PETITION FOR REVIEW

May 6, 2014

I, Peter Bormuth, file this petition for review of the Underground Injection Control Permit #MI-075-2D-0009 issued to West Bay Exploration Company for the West Bay Haystead #9 SWD well in Jackson County Michigan, T4S, R2E, Section 9, ¼ Section SW for disposal of oil and gas related brine for injection into the Niagaran at depths between 2970 and 3100 feet.

According to 40 CFR § 124.19(a) *"Any person who filed comments on [the] draft permit or participated in the public hearing may petition the Environmental Appeals Board to review any condition of the permit decision."* I claim the right of petition since I participated in the April 30, 2013 public hearing held at Columbia Central High School in Brooklyn Michigan. I also filed comments with Timothy Elkins on April 30, 2013 and May 2, 2013 by e-mail. Additionally under Section 124.13 *"the person filing the petition for review does not necessarily have to be the one who raised the issue"* during the comment period. *See In re Broward County, Florida*, NPDES Appeal No. 92-11, at 11 (EAB, June 7, 1993).

The petitioner challenges the permit decision since it is based on clearly erroneous findings of fact. Under the rules governing this proceeding, an erroneous finding of fact demands and warrants review. *See* 40 CFR § 124.19; FED. REG. 33, 412 (1980).

The burden of demonstrating that review is warranted rests with the petitioner. *See In re Avery Lake Property Owners Ass'n*, UIC Appeal No. 92-1, at 3 (EAB, Sept. 15, 1992).

The burden of demonstrating that the injection is safe and will not harm drinking water or the health of person's rests with West Bay Exploration and now since the permit has been issued, that burden rests with the EPA. *See* 40 CFR § 144.12(a). *"No owner or operator shall construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 CFR part 142 or may otherwise adversely affect the*

health of persons. The applicant for a permit shall have the burden of showing that the requirements of this paragraph are met."

The petitioner claims that the EPA clearly erred in finding that underground sources of drinking water would not be endangered by the injection of brine at this specific location. The geological formation at this site is clearly inappropriate for injection purposes. Conversion of the Anhydrite cap (to Gypsum) will definitely take place upon exposure to the injected water. The combination of the pressure from the injected liquid, the pressure created by the contained swelling of the anhydrite cap, and the natural upward flow gradient in the Michigan Basin would then allow migration of brine outside of the confining layer. The petitioner states that both laboratory and field data show that it is likely that the brine containing naturally occurring toxic chemicals will breach the cap through naturally occurring fault lines, pressure induced fractures, and areas where the converted anhydrite-to-gypsum dissolves in solution. The breaching of the anhydrite cap and the upward migration of the brine clearly would violate the Safe Drinking Water Act and endanger the health of persons.

The EPA lists these common components of oil field brines:

Benzene is a "conclusively" known human carcinogen and a notorious cause of bone marrow failure. Vast quantities of epidemiological, clinical, and laboratory data link benzene to aplastic anemia, acute leukemia, kidney cancer, and bone marrow abnormalities. Benzene exposure has been linked directly to neural birth defects, spina bifida, and anencephaly. **Ethylbenzene** exposure can irritate the eyes, nose, and throat. Very high levels can cause paralysis, trouble breathing, and death. High exposure may also damage the liver and chronic long term effects can last for months or years. **Toluene** exposure is associated with effects such as psychoorganic syndrome, visual evoked potential, toxic polyneuropathy, optic atrophy, brain lesions, and cerebellar, congnitive and pyramidal dysfunctions. Low to moderate levels can cause tiredness, confusion, weakness, drunken-type actions, memory loss, nausea, and loss of appetite, hearing, and color vision. **Xylene** is an irritant of the eyes and mucous membranes at concentrations below 200 ppm. Ingestion of xylene causes gastrointestinal distress, disturbances of liver and kidney function and may cause toxic hepatitis. Chronic exposure may

cause central nervous system depression, anemia, mucosal hemorrhage, bone marrow hyperplasia, liver enlargement, and liver necrosis. **Naphthalene** is classified as "possibly carcinogenic to humans" and may damage or destroy red blood cells. Exposure may cause confusion, nausea, vomiting, diarrhea, cataracts, blood in the urine, and jaundice. Under California's Proposition 65, naphthalene is listed as "known to the State to cause cancer". **Polycyclic aromatic hydrocarbons** are known for their carcinogenic, mutagenic, and teratogenic properties. Prenatal exposure is associated with lower IQ and childhood asthma. The Center for Children's Environmental Health reports that exposure to PAH during pregnancy is related to adverse birth outcomes including low birth weight, premature delivery, and heart malformations.

Obviously if these naturally occurring toxic chemicals breach the confining layer a serious hazard to human health could result. The petitioner claims this outcome is likely because the Salina A-2 Evaporite will be breached and the injected brine will migrate upwards.

On page 2 of the Response to Comment document dated April 9, 2014 (Final Determination) the EPA states that the Salina Group, a sequence of carbonate, anhydrite and salt layers, will act as a confining layer to prevent flow out of the injection zone.

The Petitioner contends that this statement is an erroneous finding of fact which contradicts the known scientific data. Wikipedia states: "When exposed to water, anhydrite readily transforms to the more commonly occurring gypsum." Two German investigators state: "in contact with water every anhydrite dissolves or alters to gypsum." (See Rauh & Thuro, *Engineering Geology*, Technishe Universitat Munchen, Germany, INVESTIGATIONS ON THE SWELLING BEHAVIOR OF PURE ANHYDRITES). Gypsum is more readily soluble than limestone and sinkholes and caverns readily develop in thick beds of gypsum. Salt is even more soluble than gypsum. (see Bell, Cripps & Culshaw, *Groundwater in Engineering Geology*, London 1986, A REVIEW OF THE ENGINEERING BEHAVIOR OF SOILS AND ROCK WITH RESPECT TO GROUNDWATER). Korzhinsky showed that the solubility of minerals increases when the rock fabric experiences pressures higher than that of groundwater (see Korzhinsky, D.S. *AN SSR Publ.* Moscow (1953), ESSAY ON METASOMATIC PROCESSES). Experimental data by Manikhin

suggests that the solubility of Anhydrite increases sharply with the increase of pressure; each 0.01 Pa increase in pressure results in a 3 to 5 times increase in solubility (see Manikhn, V.I. *Geokhimicheskie Materialy,* vol. 34 p.193-196, ON THE QUESTION OF SOLUBILITY OF CALCIUM SULFATE UNDER HIGH PRESSURES; see also Klimchouk, Alexander, *Int. J. Speleol* 25 (3-4), (1996), THE DISSOLUTION AND CONVERSION OF GYPSUM AND ANHYDRITE).

Laboratory experiments show that anhydrite readily reverts to gypsum when brought into contact with water (See Hardie, *The American Mineralogist,* Vol. 52, January-February 1967 – THE GYPSUM-ANHYDRITE EQUILBRIUM AT ONE ATMOSPHERE PRESSURE; see also Zen, *Journal of Petrology*, Vol. 6, Part 1, 1965 – SOLUBILITY MEASUREMENTS IN THE SYSTEM CaSO4-NaCl-H2O at 35, 50, & 70 degrees C and ONE ATMOSPHERE PRESSURE – publication approved by the Director, U.S. Geological Survey). In a study published in *Groundwater in Engineering Geology,* London 1986, researchers Bell, Cripps & Culshaw found that "massive anhydrite can be dissolved to produce uncontrollable runaway situations in which seepage flow rates increase in a rapidly accelerating manner. Even small fissures in massive anhydrite can prove dangerous....Within about 13 years the flow rate increases to a runaway situation." In CRYSTALIZATION, ALERNATION & RECRYSTALLIZATION OF SULPHATES, researcher Jonna Jaworska states: [the gypsification (hydration) of anhydrite] "under natural conditions can occur very quickly: within a few years (Farnsworth, 1925) or even within one year (Moiola & Glover, 1965);..."

It is an accepted fact of science that anhydrite will convert to gypsum upon exposure to water. Many researchers have reported evidence of this conversion at shallower depths with Murray reporting it at a depth of 3500 feet below the surface. (see Murray, *Journal of Sedimentary Petrology*, Vol. 34, No. 3 September 1964 – ORIGIN AND DIAGENESIS OF GYPSUM AND ANHYDRITE). When hydration occurs at shallower depths, the gypsum formed may be removed in solution. At greater depths, anhydrite is effectively confined which results in a gradual buildup of pressure. Such pressure may be liberated in a sudden explosive movement into the next layer of the overburden. (see Bell, Cripps & Culshaw, *Groundwater in Engineering*

Geology, London 1986, A REVIEW OF THE ENGINEERING BEHAVIOR OF SOILS AND ROCK WITH RESPECT TO GROUNDWATER). Similar Anhydrite rock layers have been observed to swell and increase in volume up to 60% upon exposure to water and when such swelling is prevented due to confining conditions immense swelling pressures from 1.7 up to 4.7 MPa have been monitored and recorded. (*see* Steiner, *International Journal of Rock Mechanics and Mining Sciences & Geomechanics Abstracts*, 30, 4, (1993) – SWELLING ROCK IN TUNNELS; see also Sass & Burbaum, *ACTA Carsologica* 39/2 Postonjna (2010) – DAMAGE TO THE HISTORIC TOWN OF STAUFEN (GERMANY) CAUSED BY GEOTHERMAL FRILLINGS THROUGH ANHYDRITE-BEARING FORMATIONS). In an over pressurized system, a depth pressure gradient greater than 0.465 psi ft for brines indicates a potential upward flow. (see Kreitler, Charles, *Journal of Hydrology,* 106 (1989) 29-53, HYRDOGEOLOGY OF SEDIMENTARY BASINS).

The scientific literature shows that certain salts activate rather than inhibit the hydration of anhydrite and thus promote the conversion of anhydrite to gypsum. In laboratory studies the best activators were found to be sodium, potassium sulfate and sulfuric acid. Anhydrite reacts very rapidly with concentrated Na2SO4 solutions to form Ca-Na double sulfates. These double-salts are unstable in dilute solutions and decompose to gypsum and/or glauberite. (see Conley and Bundy, *Geochimica et Cosmochimica Acta*, v. 15 (1958) – MECHANISM OF GYPSIFICATION; see also Hardie, *The American Mineralogist,* Vol. 52, January-February 1967 – THE GYPSUM-ANHYDRITE EQUILBRIUM AT ONE ATMOSPHERE PRESSURE); see also Singh, *Amer. Ceram. Soc.* Vol. 88 (January 2005) - EFFECT OF ACTIVATOR K2SO4 ON THE HYDRATION OF ANHYDRITE OF GYPSUM (CASO4.II).

In the laboratory Singh proposed the following mechanism for the conversion of anhydrite to gypsum: as soon as anhydrite comes into contact with water, a part of it is dissolved, making a solution saturated with respect to Ca^{2+} and SO_4^{2-} ions. These ions, which are hydrated in the solution, rapidly get absorbed at the surface of anhydrite, giving a higher surface area. The thickness of the absorbed layer increases over time. When the thickness of the absorbed layer increases beyond a certain limit, cracks are formed. Water molecules enter through the cracks and come in contact with a fresh surface of anhydrite. When there are sufficient numbers of

Figure #1

STRATIGRAPHIC SUCCESSION IN MICHIGAN

PALEOZOIC THROUGH RECENT

MICHIGAN DEPARTMENT OF CONSERVATION

Ralph A. MacMullan, Director

GEOLOGICAL SURVEY

Gerald E. Eddy, State Geologist

ACKNOWLEDGEMENT: Compiled with the counsel of colleagues in this department, the U. S. Geological Survey, Michigan's universities, other state Geological Surveys, and geologists within Michigan's oil and gas industry. Dr. Aureal T. Cross, Department of Geology, Michigan State University, identified rocks of Mesozoic age and suggested provisional age assignments.

GEOLOGIC NAMES COMMITTEE

Garland D. Ells, Chairman, Robert W. Kelley, Secretary;
Harry J. Hardenbergh, L. David Johnson, Harry O. Sorensen

PLEISTOCENE NOMENCLATURE

ERA	SYSTEM	SERIES	STAGE	
CENOZOIC	QUATERNARY	RECENT		
		PLEISTOCENE	Wisconsin Glaciation	Valders Stade
				Two Creeks Interstade
				Mankato Stade (Pt. Huron?)
				Cary Stade
				Tazewell Stade
			Sangamon Interglaciation	
			Illinoian Glaciation	

OUTCROP NOMENCLATURE

GEOLOGIC TIME: ERA	PERIOD	EPOCH	SYSTEM	TIME-STRATIGRAPHIC: SERIES	ROCK-STRATIGRAPHIC: GROUP	FORMATION	MEMBER
MESOZOIC	JURASSIC	LATE	JURASSIC	KIMERIDGIAN			
PALEOZOIC	PENNSYLVANIAN	LATE	PENNSYLVANIAN	CONEMAUGH		Grand River Fm.	Ionia, Eaton, and Woodville Sandstones
		EARLY		POTTSVILLE		Saginaw Fm.	Verne Ls.
	MISSISSIPPIAN	LATE	MISSISSIPPIAN	MERAMECIAN	GRAND RAPIDS	Bayport Ls.	
						Michigan Fm.	
				OSAGIAN		Marshall Ss.	Napoleon Sh.
		EARLY		KINDERHOOKIAN		Coldwater Sh.	
	MISSISSIPPIAN-DEVONIAN			Unassigned		Ellsworth Sh. (Western Michigan)	
	DEVONIAN	LATE		CHAUTAUQUAN		Antrim Sh.	
				SENECAN		Squaw Bay Ls.	
						Thunder Bay Ls.	
						Potter Farm Fm.	
						Norway Point Fm.	
						Four Mile Dam Fm.	
		MIDDLE		ERIAN	TRAVERSE	Alpena Ls.	
						Newton Creek Ls.	
						Genshaw Fm.	K.Bans
						Ferron Point Fm.	
						Rockport Quarry Ls.	
						Bell Sh.	
						Rogers City Ls.	
						Dundee Ls.	
		EARLY		ULSTERIAN	DETROIT RIVER	Anderdon Fm.	
						Lucas Fm.	
						Amherstburg Fm.	
						Sylvania Ss.	
						Bois Blanc Fm.	
					MACKINAC BRECCIA	Garden Island Fm.	
	SILURIAN	LATE		CAYUGAN	BASS ISLANDS	Raisin River Dol.	
						Put-in-Bay Dol.	
						St. Ignace Dol. (Northern Peninsula)	
					SALINA	Pte. aux Chenes Sh.	
		MIDDLE		NIAGARAN		Engadine Dol.	
					MANISTIQUE	Cordell Dol.	
						Schoolcraft Dol.	
						Hendricks Dol.	Fiborn Ls.
					BURNT BLUFF	Byron Dol.	
						Lime Island Dol.	
		EARLY		ALEXANDRIAN	CATARACT	Cabot Head Sh.	
						Manitoulin Dol.	
	ORDOVICIAN	LATE		CINCINNATIAN	RICHMOND	Big Hill Fm.	
						Stonington Fm.	Ogonz
							Bay de Noc
						Bill's Creek Sh.	
							Collingwood
		MIDDLE		MOHAWKIAN	TRENTON	Groos Quarry Fm.	
						Chandler Falls Fm.	
					BLACK RIVER	Bony Falls Fm.	
		EARLY		CHAZYAN			
				CANADIAN	PRAIRIE DU CHIEN	Oneota Dol.	
	CAMBRIAN	LATE		ST. CROIXAN	LAKE SUPERIOR	Trempealeau Fm.	Jordan Ss.
							Lodi
							St. Lawrence
						Munising Fm.	Miner's Castle Ss.
							Chapel Rock Ss.
		MIDDLE				Jacobsville Ss.	
		EARLY					
	PRECAMBRIAN						

SUBSURFACE NOMENCLATURE

ROCK-STRATIGRAPHIC: FORMATION	MEMBER	GROUP

Approximate maximum thickness, in feet, of rock units in the subsurface. NO SCALE

DOMINANT LITHOLOGY

Glacial Drift

"Red Beds" (unnamed)

Subsurface only(?)

220

Grand River Fm.

750

Saginaw Fm.

Bayport Ls. 160

Michigan Fm. GRAND RAPIDS 600

Marshall Ss. Napoleon Sh. 330

Coldwater Sh. -2630- 1300

Sunbury Sh. 160

Berea Ss. (Eastern Michigan) 260

Bedford Sh. 240

Ellsworth Sh. Antrim Sh. 660

Squaw Bay Ls.

Alpena Ls. TRAVERSE 830

Generally undivided in subsurface.

Bell Sh.

Rogers City Ls.

Dundee Ls. 475

Lucas Fm.

Amherstburg Fm. DETROIT RIVER 1450

Sylvania Ss.

Bois Blanc Fm. 800

Garden Island Fm. 100

Raisin River Dol.

Put-in-Bay Dol. BASS ISLANDS 700

G Unit

F Evaporite

E Unit

D Evaporite

C Unit SALINA 3150

B Evaporite

A-2 Carbonate

A-2 Evaporite

A-1 Carbonate

A-1 Evaporite

Cabot Head Sh.

Manitoulin Dol. CATARACT 200?

Queenston Sh.

Unica Sh. RICHMOND 950

Collingwood

Generally undivided in subsurface. 1100

Glenwood BLACK RIVER

St. Peter Ss. 260

Shakopee Dol.

New Richmond Ss. PRAIRIE DU CHIEN 425

Oneota Dol.

Jordan Ss.

Trempealeau Fm. Lodi 750

St. Lawrence

Franconia Ss. LAKE SUPERIOR

Munising Fm.

Dresbach Ss.

Eau Claire 1175?

Mount Simon Ss.

Jacobsville Ss. 1100+

PRECAMBRIAN

INFORMAL TERMS

Principal oil and gas pays, and informal terms used in petroleum exploration and applied to parts of formations or groups in the subsurface.

STRATIGRAPHIC POSITION	INFORMAL TERMS	PAYS
Basal sandstones of Saginaw Fm.	Parma sandstone	
In lower part of Michigan	triple grey, brown lime, stray sandy ss., stray dol.	Gas
	stray ss.	Gas & Oil
Marshall Ss.		Gas & Oil
Coldwater Sh.	Coldwater lime, Weir sand, Coldwater red-rock	Gas
In upper part of Ellsworth Sh.	"Berea" (Western Michigan)	Oil & Gas
Berea Ss.	berea sand (Eastern Michigan)	Oil & Gas
Squaw Bay Ls.	Squaw Bay	Oil & Gas
Upper part of Traverse Group in Western Michigan	Traverse formation, Traverse lime	Oil & Gas
	Stoney Lake zone	Oil & Gas
Rogers City Ls.		Oil & Gas
Dundee Ls.		Oil & Gas
Dundee Ls. (?), Upper part of Lucas Fm. (?)	Reed City zone	Oil & Gas
In Lucas Fm.	massive salt, big salt, sour zone	Oil & Gas
	massive anhydrite, big anhydrite, Richfield zone	Oil & Gas
Amherstburg Fm.	black lime	
Part of Salina Group E Unit	E zone (or Kinnigh zone)	Oil
Divisions of A-2 Carbonate in Western Michigan	A-2 dolomite, A-2 lime	Gas
A-1 Carbonate	A-1 dolomite	Oil & Gas
Upper part of Niagaran Series	brown Niagaran, gray Niagaran, white Niagaran	Oil & Gas
Part of Niagaran Series	Clinton shale (Eastern Michigan)	
Trenton Group		Oil & Gas
Black River Group	Black River formation, Black River shale, Van Wert zone	Oil & Gas
Oneota Dol.		Oil

EXPLANATION

Limestone — Cherty; Sandy or silty; Argillaceous or shaly

Dolomite — Some variations as limestone

Shale — Sandy or silty; Calcareous; Dolomitic

Sandstone — Cherty; Calcareous; Dolomitic; Argillaceous or shaly

Coal beds

Anhydrite or gypsum

Halite (Salt)

Stoneware (Kaolin)

Erosional surface or truncated strata. Not erosional valleys or channels.

PRECAMBRIAN — Igneous, metamorphic, and sedimentary rock.

GEOLOGIC NAMES COMPILATIONS: Harry O. Sorensen, Cambrian and Ordovician; Robert W. Kelley, Early and Middle Silurian; Garland D. Ells, Late Silurian through Detroit River Group of Devonian age; Harry J. Hardenbergh, Dundee Limestone through Traverse Group of Devonian age; L. David Johnson, Antrim Shale through the Pennsylvanian System; F. Wells Terwilliger, glacial geology of the Cenozoic.

CHART 1

1964

Ca^{2+} and SO_4^{2-} ions and water molecules at the surface, nuclei of gypsum are formed (Singh, *Amer. Ceram. Soc.* Vol. 88 (January 2005) - EFFECT OF ACTIVATOR K2SO4 ON THE HYDRATION OF ANHYDRITE OF GYPSUM (CASO4.II). The natural cracking is significant since under pressure the Anhydrite can be expected to fracture along naturally occurring fault lines. In a private communication with the petitioner, Dr. Timothy Bechtel PhD. P.G. stated: "the biggest problem with anhydrite is the 60% volumetric expansion it suffers when hydrating to gypsum. I have been involved with an anhydrite case in Germany (Google Staufen im Breisgau) in which introduction of water into an anhydrite bed has produced swelling and cracking of the earth. Oilfield brine could produce similar results...swelling and cracking to produce conduits for fluid migration." (e-mail – Bechtel to wardance@live.com – 7-18-12). And Suthersan in his study of hydraulic and pneumatic fracturing notes that "The injection pressure required to create hydraulic fractures is remarkably modest (less than 100 psi)." (See Suthersan, Boca Raton: CRC Press LLC, (1999) – HYRDAULIC AND PNEUMATIC FRACTURING).

In Response #2 (p.5,6) the EPA states that "if injected fluid were to exit the confining zone, it would migrate into the next rock unit capable of accepting fluid." The Petitioner agrees with this statement and notes that this would violate the issued permit. This permit is specifically written for injection into the Niagaran with the Salina Group being used as the confining layer. The Salina Group is composed of carbonate, argillaceous carbonate, anhydrite, and salt. Scientific studies cited by the Petitioner show this layer will undergo chemical transformation upon contact with the injected brine and fail to confine the injected fluid. The EPA cannot simply say "oh, well, there is another layer of rock 1000 feet above this layer that will confine the fluid before it reaches our USDW." Then the EPA should write the permit with the Coldwater shale as the confining layer and the petitioner will comment on and contest that new permit. This avoidance of responsibility for writing an accurate permit is not acceptable.

In Response #4 (p. 8) the EPA states that this secondary confining layer of Coldwater shale is 1,300 feet thick. They cite the 1964 Stratigraphic Succession map (see Figure #1 – Bentley Historical Library, University of Michigan) which shows the shale to be sandy, and thus permeable. Second, the 2000 map cited by the Petitioner shows the maximum thickness of the

Coldwater shale to be only 250 feet thick with significant inclusions of Berea Sandstone which is porous and permeable. The Petitioner claims that the newer map is more likely to be accurate, since it is based on the accumulated data from all the more recent wells which have been drilled in the southern Michigan basin since 1964. The Michigan basin is a bowl shaped geologic structure with little variance in layers. Why does the EPA get to cite the oldest map rather than the newest one?

The EPA also ignores the fact that there is a known vertical component to the Michigan hydraulic gradient which will move this brine upwards naturally through pre-existing fractures in the overburden rock formations which the EPA cites. Transport of fluid upwards, even considered as simple particle velocity, will occur. There are several studies that document cross-formational pathways in the Michigan basin which have allowed deeper saline water to migrate into shallower freshwater aquifers. This upward migration of saline fluid into the overlying glacial sediments was interpreted to reflect isostatic rebound following the retreat of the glaciers, leading to fracture intensification and increased permeability of the near surface layers above 1000 feet. (see Weaver, Frape, Cherry, *Geol. Soc. Am. Bull.* 107 (1995) – RECENT CROSS-FORMATIONAL FLUID FLOW AND MIXING IN THE SHALLOW MICHIGAN BASIN; see also Long, Wilson, Takacs, Rezabek, *Geol. Soc. Am. Bull.* 100 (1988) – STABLE-ISOTOPE GEOCHEMISTRY OF SALINE NEAR-SURFACE GROUNDWATER: EAST-CENTRAL MICHIGAN BASIN).

Recent scientific findings show that migration of injected fluid through strata is far more common and widespread than previously believed. A Duke University study (see Warner; Jackson; Darrah; Osborn; Down; Zhao; White; Vengosh. *Proceedings of the National Academy of Sciences*, (May 2012) GEOCHEMICAL EVIDENCE FOR POSSIBLE NATURAL MIGRATION OF MARCELLUS FORMATION BRINE TO SHALLOW AQUIFERS IN PENNSYLVANIA) demonstrates that deep formation brine may migrate to shallow aquifers. The EPA in Document # 600/R-00/000 (December 2011) INVESTIGATION OF GROUND WATER CONTAMINATION NEAR PAVILLION WYOMING concluded that "...when considered together with other lines of evidence, the data indicates likely impact to ground water that can be explained by hydraulic fracturing." In another study independent researcher Tom Myers used computer modeling and concluded

that "...fluid can migrate through thousands of feet of rock and endanger water supplies." (see Myers, *Ground Water*, (April 2012) POTENTIAL CONTAMINANT PATHWAYS FROM HYDRAULICALLY FRACTURED SHALE TO AQUIFERS). While these studies dealt with hydraulic fracturing, the mechanism of pressure, cracking, and gas or fluid migration does not differ from this Waste Injection situation. The EPA cannot claim that the findings of these studies may not also be applied to the waste injection process.

In Response # 14.1 (p.40) the EPA states that they used the modified Theis equation to determine the zone of influence. The EPA's calculations estimate that the injected fluid could travel 894 feet from the well. The Petitioner wonders what values the EPA used for pore size, porosity, temperature and pressure. The Michigan State University Earth Sciences Department informed me that one atmosphere (101 kPa or 14.7 psi) can lift/move water by 34 feet. West Bay's permit allows them to inject at 737 psi so they could conceivably move/lift fluid 1700 feet (50 atmosphere's times 34 feet). This does not take into account the additional pressure dynamics resulting from the confined swelling of the anhydrite. As I mentioned previously, these forces can be immense and would surely push the liquid even farther than the injection pressure alone. The temperature 100 feet below the surface is 55 degrees. There is 1 degree of temperature increase for each 100 feet you descend so an estimate of the temperature at 3000 feet as 85 degrees usable in all calculations. Michigan State also informed the petitioner that the average pressure gradient in the Michigan Basin is approximately 0.43 lb/ft, thus the ambient pressure (that is, the pressure in the absence of any additional compression) is roughly 1290 psi (87.8 atm). A calculation of pressure must take into account this value, the 1,200 BWPD of water injected into the Anhydrite rock strata at a pressure of 737 psi, the pressure of the overbearing rock strata, and the potential pressure created by the swelling of the Salina A-2 Evaporite formation upon contact with the injected fluid which could range from from 1.7 up to 4.7 MPa.

Clearly the petitioner has proven that there is a sufficient likelihood and danger of the anhydrite cap being breached. Given these circumstances, the EPA is under legal obligation to revoke this permit upon review. If the EPA wants to use the Coldwater shale as their confining

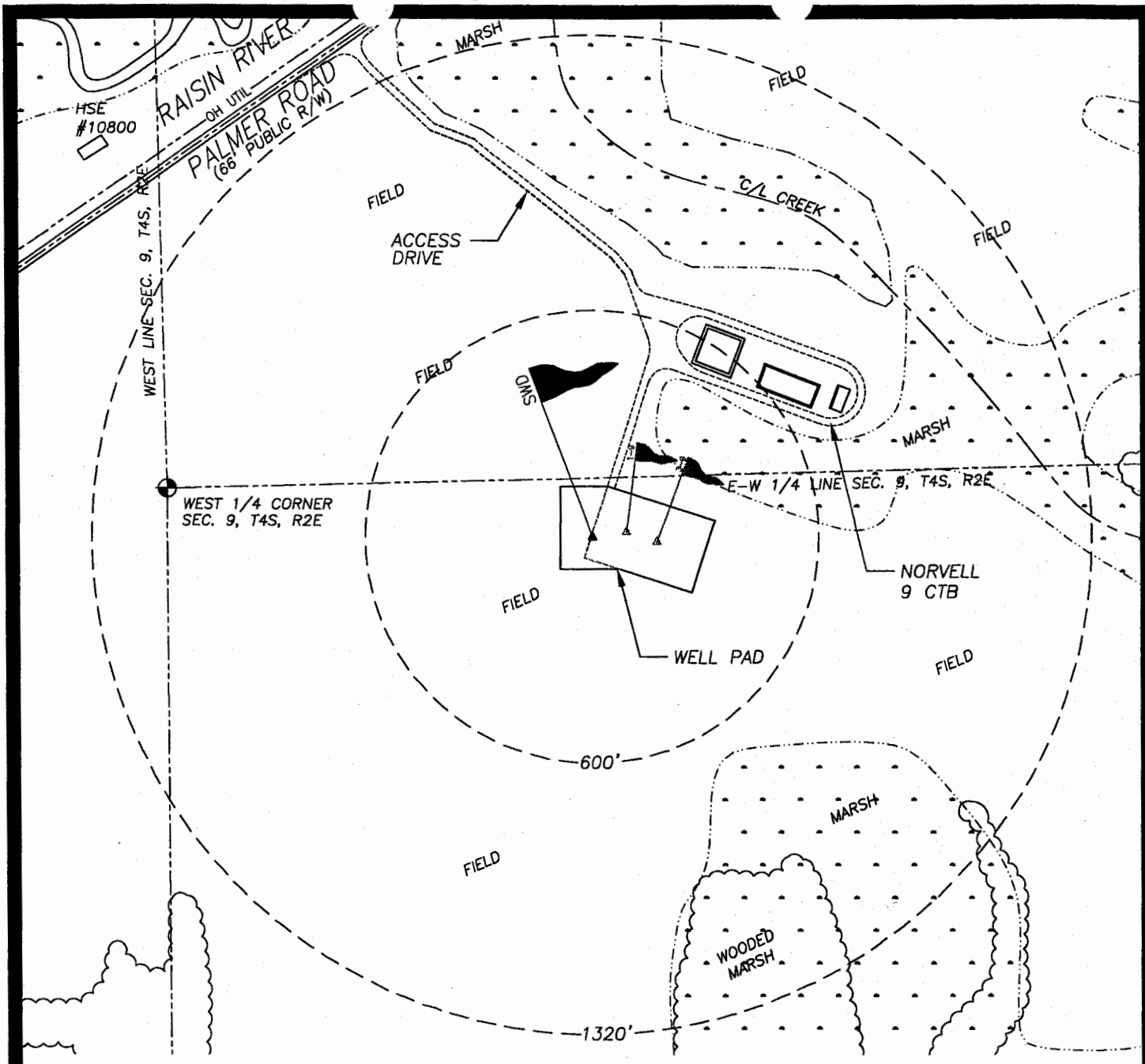
layer, write a new permit! The EPA ignoring the danger this permit poses to our USDW's, the Raisin River and our prairie Fens. Water is life. Your evil jesus is not life. The New Testament is just a stupid children's story. But WATER IS LIFE!!!!!!!!!!!!!!!!!!!!!!!!

The petitioner also claims that the Indiana bat will be endangered by this activity within its known habitat. 40 CFR § 144.4(c) specifically states: *"The Endangered Species Act, 16 U.S.C. 1531 et seq. Section 7 of the Act and implementing regulations (50 CFR part 402) require the Regional Administrator to ensure, in* consultation *with the Secretary of the Interior or Commerce, that any action authorized by EPA is not likely to jeopardize the continued existence of any endangered or threatened species."* The Indiana bat was listed as an Endangered Species by the USFWS on March 11, 1967.

In Response #28 (p. 68) the EPA states that "the well site or 'action area' is located entirely within a plowed field." Figure #2 is the diagram West Bay filed with their permit application. The diagram shows the Raisin River is approximately 1500' from the well site. It shows the C/L creek to be approximately 900' from the well site. It shows wooded marsh to be approximately 900' from the well site. And it shows marsh covering almost half of the 1320' diameter circle and one finger of marsh within 100' of the well pad (E-W ¼ line Sec 9, T4S, R2E). For the EPA to claim that the Indian bat will not be found on this property is absurd. This is prime Indiana bat habitat.

The United States Department of Agriculture published General Technical Report NE-284, REVIEW OF THE FOREST HABITAT RELATIONSHIP OF THE INDIAN BAT (*Myotis sodalist*) (2001). In 2005 the United States Department of Agriculture published MYOTIS SODALIS by Peggy Luensmann. These documents both concluded that in southern Michigan, the general landscape occupied by Indiana bats consisted of open fields and agricultural lands (55%), wetlands and lowland forest (19%), other forested habitats (17%), developed areas (6%), and perennial water sources such as ponds and streams (3%). These scientific findings clearly contradict the EPA's statement. If 55% of the general landscape used by Indiana bats is open fields and agricultural lands, and 19% is wetlands and lowland forest, and 3% is ponds and steams, then there is a 77% chance bats will be found on the well site property. Indiana bats

Figure #2



LOCATION: 2459' FEET FROM THE SOUTH LINE AND 1122 FEET FROM THE WEST LINE OF SECTION 9, T4S, R2E, NORVELL TOWNSHIP, JACKSON COUNTY, MICHIGAN.

N14°E	976'	C/L CREEK
N21°E	761'	EDGE OF MARSH
N46°E	291'	EDGE OF MARSH
S32°E	682'	EDGE OF MARSH
N81°E	91'	HAYSTEAD 1-9/1-9A WELL
N30°E	530'	NORVELL 9 CTB
S86°E	171'	HAYSTEAD 3-9 WELL

N

0 200' 400'

SCALE: 1" = 400'

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SURVEY OF THE HAYSTEAD 9 SWD WELL LOCATED IN SECTION 9, T4S, R2E, NORVELL TWP, JACKSON CO.

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use river corridors and the Raisin River corridor is directly adjacent to the proposed well site. Roosts were found roosts in southern Michigan in an elm-ash-maple forest, a woodland/marsh edge, a lowland hardwood forest, small wetlands, a shrub wetland/cornfield edge, and a small woodlot. Other than the elm-ash-maple forest, all these features exist on the well site property. On average Indiana bats travel 0.6 miles (1.0 km) between roosts. This means the property is likely used for day roosts as well as for feeding. The U.S. Dept. of Agriculture studies show that the majority of bats foraged in forested wetlands and other woodlands, while 1 bat foraged in an area around a small lake and another in an area with 50% woodland and 50% open fields. Another Indiana bat foraged over a river, while 10 others foraged in areas of farmland greater than 0.6 mile (1 km) from the same river. The farmland adjacent to the well site is therefore a foraging site of significance and cannot be dismissed by the EPA.

Mass plays a significant role in mammalian toxicity. The Indiana bat, this endangered and protected species is already fighting a losing battle against the fungus *Geomyces destructans* that causes white-nose syndrome. The studies cited by the petitioner suggest that herbicide/pesticide toxicity build-up in the cells of bats makes them more susceptible to the disease. Why is the EPA willing to expose these poor relatives of ours to toxic chemicals at this well site? Bats will feed on insects exposed to toxic chemicals at this well site. Kurta found that Indiana bats in Michigan eat a diet of Trichoptera (caddisflies: 55.1% of volume); Diptera (true flies: 25.5% of volume); Lepidoptera (moths; 14.2% of volume); Coleptera (beetles: 1.4% of volume). The remaining 3.8% consisted of spiders, midges and mosquitoes. (see Kurta, Allen, *Am. Midl. Nat.* 140:280-286, DIET OF THE ENDANGERED INDIAN BAT ON THE NORTHERN EDGE OF ITS RANGE, (1997)). Spills associated with these injection wells, pipelines, and trucks are frequent. In North Dakota 1,073 spills were reported in 2011. And this number does not include the many unreported spills. Why doesn't the EPA just say that the only thing they really care about is the political power of oil/gas/chemical companies and that there is no political will to protect the Indiana bat from harm? The Christian concept of dominion and the Christian belief in forgiveness are the two great errors of western thought. There is no forgiveness for polluting this Earth. Humans are not separate from the web of life. Already 3 out of five Americans get some form of cancer in their lifetimes. We will also face extinction. It will just take a little longer

because we are bigger and more adaptable than bats. The petitioner requests that the EPA comply with 40 CFR § 144.4(c) and protect the Indiana bat.

The Petitioner also notes that the eastern Massasauga rattlesnake will be found on this property. The U.S. fish and Wildlife Service states that "Massassaugas live in wet areas including wet prairies, marshes, and low areas along rivers. In many areas Massasaugas also use adjacent uplands during part of the year. The petitioner can personally attest that they like to sun themselves on south and west facing uplands. Once again, the petitioner requests that the Eab refer to figure #2. The lay of this well site is perfect habitat for the eastern Massasauga rattlesnake.

CONCLUSION

The EPA reached a conclusion that the geologic siting of this well was safe and that the Indiana bat would not be found on this property. Both of these conclusions have been shown by the petitioner to be erroneous findings of fact. The EPA has made a fraudulent geological assessment and ignored the likely presence of the Indiana bat at this well site. The petitioner has demonstrated that review is warranted.

Respectfully submitted,

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