3. **An isopach map showing thickness and areal extent of the strata to be mined.**
4. **A sketch showing the extent of the planned mine area.**
5. **The geological strata to be left in place for roof support.**
6. **A diagram showing the well bore with the proposed casing program and its relationship to the stratum or strata to be mined.**
7. **A plan for conducting subsidence monitoring as required in R 299.2407 or a rationale for not conducting subsidence monitoring.**

N/A. This application is not being submitted for a permit to drill and operate a well for the production of artificial brine or to convert a previously drilled well to such a well.

A public hearing may be scheduled by the Supervisor of Mineral Wells to take public comment on the proposed well. If such a hearing is scheduled, the applicant will be responsible for the scheduling and preparation and publication of the notice.

Please collate the above documents into a set and mail the original and two copies of the application (total of 3 sets) plus 3 additional copies of form EQP 7200-1 to:

Department of Environment, Great Lakes & Energy
Office of Geological Survey
P.O. Box 30256
Lansing, Michigan 48909

The above documents have been collated and appropriate numbers of document copies and copies of the application forms have been sent to the above address.