BEFORE THE ENVIRONMENTAL APPEALS BOARD

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

WASHINGTON, D.C.

In the Matter of:	)	
West Bay Exploration Co. of	)	**Permit Appeal No. UIC 15-03**
Traverse City, Michigan	)	
West Bay #22 SWD	)	
Permit No. MI-075-2D-0009	)	
Jackson County, Michigan	)	

PETITIONER PETER BORMUTH'S REPLY TO EPA RESPONSE TO PETITION FOR REVIEW

Peter Bormuth
Druid
In Pro Per
142 West Pearl St.
Jackson, MI 49201
(517) 787-8097
earthprayer@hotmail.com

TABLE OF CONTENTS

Page

TABLE OF AUTHORITIES

Page

STATEMENT OF COMPLAINCE WITH WORD LIMITATION

I hereby certify that this Reply to EPA Response to Petition for Review contains 6942 words according to the Microsoft Word program used to compose it.

INTRODUCTION

The State of Michigan is surrounded by 20% of the Earth's fresh water. The Governor's office and both chambers of the Michigan Legislature have been taken over by pro-business Republicans who seek to expand oil and gas production in the State. The Michigan Department of Environmental Quality (MDEQ) is currently financed by a 1% tax on all oil/gas production in the State. Clearly the MDEQ has a vested interest in permitting oil and gas well development. When oil and gas wells are permitted, the need arises for underground injection wells to dispose of unwanted brines, fracking fluids, and other liquid waste products that are produced by the drilling process. There are almost 1,300 underground injection wells in the State of Michigan, with new permits pending in virtually every County. MDEQ Director Dan Wyatt had been handing out permits like a child molester passing out candy at a children's playground. Wyatt recently resigned under pressure as the Director of the MDEQ due to the Flint water crisis where the MDEQ recklessly endangered the drinking water of the citizens of Flint.

In response to the Flint water crisis, Joel Beauvais, deputy assistant administrator for the EPA's Office of Water issued a new agency wide policy directing leadership to encourage "prompt and decisive action" to address public health concerns. In his statement, Beauvais said what happened in Flint "was avoidable and should have never happened." The current petition before this Board is another situation where the Michigan DEQ has recklessly placed the drinking water of Michigan's citizens at risk. The Petitioner has repeatedly and unsuccessfully tried to get the EPA to listen to his argument and take decisive action to rectify this situation.

In the Introduction and Factual and Procedural Background sections of their Response brief the EPA repeatedly suggests that this Petitioners argument has been previously heard and rejected by this Board. This is a blatant lie. The Petitioner's full argument, with supporting documents, has never been considered by this Board. In the first proceeding (UIC 13-01) the EPA used an untimely filing on February 13, 2013 by Sandra K. Yerman to unilaterally withdraw the West Bay #22 permit on April 8, 2013. The Board dismissed Petition UIC 13-01 as "moot" on April 16, 2013. EPA permit writer Anna Miller and EPA counsel Kris Vesner obviously felt that the permit was flawed and they employed the questionable stratagem of withdrawing the permit unilaterally. 78 Fed. Reg. 5281, 5282 (Jan. 25, 2013) 40 C.FR. § 124.19(j) required that the Region withdraw the permit by motion after the 29-day period following the Region's response to Petition UIC 13-01 had expired. In response to the Petitioner's motion for reconsideration pointing out this violation of the rules, the Board held on May 29, 2013 that: "To avoid any confusion in the future, the Board recommends that the Regions should not unilaterally withdraw a permit after the expiration of the 29-day period following their response to the earliest-filed petition" (5-29-13 Order, p.4, foot note 4) and then denied the Petitioner's motion for reconsideration, creating a convenient one-time exception to the rule for the EPA. Unhappy with this outcome, the Petitioner (making a *pro se* venue error) filed for relief in the U.S. District Court for the District of Columbia. Upon motion the case was transferred to the appropriate venue: the U.S. Court of Appeals for the Sixth Circuit.

While this case was pending, the EPA issued a permit for Haystead #9, UIC 14-66. The Region is correct that the Petitioner made identical arguments against that factually similar well but they neglect to point out that the Petitioner failed to provide the EPA with copies of the scientific documents supporting his argument at the public hearing. This Board, in an Order dated

September 22, 2014 ruled that Petitioner had "not preserved some aspects of this argument (conversion of anhydrite to gypsum) for review because he failed to cite or provide some of these articles to the Region at during the public comment period." (9-22-14 Order, p. 13). The Board then selectively chose which articles and aspects of Petitioner's argument it would review and stated: "The Board will not review the other articles cited in Mr. Bormuth's Petition as they were not raised to the Region's attention during the public comment period and are thus not properly before the Board." (9-22-14 Order, p. 13). The Petitioner submitted a motion to supplement (UIC 14-66, #28), which was denied, and a motion for reconsideration (UIC 14-66, #27), which was also denied.

The Petitioner did not file a Petition for Review with the Sixth Circuit Court of Appeals on UIC 14-66 because he already had the UIC 13-01 Petition for Review pending and because the Board was technically correct that all reasonably available arguments and evidence supporting the Petitioner's position were required to be brought to the permitting authority during the comment period under 40 C.F.R § 124.13. Another filing would have cost $500. Being unable to supplement his argument with the appropriate evidence, the Petitioner had not proven that the permit was based on a finding of fact that was clearly erroneous. The Court would rule that the scientific argument the Petitioner is making must be supported by the timely presentation of factual evidence. While some pro se litigants like Ms. Yerman are given latitude with regard to rules, the Petitioner is invariably held to strict interpretations by the Courts. The Petitioner knew he would lose.

On November 25, 2015 the Sixth Circuit panel issued an order denying Petitioner's Rule 40(a)(1) petition for panel rehearing. The Court found that the Petitioner lacked standing because the EPA had not yet reissued the West Bay #22 permit (the EPA immediately took that step on December 8, 2015); that the procedural violations the Petitioner alleged were insufficient to establish standing; and that the Petitioner had failed to seek judicial review of the administrative decision to issue the Haystead #9 well (UIC 14-66) (the panel was never made aware of the Petitioner's reasoning for not challenging that permit). At no point during the proceeding did the Sixth Circuit consider the merits of the Petitioner's geological argument.

The Petitioner notes that the two most damaging pieces of evidence to the EPA's position, EPA Permit #MI-163-3G-A002, issued June 14, 2006 for the Sunoco Inkster Facility in Wayne County authorizing the dissolution of Salina Group salt and anhydrite layers through injection of salt water for the purpose of enlarging pre-existing natural gas storage caverns, and the Weaver article (*Recent cross formational fluid flow and mixing in the shallow Michigan basin*, Geological Society of America, Bulletin 107 (June 1995) have never been considered by this Board or any Court. The Petitioner will address the EPA's response to this evidence in the legal argument section of this reply brief, but specifically requests that this evidence be considered for the first time.

STANDARD OF REVIEW

The standard of review for appeal of a permit issued under 40 C.F.R. Part 124 is governed by 40 C.F.R. § 124.19. The Board has the discretion to grant or deny review of a permit decision. See *In re Avenal Power Ctr., LLC*, 15 E.A.D. 384, 394 (EAB 2011) slip op. at 14-15 (EAB Aug. 18, 2011).

In considering a petition for review filed under 40 C.F.R. § 124.19, the EAB must first evaluate whether the petitioner has met certain threshold requirements of the applicable regulations such as "timeliness, standing, issue preservation and specificity." 40 C.F.R. § 124.19(a)(2)-(4); see also *In re Seneca Resources Corp.*, UIC Appeal Nos. 14-01 through 14-03, 2014 EPA App. LEXIS 21, *2 (EAB May 29, 2014) (citing *In re Indeck-Elwood, LLC*, 13 E.A.D. 126, 143 (EAB 2006).

The Board generally endeavors to construe liberally the issues presented by an unrepresented petitioner, so as to fairly identify the substance of the arguments being raised. The Board nevertheless "expect[s] such petitions to provide sufficient specificity to apprise the Board of the issues being raised." *In re Seneca Res. Corp.,* UIC Appeal Nos. 14-01 through 14-03, slip op. at 2 n.1 (EAB May 29, 2014), 16 E.A.D. ___ (quoting *In re Sutter Power Plant*, 8 E.A.D. 680, 687-88 (EAB 1999)); see also *In re Envtl. Disposal Sys., Inc.*, 12 E.A.D. 254, 292 n.26 (EAB 2005). "The Board also expects the petitions to articulate some supportable reason or reasons as to why the permitting authority erred or why review is otherwise warranted." *In re Beckman Prod. Servs.*, 5 E.A.D. 10, 19 (EAB 1994).

The permit issuer must adequately explain and support in the administrative record the rationale for its conclusions. See, e.g., *In re NE Hub Partners, LP*, 7 E.A.D. 561, 568 (EAB 1998), review denied sub nom. *Penn Fuel Gas, Inc. v. EPA*, 185 F.3d 862 (3d Cir. 1999). As a whole, the record must demonstrate that the permit issuer "duly considered the issues raised in the comments" and ultimately adopted an approach that "is rational in light of all information in the record." *In re Gov't of D.C. Mun. Separate Storm Sewer Sys.,* 10 E.A.D. 323, 342 (EAB 2002).

The Petitioner bears the burden of showing the Region's decision was "based on...a finding of fact or conclusion of law that is clearly erroneous." *In re West Bay Exploration Co.,* 2014 EPA App. LEXIS 35 at *5. The EAB is also obligated to review a permit if, as in this case, it involves "an important policy consideration" or "exercise of discretion" that warrants review by the Board. 40 C.F.R. § 124.19(a)(4); see also *In re Envtl Disposal Sys.*, 12 E.A.D. at 263. (citations omitted).

LEGAL ARGUMENT

1. PETITIONER MET THE PROCEDURAL REQUIREMENTS FOR OBTAINING REVIEW

The Petitioner refers the Board to page 7 of the EPA response where the EPA states: "Petitioner attended the public hearing [on November 20, 2014], where he provided oral comments and submitted copies of multiple Wikipedia excerpts, draft reports and scientific article to Region 5. Att. B-10. Petitioner's comments included the issue he now raises in the petition. Att. B-10."

A. Petitioner raised his arguments and submitted his evidence during public comment.

The Board will find the Petitioner's arguments and citations on pages 22-34 of the EPA's final copy of the public hearing of November 20, 2014 transcribed by Jane Rose Reporting. The Petitioner notes that page 35 is missing from the file the EPA submitted to the Board and that the Petitioner made additional comments on page 36.

B. Petitioner cited Region 5 responses and explained why Region 5 responses are clearly erroneous.

1. Petitioner cited Region 5 responses on page 3 of his petition and offered specific reasons why the EPA's conclusion that the Salina Group will act as a confining layer is clearly erroneous.
2. Petitioner cited Region 5 response to comment #11 on page 4 of his petition and explained why Region 5 erred when not considering the scientific studies Petitioner submitted which prove that the Salina Group Anhydrite and Salt layers will not act as a barrier to flow.
3. Petitioner cited Region 5 response to comment #11 on page 8 of his petition, questioned the EPA tactic of saying "other layers will prevent migration", proved that there is an upward vertical component to the Michigan hydraulic gradient, and introduced evidence showing that the EPA has previous regarded shale formations as impenetrable in Wyoming and Pennsylvania, and been unpleasantly surprised when fluid migration though these formations occurred.
4. Petitioner cited Region 5 response to comment #11 on page 10 of his petition and noted 18 waste injection wells already permitted by the EPA in the southern Michigan basis which are operating in violation of 40 C.F.R. § 144.12(a) and the Safe Drinking Water Act, Part C, § 1421(a)(3)(C).

2. REGION 5 CLEARLY ERRED IN DETERMINING THE UPPER CONFINING ZONE FOR WEST BAY #22. THE SALINA GROUP WILL NOT CONFINE THE INJECTED WASTE.

A. The injection zone will accept, but not contain the injection fluid. The Niagaran Group is both porous and *permeable*.

The EPA October 2014 memorandum regarding geologic siting states: "the injection zone consists of dolotomized skeletal limestone and carbonate reef complexes that constitute '**very porous and permeable formations**'." (bold emphasis added). The RTC likewise states that:

> The Niagaran, or Niagaran Group, is a vast limestone and dolomite rock structure underlying Michigan and parts of Illinois, Ohio, and New York. The Michigan Hydrogeologic Atlas describes the Niagaran rock group as generally very porous **and permeable...** [Att. B-11, p. 2]

Permeable means that fluids can flow through the strata. EPA suggests this will not happen because the injected fluid will spread horizontally, but they offer no evidence to prove this assertion. Meanwhile the Petitioner has offered evidence showing that there is a natural upward gradient in the southern Michigan basin so that the injected fluid will flow upward and contact the anhydrite confining zone. Petitioner notes that on page 18, ¶3 of their response, the EPA admits that "Region 5 cannot say with certainty that upward migration will not occur."

EPA also asserts that their model shows that after 20 years of continuous injection, the injected fluid would migrate between 68 and 835 feet. This is a faulty model. The specific pressure gradient in the Michigan Basin is 0.43 lb/ft, thus the ambient pressure at the depth of this well is roughly 1290 psi. If you take the injection pressure allowed by the permit (683 psi) and add that to the ambient pressure and multiply it by the ability of pressure to move fluid (one atmosphere or 14.7 psi will lift/move water by 34 feet), this well could conceivably move/lift fluid to the surface unless checked by an impenetrable formation. There is also the potential for additional pressure created by the swelling of the Salina A-2 Evaporite formation upon contact with the injected fluid (which could range from 1.7 up to 4.7 MPa) which would dramatically multiply distance fluid is conveyed if such pressures actually came into play. The Petitioner notes that in an over pressurized system, a depth pressure gradient greater than 0.465 psi for brines indicates a potential upward flow. (see Kreitler, Charles, *Journal of Hydrology,* 106 (1989) 29-53, HYDROGEOLOGY OF SEDIMENTARY BASINS).

B. The injected fluid will move vertically.

The Petitioner first notes that the EPA has not conservatively limited injection pressure. For example, EPA Permit #MI-163-3G-A002, issued June 14, 2006 for the Sunoco Inkster Facility in Wayne County limited the injection pressure to 382 psi to prevent formation fracturing. In making this determination the EPA used 0.433 lb/ft for the specific pressure gradient in the Michigan basin and used 14.7 psi for the value of one atmosphere. These are identical to the values Petitioner used in his calculations in section A above which the EPA characterizes as a "jumble of facts" and which it urges the Board not to consider. Since the EPA utilized the same facts in issuing EPA Permit #MI-163-3G-A002, I think this Board is obliged to consider them.[1] The EPA also used a fracture gradient of 0.8 psi/ft as the default value for Michigan. So the EPA has previously determined that an injection pressure of 382 psi is conservative and safe. But for the West Bay #22 well, the EPA is allowing nearly double this injection pressure. So much for safety.

The EPA criticizes the Weaver article (*Recent cross formational fluid flow and mixing in the shallow Michigan basin*, GEOLOGICAL SOCIETY OF AMERICA, Bulletin 107 (June 1995) as studying an area of southwestern Ontario Canada that borders Michigan, rather than central Michigan.

---

[1] The Petitioner notes that nearly all Professors in Earth Sciences either get research money or consulting fees from the oil, gas, coal, & mineral industries. It is nearly impossible for a citizen like the Petitioner to find an academic scientist at a College or University who is willing to testify on-the-record, even if the citizen could afford the hefty consulting fees of $170 to $320 per hour. Marc Edwards, the world-renowned expert on lead corrosion who brought the Flint crisis to light has noted that he sought to collaborate with two groups of University of Michigan experts before he assembled a team of Virginia Tech researchers who demonstrated the widespread elevated lead levels in Flint water. Edwards said "The reality is most professors are going to run from a controversy like this," Edwards said. "One of my criticisms of professors is we're cowards because we are always worried about our future funding. With one word, you can destroy relationships you spent years building." Detroit News, Feb 18, 2016, http://detne.ws/1XAVwfP.

The Petitioner concedes this is true but the geological strata at issue extend into this area of Ontario and the authors remark that:

> Other saline end members that could have been involved in this mixing process include the...Detroit River Group (Wilson and Long, 1993) in central Michigan, which are at depths of >1.5 km in the Michigan Basin.
>
> p. 702

The EPA asserts that the Weaver article referenced prehistoric times. This assertion is false. While the authors posit glacial/post glacial origins for the phenomena, the authors specifically state that:

> Stable-isotope data coincident with the local meteoric water line indicate that leakage of moderately saline, recently recharged meteoric water **has occurred since petroleum production began in the last century.** (bold emphasis added).
>
> p. 697

The authors also note that:

> ...regional fractures could have provided pathways for the large volumes of fluids **required to dissolve sufficient amounts of halite and anhydrite** from the Silurian formations to promote collapse. (bold emphasis added)
>
> p. 699

Please observe (once again!!!) that these geologists believe the dissolution of buried anhydrite by exposure to water to be an accepted scientific fact.

The Petitioner notes that the Weaver article provides evidence for potential fractures in the shale formations which the EPA states will contain the injected fluid, should it migrate past the anhydrite and salt layers of the Salina confining zone. The authors state:

> Upon deglaciation, bedrock and overburden sequences would have expanded at differential rates because of the different formation compressibility values. In the lithified Paleozoic sequence, this expansion may have created new fractures or reactivated or enlarged existing fractures.
>
> p. 706

And they conclude:

> Results of this research indicate that more recent cross-formational flow has occurred in this region. Saline fluids migrated vertically along fracture networks from depths of several hundred meters...Consequently, the shallow Michigan basin in this area should be viewed as a hydrogeologically active rather than static system.
>
> p. 706

There are two other articles of interest concerning this discussion of naturally occurring upward brine migration in the Michigan Basin: Long, Wilson, Takacs, Rezabek, *Geol. Soc. Am. Bull.* 100 (1988) – STABLE-ISOTOPE GEOCHEMISTRY OF SALINE NEAR-SURFACE GROUNDWATER: EAST-CENTRAL MICHIGAN BASIN; and Wilson, Long, *Applied Geochemistry,* Vol. 8, pp. 81-100 (1993) GEOCHEMISTRY AND ISOTOPE CHEMISTRY ON MICHIGAN BASIN BRINES: DEVONIAN FORMATIONS. The Petitioner acknowledges that he did not provide Region 5 with a copy of either study at the public hearing and thus this Board is not required to consider them. Neither is essential to the Petitioners argument.[2]

---

[2] Part 124 does not specify if and when the Board, in the course of its review of final permit decisions, may consider materials not included in the administrative record at the time of permit issuance but the Board in *In re Dominion Energy Brayton Point LLC*, 12 EAD 490, 510 (EAB 2007) previously determined that: "the appellate review process can serve as a petitioner's first opportunity to question the validity of material added to the administrative record in response to public comments. In such cases, where a petitioner submits documents in response to new materials added to the record by the Region in response to comments or on remand, and where the Board's task is to review the record and the Region's rationale for its final decision, it seems logical if not necessary that the Board consider the petitioner's proffer of evidence in support of its assertion that the Region's conclusions are erroneous or that the Region erred in failing to take into account such materials. For this reason, among others, we have in the past considered such newly submitted materials in the course of evaluating the merits of a petition." See, e.g., *In re*

The EPA dismisses the studies and draft report the petitioner submitted showing 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 Petitioner acknowledges that these studies relate to different regions of the United States with different geographical features but disputes the EPA's claim that the findings of these studies may not also be applied to the waste injection process.

Metcalf Energy Ctr., PSD Appeal Nos. 01-07 & 01-08, at 22 n.13 (EAB Aug. 10, 2001) (Order Denying Review); see also *In re Marine Shale Processors, Inc.*, 5 E.A.D. 751, 797 n.65 (EAB 1995); *In re Three Mountain Power, L.L.C.*, PSD Appeal No. 01-05, at 2-3 (EAB Apr. 25, 2001).

C. The injection fluid will start a chemical reaction that will convert anhydrite to gypsum, creating enormous pressures before the gypsum dissolves in solution. Anhydrite always converts to gypsum upon exposure to water.

The Petitioner has read through the available scientific record and builds a coherent & well documented argument. It is Region 5 which has made the erroneous finding of fact when they concluded that anhydrite at depth will not undergo a transition to gypsum when exposed to water.

The Petitioner first cited laboratory studies to demonstrate the chemical mechanism through which the anhydrite to gypsum conversion process takes place. (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). The Region dismisses these studies because they do not evaluate the conversion under the precise depth, temperature and pressure conditions at the site but the Petitioner just uses these studies to establish the mechanism of anhydrite/gypsum conversion.

The Petitioner then cited studies showing that massive anhydrite formations undergo this transformation. The Region has consistently claimed that massive anhydrite will not undergo the transformation witnessed in the laboratory. The Petitioner cites studies proving the Region's claim is erroneous. Region 5 claims the Petitioner selectively quotes Rauh & Thuro, *Investigations on the swelling behavior of pure anhydrites,* ENGINEERING GEOLOGY, Technishe Universitat Munchen, but the researchers clearly state:

> **In contact with water every Anhydrite dissolves or alters to gypsum**...The 60.8% volume increase from anhydrite to gypsum can be calculated from the solids. It is irreversible under atmospheric conditions. (bold emphasis added)
>
> p. 1

The EPA notes that this study and the Steiner study, (Steiner, *International Journal of Rock Mechanics and Mining Sciences & Geomechanics Abstracts,* 30, 4 (1993), SWELLING ROCK IN TUNNELS) are inapposite because atmosphere is introduced into tunnels, thus creating surface conditions. But what the Petitioner would like the Board to observe is that these studies show that overburden is not a factor in the conversion of massive buried anhydrite and anhydritic shales. The Steiner article shows that such conversion will take place even with 700-1000 meters of overbearing rock strata above the anhydrite bearing layers where the tunnel exists. From these two studies, the Petitioner and the Board can securely conclude that the pressure of overburden alone will not prevent the conversion process from taking place when anhydrite is exposed to water.

The EPA then notes that the Board previously found the Sass & Burbaum article, (Sass & Burbaum, *ACTA Carsologica* 39/2 Postonjna (2010), DAMAGE TO THE HISTORIC TOWN OF STAUFEN (GERMANY) CAUSED BY GEOTHERMAL FRILLINGS THROUGH ANHYDRITE-BEARING FORMATIONS) to be inapposite because it concerns a much shallower conversion of anhydrite to gypsum at a depth less than 200 meters. What the Petitioner would like the Board to observe is that atmosphere did not play a role in this conversion. Water was introduced into the strata through geothermal boreholes. Water alone, without atmosphere, caused this massive buried anhydrite formation to convert to gypsum, swell, and uplift. The chemical reaction took place underground in the absence of atmospheric conditions. So the Petitioner has proven that

conversion of massive anhydrite to gypsum will take place upon exposure to water. Exposure to atmosphere is not necessary, and the pressure of overburden will not inhibit this reaction though it would confine the swelling behavior, creating enormous in-situ pressures of up to 2-2.5 MPa.

The Region dismisses the Murray article (Murray, *Origin and Diagenesis of Gypsum and Anhydrite,* 34(3) JOURNAL OF SEDIMENTARY PETROLOGY 512 (1964)) which noted evidence for conversion of anhydrite at a depth of 3500 feet as lacking detail and they ignore the Weaver article (Weaver Frape; Cherry, *Recent cross formational fluid flow and mixing in the shallow Michigan basin*, GEOLOGICAL SOCIETY OF AMERICA, Bulletin 107 (June 1995) which found that anhydrite and halite had been dissolved at depth from the Silurian formations in Michigan (p. 699). The Region also chooses to ignore the additional studies showing conversion at depths, such as the *Bell, Cripps & Culshaw* study (Bell; Cripps; Culshaw, *Groundwater in Engineering Geology*, London (1986) A REVIEW OF THE ENGINEERING BEHAVIOR OF SOILS AND ROCKS WITH RESPECT TO GROUNDWATER) which 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.
>
> p. 20

and they ignore the Jawarski paper which noted that gypsification of massive anhydrite when exposed to water under natural conditions can occur very quickly: "within few years or even within one year." Jaworski, *InTech: Advances in Crystallization Processes*, (April 2012), CRYSTALLIZATION, ALTERATION AND RECRYSTALLIZATION OF SULPHATES, p. 469

The Petitioner acknowledges that he failed to provide the Korzhinsky, D.S. *AN SSR Publ.* Moscow (1953), ESSAY ON METASOMATIC PROCESSES) and Manikhn, V.I. *Geokhimicheskie*

Materialy, vol. 34 p.193-196, ON THE QUESTION OF SOLUBILITY OF CALCIUM SULFATE UNDER HIGH PRESSURES studies to Region 5 at the public hearing and thus this Board need not consider them. However, both studies are quoted by Klimchouk in his study (Klimchouk, *International Journal of Speleology*, 25, (1996) - THE DISSOLUTION AND CONVERSION OF GYPSUM AND ANHYDRITE) and the Petitioner did provide this reference to Region 5. The Petitioner utilized this study to show that the process of anhydrite conversion is accelerated by two independent factors: pressure and the sodium content of the injected fluid. On page 24 Klimchouk documented that the solubility of anhydrite increases sharply with the increase in pressure: each 0.01Pa increase in pressure results in a 3 to 5 times increase in solubility. Steiner and Sass & Burbaum confirm this data. Region 5 just chooses to ignore this aspect of the Petitioners argument. The scientific literature the Petitioner submitted (Klimchouk, Conley, Hardie, Singh) also documents that certain salts, particularly sodium chloride and magnesium chloride, activate rather than inhibit the hydration of anhydrite and thus promote the conversion of anhydrite to gypsum. The Region again declines to respond to this argument. The waste solutions that West Bay plans to inject are greater activators of the conversion process than fresh water alone. For solution mining of salt caverns, which will be addressed in the next section, a 25% to 35% saturated brine solution is generally injected.

D. The injection fluid will dissolve the salt layers of the confining zone.

The Bell, Cripps & Culshaw study (Bell; Cripps; Culshaw, *Groundwater in Engineering Geology*, London (1986) A REVIEW OF THE ENGINEERING BEHAVIOR OF SOILS AND ROCKS WITH RESPECT TO GROUNDWATER) clearly states:

> Salt is even more soluble than gypsum and the evidence of slumping, brecciation and collapse structures in rocks which overlie saliferous strata bear witness to the fact that salt has gone into solution in past geological times.
>
> p. 21

The EPA is well aware that the Petitioner's scientific argument is not an untested hypothesis but an established scientific fact upon which an engineering technology has been developed over the last 40 years in the related field of gas storage. Engineers have created caverns in large domal structures (salt) since the 1960's. Today advances in technology allow caverns to be shaped into extensive horizontal strata of salt and anhydrite, typically at depths ranging between 600 and 7000 feet. The EPA has documentation of this process in their files. EPA Permit #MI-163-3G-A002, for underground injection was issued June 14, 2006 for the Sunoco Inkster Facility in Wayne County. It authorized the dissolution of Salina Group salt and anhydrite layers through injection of salt water for the purpose of enlarging pre-existing natural gas storage caverns. All underground injection regulations this well was required to meet are identical with those that apply to the instant case. The Petitioner asks the Board to look at the permit and the construction and abandonment and plugging diagrams of the Sunoco well and compare them with the West Bay #22 well. This is an identical technology with only one difference: a second string in the well returns brine to the surface. The Sunoco well pumped a 35% saturated brine down into the formation through a borehole (leaching string). A fully saturated brine (95%) was returned through the withdrawal/production string so that the formation was dissolved in a controlled manner. West Bay is going to be injecting fresh drilling water, hydrochloric acid, brines, and other oil field (and possibly fracking) wastewaters into the formation without removing them, thus dissolving the Salina Group salt layers in an uncontrolled manner. The West Bay #22 waste

injection well will probably operate for 20 years. The Salina A-2 Evaporate layer, the Salina A-1 Evaporate layer, the B-Salt and B-Unit layers, the D-Unit layer, and the E-Unit layer can all be expected to dissolve or partially dissolve in solution. The EPA's assertion that these layers will confine the injected fluid is contrary to all known scientific theory and all current technological practices.

E. Shale formations in the Salina Group will not contain the injection fluid.

The Steiner study, (Steiner, *International Journal of Rock Mechanics and Mining Sciences & Geomechanics Abstracts,* 30, 4 (1993), SWELLING ROCK IN TUNNELS) shows that anhydritic shales, such as the Salina Group shales, differ from regular shales, and that swelling phenomena are particularly severe in anhydritic shales. They note that for pure clay shales, in situ swelling pressures (from exposure to water) up to 0.3 MPa can be expected. Meanwhile they note that "for anhydritic shale rocks, extreme heave and the crushing of strong inverts were observed" (p. 361) and that "in anhydritic shales, where a chemical component influences swelling behavior, swelling pressures in the range of 2.0 – 2.5 MPa have been observed in situ." (p. 361). The very thin shales of the Salina group will easily fracture under this pressure and allow for fluid migration. As the authors note:

> Not all the interaction phenomena between shale and anhydrite/gypsum are understood, but there is definitely an interaction between swelling of shale (physical) and the transformation of anhydrite into gypsum (chemical effects).
>
> p. 378

The Stratigraphic Lexicon for Michigan, Bulletin 8, (2002) notes that the Salina A-1 Evaporate is salt (halite), and anhydrite. The Salina A-2 Evaporate is salt (halite), and anhydrite. (Salt layers will dissolve in solution and the anhydrite layers will transform to gypsum and dissolve). The

Salina A-2 carbonate is limestone and dolomite (porous and permeable). The Salina B-Unit is a massive salt formation. The Salina C-Unit strata consists of greenish-gray shale containing anhydrite nodules. The Salina E-Unit consists of carbonate and a series of gray, greenish-gray and red shales interbedded with thin porous Dolomites. The Salina F-Unit is salt, thin anhydrites, and thin anhydritic shale beds. The Salina G-Unit is a gray shaley dolomite easily removed by erosion. (porous and permeable). None of these layers will prevent upward migration of fluid.

F. There are no impermeable formations above the Salina Group that will contain the injection fluid.

Most of the shale layers that the EPA suggests will stop upward migration of injected fluid once it escapes the confining zone are Devonian Shales, except for the Coldwater Shale (which is Early Mississippian and full of siltstone and sandstone) and the Sunbury Shale (which is Early Mississippian) according to the Stratigraphic Lexicon for Michigan, Bulletin 8, (2001). The Antrim Shale is Late Devonian. The Bedford Shale is Late Devonian (and full of Berea Sandstone). The Bell Shale is Middle Devonian. The fracture gradient for Devonian Shale varies with depth, according to a study conducted in eastern Kentucky and western West Virginia, ranging from over 1.0 psi/ft at shallow depths to generally between 0.4-0.6 psi/ft at 2,500 to 5,500 feet. It is noted that glacial unloading known to have occurred in the northern part of the basin could have resulted in shallow formations "readjusting" (McKetta, 1980). Devonian shales are water-sensitive formations, and most operators have used nitrogen as a fracturing fluid since the mid-1980s. Gas pressures of 360 to 380 psi have produced fractures in the bedrock of the Ohio Shale and Berea Sandstone, thus providing far-reaching fractures for gas migration from the deep bedrock (Stidham and Tetrick, 2002). The Board must conclude that the Devonian Shales the EPA relies

on as secondary confining layers are easily fractured. Recall that the EPA is permitting an injection pressure of 682 psi for the West Bay #22 well, nearly double the pressure required to fracture these shales.

The Petitioner also directs the Board's attention to the drilling record attachments to the West Bay #22 permit by geologists Fowler/Baker/Vancycle. Permit #60094 shows from 2416 - 2200 ft. a Bass Island/ Bois Blanc which consists of Dolomite (permeable), Anhydrite (subject to chemical change on contact with saltwater, and Limestone (permeable). From 2200 – 1978 ft. a Detroit River formation consisting of Anhydrite (chemical change) and Dolomite/Limestone (permeable). From 1978 – 1744 ft. an unnamed Shale embedded with Dolomite and Limestone (permeable). From 1744 – 1622 ft. a Traverse Limestone containing Bell shale (permeable). From 1622 – 1554 ft. another Traverse Formation Limestone (permeable). From 1554 – 1370 ft. an Antrim shale. From 1370 – 1230 ft. a Sunbury Shale with Berea Siltstone (permeable). And from 1230 – 290 ft. a silty Coldwater Shale (potentially permeable and subject to isostatic rebound following retreat of glaciers).

The drilling record from Permit # 60011 (geologists Fowler/Baker/Vancycle) shows 2685 – 2416 ft. a G-Unit Dolomite grading to Anhydrite (permeable and subject to chemical change). From 2416 – 2200 ft. a Bass Island/Bois Blanc Dolomite, Anhydrite and Limestone formation (permeable and subject to chemical change). From 2200 – 1978 ft. a Detroit River Anhydrite and Dolomite/Limestone (permeable and subject to chemical change). From 1978 – 1744 ft. an unnamed Shale interbedded with Dolomite and Limestone (permeable). From 1744 – 1622 ft. a Traverse Limestone containing Bell Shale (permeable). From 1622 – 1554 ft. another Traverse

Formation Limestone (permeable). From 1554 – 1370 ft. an Antrim shale. From 1370 – 1230 ft. a Sunbury Shale/Berea siltstone (permeable). From 1230 to 290 ft. a silty Coldwater Shale (potentially permeable and subject to isostatic rebound following retreat of glaciers).

Now the EPA claims on page 33 of their response that there are no known fractures in the Coldwater shale formation. The Petitioner would like to introduce some new evidence to rebut this contention.[3] As previously discussed in Footnote #2, it is within the Board's discretion to accept newly submitted material. At the annual Geological Society of America meeting in Vancouver Canada, Wayne State University Department of Geology Professor Amanda M. Pruehs read a paper noting that:

> Existing groundwater flow models in Ann Arbor [Michigan] incorporate Mississippian Coldwater Shale bedrock as an impermeable basal layer. These models incorporate large Kx/Ky anisotropy ratios to correct for contaminant transport that does not follow observed flow path directions. An alternate explanation for contaminant flow pathway orientations is the potential influence of bedrock as a transmissive basal layer.
>
> ...Bedrock characteristics were investigated by examining the Coldwater Shale in available core and outcrop. Bedrock topography was remapped using newer well data. Local structural trends were evaluated using regional bedrock maps. **Results of core analysis reveal matrix permeability and low angle horizontal fractures.** Observations of mapped Coldwater Shale outcrops document near vertical set joints along with low angle fractures indicating plausible transmissivity at scales that could affect contaminant transport model performance. (bold emphasis added).

Professor Pruehs is investigating the migration of 1.4-dioxane below Ann Arbor but her investigation clearly shows the horizontal fractures in the Coldwater Shale formation that the

---

[3] Pruehs, Amanda, *Modeling Bedrock Transmissivity; Implications for Contaminant Transport in an Overlying Glacial Aquifer System,* Abstract of paper No. 17-11 presented in Vancouver Canada, GEOLOGICAL SOCIETY OF AMERICA, (October 2014).

Petitioner hypothesized as existing due to isostatic rebound following the retreat of glaciers. As the Petitioner has repeatedly suggested, the Coldwater Shale formation is not impermeable.

3. **HAYSTEAD #9 AND AT LEAST 17 OTHER OIL WASTE INJECTION WELLS ARE CURRENTLY INJECTING TOXIC WASTE CONTAINING BENZENE, ETHYLBENZENE, TOLUENE, XYLENE, NAPHTHALENE, AND POLYCYCLIC AROMATIC HYDROCARBONS INTO THE SAME SUSPECT GEOLOGICAL FORMATIONS IN THE SOUTHERN MICHIGAN BASIN. THE BOARD SHOULD EXERCISE ITS DISCRETION TO REVIEW AN IMPORTANT POLICY MATTER AND IMMEDIATELY SUSPEND OPERATION OF THESE WELLS.**

The Petitioner notes in Response to Comment #11 on page 10, ¶ 3 of their Response to Public Comments document that: "the EPA has have permitted many wells across Michigan with the same injection and confining zones as the West Bay #22 well." This comment is true and reason for concern. The Petitioner has identified 18 Waste Injection wells permitted at similar strata in the lower Michigan basin: State of Michigan WI Permit #30108, #30248, #30123, #36867, #31503, #36958, #30229, #40099 in Calhoun County, Michigan; WI Permit #36629, #42486, #37378 in Macomb County, Michigan; WI Permit #23252, #23701, #23011, #22661 in Saint Clair County, Michigan; WI Permit #25224, and #20452 in Allegan County, Michigan; and MI Permit #075-2D-0010 in Jackson County, Michigan.

These 18 wells are operating in violation of 40 C.F.R. § 144.12(a) and the Safe Drinking Water Act, Part C, § 1421(a)(3)(C). The EAB has previously ruled that: *"In reviewing an underground injection well permit application, the Region has a regulatory obligation to consider whether geological conditions may allow the movement of any contaminant to underground sources of drinking water." In re Stonehaven Energy Management*, UTC Appeal No. 12-02 LLC Permit No. PAS2DOIOBVEN (EAB March 28, 2013). The Petitioner claims the Board should exercise its

discretion to review an important policy matter; ie whether these wells constitute a danger to our Michigan aquifers (see 40 C.F.R. § 124.19(a)(4); see also *In re City of Attleboro*, NPDES Appeal No. 08-08, slip op. at 10 (Sept. 15, 2009).

CONCLUSION

EPA counsel Vesner requests the Board deny this Petition because they denied the Haystead #9 Petition (UIC 14-66). They correctly note the Petitioner brings the same argument. In UIC 14-66 the EPA successfully prevented the Petitioner from having his evidence heard and thus that flawed decision should have no bearing on this one. This Board must consider EPA Permit #MI-163-3G-A002, issued June 14, 2006 for the Sunoco Inkster Facility in Wayne County authorizing the dissolution of Salina Group salt and anhydrite layers through injection of salt water for the purpose of enlarging pre-existing natural gas storage caverns when considering the EPA decision to issue this permit. The EPA knows that their argument for this permit is fatally flawed. Their own files prove it. The issuance of this permit is negligence by the Michigan DEQ and the EPA Region 5.

The EPA is institutionally wedded to their opinion and has consistently prevented fair consideration of the Petitioner's argument and evidence (see UIC 13-01; UIC 14-66; *Marine Shale*, 5 E.A.D. at 788; *Withrow v. Larkin*, 421 U.S. 35, 57-58(1975)); *accord Jett Black*, 8 E.A.D. at 375). The Petitioner has demonstrated that this Permit was based on an erroneous finding of fact and that it constitutes an important policy matter which demands review. The EPA's decision to issue this permit is not rational in light of the evidence presented. *In re Gov't of D.C. Mun. Separate*

Storm Sewer Sys., 10 E.A.D. 323, 342 (EAB 2002). The Petitioner thanks the Board for the Order granting extra time and word length to reply to the EPA's Response to Petition 15-03, and asks that this Board properly defend Michigan's underground sources of drinking water from contamination.

Respectfully submitted,

Peter Bormuth
Druid
In Pro Per
142 West Pearl St.
Jackson, MI 49201
(517) 787-8097
earthprayer@hotmail.com

Dated: February 29, 2016

CERTIFICATE OF SERVICE

I hereby certify that on February 29, 2016 I did send a copy of my Reply to EPA Response to Petition for Review and Appendix B to Kris Vesner, EPA Region 5, Environmental Protection Agency, 77 West Jackson Boulevard (C-14J), Chicago, IL 60604 and to William Horn, Mika, Meyers, Becket & Jones, 900 Monroe Ave. NW, Grand Rapids, MI 49503 by regular mail.

Peter Bormuth
Druid
In Pro Per
142 West Pearl St.
Jackson, MI 49201
(517) 787-8097
earthprayer@hotmail.com

Dated: February 29, 2016

APPENDIX B

1. Pruehs, Amanda, *Modeling Bedrock Transmissivity; Implications for Contaminant Transport in an Overlying Glacial Aquifer System,* Abstract of paper No. 17-11 presented in Vancouver Canada, GEOLOGICAL SOCIETY OF AMERICA, (October 2014).

2. E-mail from Bechtel to Bormuth, July 18, 2012.

GSA 2014
19-22 October | Vancouver, BC, Canada

2014 GSA Annual Meeting in Vancouver, British Columbia (19–22 October 2014)

Paper No. 17-11
Presentation Time: 10:35 AM

MODELING BEDROCK TRANSMISSIVITY; IMPLICATIONS FOR CONTAMINANT TRANSPORT IN AN OVERLYING GLACIAL AQUIFER SYSTEM

PRUEHS, Amanda M. and LEMKE, Lawrence D., Department of Geology, Wayne State University, 0224 Old Main, 4841 Cass, Detroit, MI 48202, a.m.pruehs@gmail.com

Glacial drift aquifer systems supply reliable groundwater to much of the northern United States and southern Canada. Regional groundwater models for these systems often treat the underlying bedrock as an impermeable (i.e., no-flow) boundary. Although this approach may be acceptable for groundwater supply applications, it may be inappropriate for contaminant transport models. For example, below the city of Ann Arbor, Michigan, the migration of 1, 4-dioxane in a glacial aquifer system has led to the establishment of a 10 km^2 groundwater use prohibition zone along the expected transport pathway. Moreover, located just outside of this zone, the city's Northwest Supply Well is no longer pumped due to 1, 4-dioxane contamination. Existing groundwater flow models in Ann Arbor incorporate Mississippian Coldwater Shale bedrock as an impermeable basal layer. These models incorporate large Kx/Ky anisotropy ratios to correct for contaminant transport that does not follow observed flow path directions. An alternative explanation for contaminant flow pathway orientations is the potential influence of bedrock as a transmissive basal layer.

This study evaluates the effects of changes to basal layer bedrock conditions in an existing 11 km x 15 km x 116 m numerical groundwater model. Bedrock characteristics were investigated by examining the Coldwater Shale in available core and outcrop. Bedrock topography was remapped using newer well data. Local structural trends were evaluated using regional geologic bedrock maps. Results of core analysis reveal matrix permeability and low angle horizontal fractures. Observations of mapped Coldwater Shale outcrops document near vertical joint sets along with low angle fractures indicating plausible transmissivity at scales that could affect contaminant transport model performance. The combined results of these investigations inform ongoing modifications to the bedrock erosional topography, matrix and fracture permeability, and structural features influencing anisotropy in the current model. Sensitivity analysis will be used to quantify the influence of those parameters on 1, 4-dioxane transport in the model.

Session No. 17

T158. Assessing Vulnerability of Water Supply Wells from Wastewater: Sources, Contaminants, Tracers, and Pathways
Sunday, 19 October 2014: 8:00 AM-12:00 PM

114/115 (Vancouver Convention Centre-West)
Geological Society of America *Abstracts with Programs.* Vol. 46, No. 6, p.65

Back to: T158. Assessing Vulnerability of Water Supply Wells from Wastewater: Sources, Contaminants, Tracers, and Pathways

<< Previous Abstract | Next Abstract >>

Date: Wed, 18 Jul 2012 13:02:15 -0400
From: tbechtel@enviroscan.com
Subject: Anhydrite Hydration Reaction
To: wardance@live.com

Hello Peter;

You have come to the right person. 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.

I am attaching my CV.

My fees are as follows:

Travel: out-of-pocket at cost, plus $60/hour

Research, meetings, writing: $155/hour

Testimony: $250/hour

We do have standard Terms & Conditions, of which I attach a copy. We typically request a retainer of $2500, and will refund proportionally if things wrap-up or settle before I do enough to cover that amount.

Thanks

Tim

Timothy D. Bechtel, Ph.D., P.G.
Principal Geophysicist
Enviroscan, Inc.
1051 Columbia Ave
Lancaster, PA 17603
717-396-8922
717-396-8746 Fax
www.enviroscan.com