

Attachment "D" & "E"
Maps and Cross Section of USDW's
Names and Depths of USDW's

The Hydrology report completed by Resource Management Services Inc. included in this attachment provides the required information for the section of the application.

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**HYDROLOGY REPORT
FOR THE**

**Zelman Injection/Disposal Well
Brady Twp., Clearfield County, PA**

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USDW INJECTION WELL REPORT
UIC Class II

This report Addresses Attachment B, D, P and associated sections of the UIC Permit Application.

GENERAL SITE LOCATION AND REPORT CONTECT

The proposed brine injection well is located on the Zelman Tract in Brady Twp., Clearfield County as noted on the Plat Map and Exhibit 1, approximately 2 miles southeast of the city of Dubois. Windfall Oil & Gas, Inc. (Windfall) has contracted Resource Management Services, Inc. (RMS) to prepare this report to address Attachments B, D and P of the Permit Application for Class II Wells under the Federal Underground Injection Control regulations.

The location key on the Plat Map and Exhibit 1 are topographic maps extending one mile from the Zelman property boundaries and show the one-quarter mile radius area of review. During the field investigation for this project, no intake or discharge structures, nor any hazardous waste treatment, storage or disposal facilities were noted as required in the Attachment B instructions. This application is not for an area permit.

Included on the large Plat Map drawing are the number, name and location of all producing gas wells, injection wells (none other than proposed), abandoned wells, dry holes, surface bodies of water, springs, mines, quarries, residences, roads and faults (only in subsurface). More detailed information is included within the quarter mile radius detailed area of review.

This report also provides a description of underground sources of drinking water (USDWs) at the site as it relates to Class II wells and as requested in Attachments D and E of the permit application.

Also included is a description of the background sampling program information and the number and location of the sample points in the planned monitoring program as requested in Attachment P.

HYDROGEOLOGIC SETTING – ATTACHMENT B

The proposed well location is at a surface elevation of approximately 1697 feet near highest portion of the Zelman tract. The site is near the top of an upland area which forms a north-south trending divide with surface drainage directed off the slopes to the, south, west and east. This north-south trending hill is incised by trench cut of the old B &

O Railroad tracks to the south of the site. This cut grade forms a divide so that flow is ultimately directed to the east and west of the site (see Exhibit 1).

The estimated topographic relief in the immediate area of the site is approximately 150 feet from hilltop to stream valley. Due to the configuration of the hill, near surface flow from the site is directed to springs & streams to the west along SR 4009/Highland Street Extension (refer to several sample points on the Plat Map and the Background Water Sampling section below), to the east of the site (sample points RMS 3-9-14 though 5-9-14), and even to the north (RMS10-9-19). Also the B&O cut grade acts as a drainage feature conveying runoff from the site (RMS 4-9-19 and RMS 7-9-14).

Geologically, the site is located on the border of the Highland portion & Pittsburgh Plateau portion of the Appalachian Plateau physiographic province (Edmunds et al, 1971). Exhibits 2, 3 and 4 provide the mapping of the near surface bedrock units of the Pennsylvanian System within the area surrounding the site. The main structural feature is folding which generally trends to the northeast and southwest. Exhibit 2 indicates that the location of the site is on the eastern flank of the Punxsutawney-Caledonia syncline, about 5000 feet from the axis. This Exhibit shows the structural contours of the Lower Freeport coal. The Chestnut Ridge Anticline is 6 ½ miles to the southeast of the site. Bedrock, therefore, dips to the northwest at 2.2 degrees (3.8%) as determined from the structure contours on the Lower Kittanning coal as shown on Exhibit 4. At the site of the proposed well, the near surface rock units are composed of the Glenshaw Formation of the Conemaugh Group, approximately 300 above the base of the Lower Freeport Coal which is the main commercial coal seam in the area. No apparent surface or underground mining has occurred on or directly adjacent to the Zelman tract but extensive deep mining of the Lower Freeport coal has occurred to the northwest of the site (see Exhibit 3). Underlying the near surface Conemaugh units, the Allegheny and Pottsville Groups make up the remainder of the Pennsylvanian System and include the Glen Richey, Laurel Run, Mineral Springs, Millstone Run, Clearfield Creek, Curwensville and Elliott Park Formations as described by Glover and Bragonier, 1978 (see stratigraphic column, Exhibit 7). The Lower Kittanning coal is positioned approximately 150 feet below the Lower Freeport at an elevation of 1250' MSL near the proposed site and marks the lowest major seam in the area. Several other coal seams have been identified regionally and have been mined outside the area of interest for this site. However, the Lower Freeport and Lower Kittanning provide the best stratigraphic markers directly associated with the immediate area.

Underlying the Pottsville Group is the unconformity created with the Mississippian System. It is unknown how much of the upper Mississippian Mauch Chuck Formation is missing in the area but most likely the units of the Pocono Formation are present. Below the Mississippian System are the Devonian Formations of which the Oriskany Sandstone is the proposed injection well target formation at a depth of approximately 7,500 feet. Several of the older, shallower gas wells in the area targeted the sandstone units of the upper Devonian.

There are no distinct surface representations of faulting within the area of interest but subsurface faulting is present throughout the surrounding area. Exhibit 6 has been included to indicate that ground surface fracture trace evaluations have been conducted in the general area and have an influence on the orientation of surface drainage features.

UNDERGROUND SOURCES OF DRINKING WATER (USDW) – ATTACHMENT D

A cross-section A-A' (dip-section) has been prepared (See Plat Map) to show the relationship of the near surface bedrock units along the trend line noted on the large plat drawing (below cross-section). The location of gas wells and domestic water wells have been included on this cross-section. As noted on the driller's logs and as derived from background water sampling, information such as total well depth, coal seam intervals and water bearing zones are located on the cross-section. Although data from old logs and personal recollection can be suspect at times, correlations, such as the Lower Freeport coal seam appear to be consistent with the published information. RMS also checked the Department of Conservation and Natural Resources' (DCNR's) water well inventory for any available water well driller's reports (see Appendix C).

Generally, the groundwater flow of the near surface rock units will be topographically and structurally controlled based on the dip of the bedrock. The prevailing groundwater flow direction will therefore be to the west and northwest. Shallow groundwater flow within the near surface bedrock will be to the northwest. The main Plat Map shows the location of several springs and seeps on the western portion of the hillside near the Zelman property, as would be expected given the regional bedrock structure. Where data was available (see Table 1), many of the domestic wells are very shallow, but most average 100-120 feet deep, probably within sandstone aquifers of the lower Conemaugh or upper Allegheny Groups. The domestic wells noted on the cross-section indicate that some water wells may have total depths in aquifers somewhat lower, in the Freeport sandstone of the Laurel Run Formation or near the Lower Freeport coal. The deepest domestic well within the area of interest was 360 feet deep, most likely accessing aquifers in the middle and lower portions of the Allegheny Group.

Exhibit 5 provides a representation of depth to water as develop by Shuster (1979). The color code on this Exhibit suggests that the initial water level below the proposed site is between 55 to 120 feet deep, with an average, approximated depth around 73 feet.

DEPTH TO SALT WATER

Shuster (1979) has provided much of the hydrogeologic information for this region. He has mapped the "depth to salt water" at an elevation below 1000 feet MSL within the area of interest (Exhibit 5). This suggests that salt water can be encountered between 600 to 700 feet below the site. This is slightly greater than the "rule of thumb" estimate that suggests that Total Dissolved Solids (TDS) values in excess of 500 mg/L will be

encountered at depths near 500 feet in the Appalachian Plateau physiographic province. However, the information noted on the driller's logs from the gas wells in this area seem to confirm Shuster's assertion and are probably consistent with the definition of a USDW as any water bearing unit with a TDS of less than 3,000 mg/L. The logs from gas wells 20553 and 20597 indicate "fresh water" at depths of 540 feet and 750 feet, respectively (see Appendix A and Table 2). The cross-section on the Plat Map provides a representation of this lower fresh water zone for gas well 20553 at an elevation of 1038 feet MSL. As noted on the driller's log from gas well 20597, the lowest fresh water zone would be at an elevation of 917 feet MSL in a range consistent with Shuster interpretation (Exhibit 5). Given the elevation of these zones and based on the gas well driller's logs, the aquifers are stratigraphically positioned above the Mississippian red shales & claystones ("Patton Redbeds" Edmunds et al, 1971) and most likely within the Burgoon Sandstone.

Many of the gas well logs also indicate shallower fresh water zones which most likely correspond to the domestic well aquifers. However, for the zones noted on the gas well logs over 400 feet (possibly within the Pottsville Connoquenessing Sandstone or Burgoon Sandstone) TDS values will probably exceed 500 mg/L (drinking water standard).

EXISTING GAS WELL DATABASE AND FRESH WATER SEPARATION

Appendix A includes the logs of the gas wells within the project area of interest. Information and data obtained from these logs have been summarized on Table 2. Some of the gas wells have total depths within the upper Devonian gas yielding units and some are Oriskany wells. As noted above, the driller's logs from the adjacent gas wells provide some information as to the presence of fresh water. The target horizon of the proposed injection well is the Oriskany Sandstone/Huntersville chert interval at an anticipated depth of approximately 7,300 feet or minus 5,600 feet BSL. The existing well logs indicate that there are no fresh water zones below 900 feet MSL under the surrounding area. The water well inventory indicates that there are no water supply wells below 1200 feet MSL. As a result, it is concluded that over 6500 feet of separation exists between the lowest fresh water aquifer (USDW with TDS lower than 3000 mg/L) and the injection zone and 6,800+ feet of separation between the injection zone and the deepest domestic water well in the area. Refer to the cross-section A-A' through the area (Plat Map) for a graphical demonstration of these relationships.

BACKGROUND WATER SAMPLING

Sampling in the general area of the proposed injection disposal well was conducted to characterize existing shallow ground and surface water quality. Primarily sampling was conducted within a one quarter mile radius of the proposed injection well. This area includes sample positions that are down gradient and/or potentially hydrologically connected to the proposed facility.

Surface waters receiving drainage which may originate from the injection well position have been characterized utilizing data obtained by recent field sampling, see Appendix B.

Emphasis was placed on sampling those ground-water points that are stratigraphically connected to the well location or contain water which originates within a recharge area containing the proposed injection well. Surface water samples were obtained and are provided in order to define overall surface water characteristics.

The Sandy Lick Creek drainage basin, which contains the proposed injection disposal well, is classified as a TSF – Trout Stockable Fishes stream within Chapter 93 of the Pennsylvania EQB's PROTECTION OF NATURAL RESOURCES; Article II. WATER RESOURCES; Title 25. RULES AND REGULATIONS.

As noted, the proposed injection well is positioned on the ledge of a local round top approximately 50' below the peak of that round top and on a minor local watershed divide. Surface runoff flowing east will flow towards the Luthersburg Br. of Sugarcamp Run into the Laborde Br. prior to entering Sandy Lick Creek while surface runoff to the west will flow into Pentz Run prior to reaching Sandy Lick Creek. All the tributaries to Sandy Lick Cr. are classified as CWF – Cold Water Fisheries within Chapter 93.

Numerous private ground water supplies are located in the immediate study area of the proposed injection well. These supplies are all down gradient of the proposed facility and would receive recharge from infiltrating surface waters in the project area.

The analytical results from the background water sampling event are summarized on Table 3 and the laboratory data sheets are included in Appendix B.

Existing water quality characteristics observed in stream/spring samples RMS 1/9/13 through RMS 4/9/20 indicate that general water quality is excellent with minor levels of degradation observed at the RMS 2/9/20 and 4/9/20 sample positions.

Existing water quality characteristics observed in private water supply samples RMS 6/9/13 through RMS 1/9/26 all exhibit measured parameter concentrations which are generally excellent in water quality characteristics. However, existing iron and manganese concentrations are above established EPA Secondary drinking water limits, established for these parameters, for aesthetic reasons.

A low level chloride concentration was also observed (RMS 2-9-20) above what is typically found in areas unaffected by any industrial, residential or other human development activities.

As required, a monitoring program has been developed in response to Attachment P of the permit application. The monitoring program includes selected domestic water wells, a surface seep and stream points. Sampling will be conducted monthly during construction of the well and semi-annually during operations, and will include the analytical parameters noted in Table 3 minus Oil & Grease.

The proposed monitoring program is summarized on Table 4.

CONCLUSIONS

This report describes the hydrogeologic investigation conducted by Resource Management Services, Inc. in order to address Attachments B, D and P for Windfall Oil & Gas Corporation's Underground Injection Control Permit Application for an injection well on the Zelman Property in Brady Township, Clearfield County, Pennsylvania.

The investigation indicates that the proposed injection well is located on a near hilltop ledge, upslope and up-dip from several water supplies, primarily to the west of the site. Near surface flow from the site radiates to the east, west and south with the prevailing groundwater flow direction to the West-Northwest.

A review of water supply information indicates that total well depths are less than 400 feet with most in the 100-150 foot range within the Conemaugh or upper Allegheny groups of bedrock formations. There are no existing domestic water wells with total depths below an elevation of approximately 1200 feet MSL.

A review of published information and gas well logs indicate that "fresh water" would not be encountered below an elevation of 900 feet MSL.

As a result of these findings, there are several thousand feet of separation between usable groundwater aquifers and the target injection zone, the Oriskany Sandstone.

However, the injection well site is located within the recharge area of several domestic water supplies and proper construction and cementing techniques used when installing the injection well casing(s) will be imperative so that there are no impacts to these supplies. The background sampling event indicated that the water quality of these supplies is generally very good. As a result, a sampling plan has been proposed in this report to test selected water supplies and surface water points to monitor for potential influences during the initial drilling and operational periods of the proposed injection well.

**Windfall Oil & Gas – Zelman Injection Well
Brady Twp., Clearfield County, PA**

USDW INJECTION WELL REPORT WITH HYDROLOGY

REFERENCES

Groundwater Resources of the DuBois Area, Clearfield and Jefferson Counties, Pennsylvania.
PaDEP; Water Resource Report 45. Evan T. Shuster; 1979

Geology and Mineral Resources of the Southern Half of the Penfield 15-Minute Quadrangle,
PaDEP; Atlas 74cd. William E. Edmunds & Thomas M. Berg with appendix by William C. Darrah;
1971, reprinted 1973.

Geology and Mineral Resources of the Hazen, Falls Creek, Reynoldsville, and DuBois
Quadrangles, Clearfield and Jefferson Counties, Pennsylvania. PaDEP; Atlas 64. Albert D. Glover,
William A. Bragonier; 1978

PaDEP Bureau of Oil & Gas; Well Records (see Appendix A)

PaDEP Permit # CLE- or 033-

20341-P, 20333, 20626-P, 20553, 20325-P, 20327, 20597.

WINDFALL OIL & GAS – UIC INJECTION - ZELMAN PROPERTY
LIST OF EXHIBITS, TABLES, APPENDICES

Figures

Large Plat Map Topographic Drawing

Exhibits

- 1- Topographic Map w/Location Key (Area of Interest Radius)
- 2- Part Dubois Quadrangle Geology with L. Freeport Coal Structure Contours and Synclinal Axis
- 3- Part Luthersburg Quadrangle with Lower Freeport Coal Distribution & Extent of Mining
- 4- Part Luthersburg Quadrangle Geology, Lower Kittanning Coal Structure Contours indicating Dip Direction near Injection Site
- 5- Shuster (1979) Groundwater and Salt Water Depths
- 6- Regional Geology and Fracture Trace Analysis
- 7- Stratigraphic Column

Tables

- 1- Domestic Water Well Information
- 2- Information from Gas Well Driller's Logs
- 3- Analytical Data Summary
- 4- Monitoring Program

Appendices

- A- Gas Well Logs
- B- Laboratory Analytical Data
- C- DCNR Water Well Inventory Logs