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July 25, 2023

Kevin Rowsey
Source Water & UIC Section
U.S. Environmental Protection Agency
Region 3
1600 John F. Kennedy Boulevard
Philadelphia, PA 19103-2852
Via email: R3_UIC_Mailbox@epa.gov

RE: Public Comment of Damascus Citizens for Sustainability

**Draft UIC Permit PAS2D061BFAY
G2 Stem LLC/Diversified Oil & Gas - Orville Higinbotham #1 -
Nicholson Twp., Fayette County, PA**

Dear Mr. Rowsey,

We respectfully submit this comment on behalf of Damascus Citizens for Sustainability ("DCS") and its members and supporters, some of whom live in western Fayette County.

DCS strongly urges the denial of an underground injection control ("UIC") permit for the proposed operations because G2 Stem LLC ("G2, "Applicant") has not met its regulatory burden of showing its operations will not contaminate underground sources of drinking water ("USDWs"). Reasons for this include, *inter alia*, the proximity of multiple abandoned wells, including one abandoned and unplugged well that G2 failed to identify and which is located within the ¼ mile Area of Review ("AOR"); insufficient analysis and information on impacts to USDWs, particularly in light of the pressure loss during G2's injectivity test, which suggested loss of injected fluid through fractures; a blowout that occurred within a mile of the proposed UIC operations; and the poor compliance history of Diversified Oil and Gas (the well's owner and operator, and possibly parent company of, or related company to, G2).

DCS also urges that additional time be provided for review and comment because: 1) G2 omitted important geologic/well information that had to be gathered independently; 2) the proposed UIC operations are to occur in a state Environmental Justice area; 3) EPA failed to provide public access online to the documents listed in its administrative record index; and 4) the more DCS reviewed this application, the more



problems became apparent, and it is likely that DCS has missed some items due to comment period constraints. Additional time is necessary to fully address the proposed operations and its effects on the surrounding residents and environment, which can be catastrophic and permanent. Also, even though EPA extended the time allowed to comment, the initial short commenting time precluded members of the public from hiring experts to file technical comments.

I. DCS's Interests in this Matter

DCS is a 501(c)(3) non-profit, grassroots organization established in 2008 originally to protect people and watersheds from the risks associated with oil and natural gas exploration, production, processing and transportation. DCS was spurred to act based on evidence of what the oil and gas industry had done in Colorado, Texas, and the initial years of the shale gas boom in western Pennsylvania, as well as frack sand mining in the upper Midwest.

DCS is dedicated to protecting clean air, land, and water from pollution caused by fossil fuel extraction, including waste disposal from oil and gas operations. DCS works to provide individuals and communities – whether in Pennsylvania or beyond – directly or potentially threatened by fossil fuel extraction processes with the tools necessary to defend themselves.

Since DCS's inception, DCS has been highly involved in understanding the impacts and hidden costs of, and in pushing for better regulation and oversight of, oil and natural gas extraction, production, and transportation. Such efforts have included a focus on the wastes produced at each stage and their subsequent disposal, whether to injection wells or landfills, into water sources, into the air, or onto land, including roadspreading (disposal on roads) of liquid waste from wells, (sometimes termed "brine") and other related wastes, which can directly impact DCS members and their physical and economic health and well-being.

II. Setting of the Proposed UIC Operations at the Higinbotham #1 Well

The very complexity and variety of geologic factors which provide Pennsylvania with its great mineral wealth and its scenic beauty serve to limit its opportunities for subsurface waste disposal. Because of the extent and importance of the Commonwealth's mineral extractive industries, and because of the comparatively high population density within the Commonwealth, it is particularly important that the potential impact of waste disposal operations on the whole economic and human environment be considered. . . .



Pennsylvania has few reservoirs of adequate permeability and porosity for feasible liquid waste disposal projects. Its structural geology is complex, creating difficulties in geological interpretation of the subsurface and producing a profusion of mechanical interruptions in rock continuity—faults, joints, and fractures.

Because of the complexity of the geology of Pennsylvania, it is particularly important that each individual disposal project be subject to extensive geological investigation.¹

G2 proposes to use an existing well – the Higinbotham #1 well – for its proposed UIC operations. The Higinbotham #1 well is a vertical wellbore developed in 1987, with an apparent target formation of the Balltown Sandstone.² The well has a total depth of 3525 feet.³ Well records show that the well was “shot” (fracked) 11 times in the interval open to the Balltown Sandstone.⁴

Plans show that G2 plans to run a 6-inch pipeline across the yard of the Higinbotham property to the well from a new set of tanks and other equipment that will be used to offload wastewater from trucks that will enter and leave the property through the existing driveway onto SR 3010 (Smithfield Road).⁵ This will place heavy, regular truck traffic less than 100 feet from homes across the street.⁶ The Higinbotham well itself is *less than 300 feet* from nearby homes and farms.⁷ The entire operation will encircle the Higinbotham house.⁸ The truck offloading area is directly next to a downhill slope that drains into tributaries feeding Jacobs Creek.⁹

¹ PA Geological Survey, Subsurface Liquid Waste Disposal and its Feasibility in Pennsylvania, Env'tl Geology Report No. 3 (“PGS EG3”), 1972, p.66. Available at: <https://maps.dcnr.pa.gov/publications/Default.aspx?id=62>

² G2 Application, PDF pp.52-53.

³ G2 Application, PDF p.53.

⁴ G2 Application, PDF pp.52-53.

⁵ G2 Application, PDF p.19. This said, the more detailed site schematics do not match the proposed site. G2 Application, PDF pp.74-75. For instance, both schematics on PDF pp. 74 and 75 state that the truck offload pad will be located close to Walston Road. There is no Walston Road in the local area. There is a Walston Road in Punxsutawney, but that is not where this is being built.

⁶ Measured using Google Earth. See also Attachment K (Google Earth Maps and Street View Images).

⁷ Measured using Google Earth. See also Attachment K.

⁸ G2 Application, PDF p.19.

⁹ G2 Application, PDF p.19. See also Attachment K.



The entire proposed operation is located in Nicholson Township, Fayette County, in the heart of what used to be coal camp/coal patch town country,¹⁰ and is now a state Environmental Justice area.¹¹ Within less than a mile of the proposed UIC operations are former surface and underground mines, as well as a mine portal and other remnants of coal operations.¹² The area has also been extensively developed with oil and gas wells, some of which are nearly 100 years old and lack modern casing and/or plugging. As one example, the JN Johnson well – drilled in 1925 – is located within ¼ mile of the proposed UIC operations and is identified as an unplugged well completed into the “Fifth Sand.”¹³ G2 did not include this well in its application materials or analyses.

The most difficult aspect of the [proposed waste injection] enclosure to evaluate in the shallow sands is the effect of the extensive oil and gas development to which they have been subjected. Literally hundreds of thousands of wells in Pennsylvania have explored the prolific oil and gas producing section of the Upper Devonian, Mississippian, and Pennsylvanian over a period of more than 100 years. Regrettably, as a result of lack of foresight and inadequate regulation and supervision, many of these wells represent a severe impediment to waste disposal.¹⁴

The Higinbotham #1 well is also located less than 2 miles west of the Fayette anticline.¹⁵ Such “[f]old hinges may be associated with areas of increased fracturing.”¹⁶ The proposed site drains directly into tributaries of Jacobs Creek, with Jacobs Creek also located within a ¼ mile of the facility.¹⁷

¹⁰ See, e.g., <https://coalcampusa.com/westpa/klondike/klondike.htm>; Attachments B and C (showing mined-out areas and mine impacts). A coal camp or coal patch town is a town that sprung up around coal mine operations. These towns were almost always owned by the mining company, which resulted in events like miners being kicked out of their homes if they went on strike. Some towns still exist, although many are significantly smaller than before the coal was mined out and mines closed down. The boundaries of the Leckrone No. 1 mine, and Leckrone strip mine, are within a mile of the proposed UIC operations. (Attachment C).

¹¹ See PADEP Environmental Justice Areas Viewer, <https://padep-1.maps.arcgis.com/apps/webappviewer/index.html?id=f31a188de122467691cae93c3339469c>

¹² Attachments B and C.

¹³ Attachment A.

¹⁴ PGS EG3, p.76.

¹⁵ PA Geological Survey, Groundwater Resources of Fayette County, Pennsylvania (Water Resource Report 60), 1988. (“PGS WRR 60”), Plate 1.

¹⁶ PGS WRR 60, p.11.

¹⁷ See, e.g., Attachment K, G2 Application, PDF pp.9-10.



Instead of flat, layer-cake geology (as implied by the generic Marcellus Shale Coalition diagram in G2's application),¹⁸ the area is somewhat like a tilted piece of fractured Swiss cheese. This is due to fractured bedrock geology, past mining activity (e.g., mine voids), past and current oil and gas exploration and development, and induced geologic changes caused by such activity, such as human-induced fracturing from: blasting for strip mine operations, mine subsidence, and fracking activity.

In addition, four water wells are located within a mile of the proposed facility, per the Pennsylvania Groundwater Information System ("PAGWIS"), none of which G2 included in its analyses. One such water well is listed for domestic use.¹⁹ The three other are identified as test²⁰ wells, drilled to a depth of 2688 feet (casing ends at 395 feet), 2680 feet (casing ends at 396 feet), and 8697 feet (casing ends at 2708).²¹ The deepest of these three wells very likely intersects the Balltown formation based on its location relative to wells included in G2's isopach analyses.²² G2 appears to rely heavily on the fact that residents receive public water as a means of avoiding identifying all water wells in the area, some of which may not be in the PAGWIS database due to age.²³ Identification of *all* such wells is crucial because each provides an additional pathway for potential fluid or gas migration.

DCS has provided maps with this comment identifying the above-listed items G2 failed to include in its application.²⁴

III. G2 Has Failed to Meet its Regulatory Burden and Is Not Entitled to a UIC Permit

40 C.F.R. § 144.12(a) clearly states that G2 has the burden of showing that its activities will not "allow[] 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." G2 has not met that burden. In fact,

¹⁸ G2 Application, PDF pp.23-24.

¹⁹ Well 103163 – Attachment E.

²⁰ DCS presumes these to be water wells, and not oil/gas wells, given that they were logged in PAGWIS. However, this should be confirmed by G2 and EPA.

²¹ Attachment E.

²² Attachment E. Well No. 47741 has a depth of 8697 feet. It is located in between two gas wells that G2 identifies as intersecting the Balltown Sandstone: H. Murphy Unit 1 (051-20500), and Robert W. Honsaker 1 (051-20408) – G2 Application, PDF pp.28-29. It is possible that the three test wells are: 1) one well drilled deeper several times; 2) plugged; and/or 3) some combination thereof. However, G2's application lacks any investigation as to the status of these wells.

²³ https://elibrary.dcnr.pa.gov/GetDocument?docId=4842476&DocName=Guide_PaGWIS-WaterWell-Spring_Data.pdf, at PDF p.7 ("Completeness of Data"). The same situation applies to spring locations.

²⁴ Attachments A-C, H; see also PGS WRR 60, Plate 1 (<https://maps.dcnr.pa.gov/publications/Default.aspx?id=157>).



G2's application materials, and particularly its injectivity test, are incomplete and leave key questions unanswered that must be addressed before EPA issues a permit in order to protect public health, safety, and the environment.

A. *Injectivity Test Demonstrates Pressure Loss Through Fractures, As Noted by G2's Own Contractor*

G2's injectivity test is the most straightforward example of the question marks that surround the proposed operations, and that neither G2 nor EPA has sought to answer. During the injectivity test, there was a pressure drop "after 8 hours and 37 minutes into the test . . . while injecting at the 5 bpm rate and a surface pressure of 1753 psi."²⁵

After the drop in pressure, injection operations were temporarily shut down to consider whether the pressure drop may have been due to formation breakdown. Injection was paused for approximately 40 minutes before recommencing. As agreed with Mr. Rectenwald, the 1753 psi seemed low for breakdown pressure for an Upper Devonian Sandstone at that depth. Potentially the drop in pressure *could be related to opening a pre-existing fracture (from the original frac job) or possibly pressure drop from the opening of a previously blocked perforation(s)*.

To be conservative, the decision was made to make 80% of 1753 psi, equivalent to 1402 psi, the MIP for the duration of the test (unless formation breakdown was observed at or below this level). Injection continued from that point forward with 1402 psi as the MIP during which the rate was adjusted to try to identify an optimum injection rate while staying below the assigned MIP.

(Emph. added).²⁶

No analysis appears to have been done to confirm that the pressure loss was *not* due to loss of fluid or formation gas/fluid through fractures/ perforations; likewise, no analysis was done to determine how any such migration of formation gas or fluid, or injected fluid, would affect the surrounding community, including USDWs. Further, the injectivity test fails to account for the potential for the pressure loss to have occurred

²⁵ G2 Application (Injectivity Test), PDF p.39.

²⁶ G2 Application (Injectivity Test), PDF p.40 (emph. added).



due to *naturally-occurring* fractures, not merely opening or reopening of fractures, although either mechanism presents a clear environmental danger. Instead of actual analysis, the injectivity test contractor suggested a maximum injection rate of “at least” 1753 psi²⁷, which is the *same* pressure at which pressure loss occurred. Even worse, however, G2 is requesting an injection rate of even *more* than that (1800 psi average, 2000 psi maximum).²⁸ There is no analysis of the surrounding geology, or any fracture analyses, or other geophysical data to substantiate that these pressures will not contaminate USDWs, force formation water and gas into surrounding abandoned wells, or otherwise pose threats to public health and safety. The Higinbotham #1 well was shot (fracked) 11 times when developed in 1987, making it very likely that there are fractures emanating from the Balltown Sandstone.

EPA regulations are clear:

Injection pressure at the wellhead shall not exceed a maximum which shall be calculated *so as to assure* that the pressure during injection does not initiate new fractures or propagate existing fractures in the confining zone adjacent to the USDWs. *In no case* shall injection pressure cause the movement of injection or formation fluids into an underground source of drinking water.

40 C.F.R. § 146.23(a)(1) (emph. added); see also 40 C.F.R. § 144.12. However, G2 provides no way to confirm that the pressures it has requested, which exceed that which caused pressure loss during the injectivity test, will not open or reopen fractures, follow existing faults or fractures, or otherwise result in migration of formation gas and fluid into USDWs. G2 seems to merely assume the absence of such features, despite the pressure loss during the injectivity test.

The most basic purpose of permitting is to prevent harm, not hope it does not happen. Protection of USDWs both now *and in the future* is a cornerstone of UIC permitting, as well as Article I, Section 27 of the Pennsylvania Constitution. And yet that basic question – will this proposed operation harm USDWs and the people and aquatic life that rely on them – has not been answered by the applicant (who has the burden)²⁹ or by EPA. “In western Fayette County, more than half of the streamflow is supplied by groundwater”³⁰ Thus, protection of USDWs also means protection of streams and the community. However, the Applicant appears to ignore the available

²⁷ G2 Application (Injectivity Test), PDF p.42.

²⁸ G2 Application, PDF p.70.

²⁹ 40 C.F.R. § 144.12(a).

³⁰ PGS WRR 60, PDF p.8.



data from the injectivity test and well records (discussed next below), and states instead: “No known or suspected faults or fracture systems.”³¹ This is directly contradicted by the record, and not supported by any data or analysis by the Applicant. Based on the application materials, it is not clear that G2 did any analysis, or research on local geologic and hydrologic conditions, to determine the presence or absence of faults and fractures. As the one with the burden, G2 has simply failed to meet the regulatory standard. However, EPA is still proposing to issue a permit.

B. *Omission of Known, Unplugged Abandoned Well from AOR Analysis*

In addition to the pressure loss and fracture concerns from the injectivity test, G2 omitted a known, *unplugged* abandoned well within the ¼ mile AOR from its maps and analyses, and thus EPA did not include this well in its statement of basis. The Pennsylvania Department of Environmental Protection’s (“PADEP”) Oil and Gas Mapper (publicly available online) shows that the JN Johnson well is located approximately 1095 feet to the northeast of Higinbotham #1. According to records obtained from DCNR, the JN Johnson well is approximately 2365 feet in depth.³² PADEP’s Oil and Gas Mapper and abandoned well database both identify that the well *is not plugged*;³³ the location of an unplugged, abandoned well within the AOR requires additional analysis and review that has not been completed.

G2’s omission of this well is crucial because it affects EPA’s ¼ mile AOR analysis. EPA’s Statement of Basis claims that there is only one gas well in the AOR, which is plugged;³⁴ this is factually inaccurate due to G2’s failure to include all known abandoned wells within the AOR. Thus, not only has G2 not properly addressed the risks of migration and USDW contamination through geologic pathways, as noted by the injectivity test, it has also failed to address migration/contamination and blowout risks via nearby abandoned wells.

G2 also omitted from its Map #2 another abandoned, unplugged well within ½ mile of the proposed facility, i.e. the Joseph Hibbs 1 well (051-90114).³⁵ DCS has not checked for every well on PADEP’s abandoned list, but has attached a list of all such wells in Nicholson Township, as well as maps from PADEP’s Oil and Gas Mapper, for

³¹ G2 Application, PDF p.25.

³² Attachment A.

³³ Attachments B and G.

³⁴ EPA Statement of Basis, p.2 (“The only well within the Area of Review is the Dominick Diamond G915 well (API No. 37-051-00076), a plugged oil and gas production well.”).

³⁵ Attachment B (1/2 Mile Radius Map).



EPA's review as it appears that G2 may have omitted such wells from its analyses.³⁶ DCS has also included a farmline map of the area with this comment.³⁷

The risk of migration or communication with other wells – gas, oil, water, or otherwise – is not remote, and communication with other wells has occurred not just in Pennsylvania, *but within a mile of this proposed facility*. In 2008, Atlas Resources' operations at the Yasenosky 2 well caused a blowout in a nearby abandoned well that ejected well casings and sent a geyser into the air.³⁸ This happened approximately one mile from the proposed Higinbotham injection well. This incident is not mentioned or discussed in any of G2's application materials.

C. *Incomplete Information on Wells and other Regulatorily-Required Information*

G2's omission of required information and analysis does not end there. 40 C.F.R. § 144.31(e)(7) requires, *inter alia*, that an applicant identify on a map "those wells, springs, and other surface water bodies, and drinking water wells listed in public records or otherwise known to the applicant within a quarter mile *of the facility property boundary*." (emph. added).

G2 failed to provide a complete map, and also appears to have only measured ¼ mile from the proposed injection well (i.e., the area of review), rather than from the property boundary, which is required by Section 144.31(e)(7).

The maps provided by G2 in its application are incomplete and cannot be relied upon as accurate. Although G2 claims to have checked Pennsylvania water and oil/gas well records, its maps are missing multiple water wells and oil/gas wells within a mile radius of the facility, and its Map #2 should show at least some of the water wells at the edge of the ½ mile radius it drew. One such water well is listed for domestic use.³⁹ Three wells are test wells, one of which is deeper than 8000 feet and very likely intersects the Balltown Sandstone given its proximity to wells noted in G2's Application. G2 appears to rely heavily on the fact that residents receive public water as a means of avoiding identifying all water wells in the area, some of which may not be in the PA GWIS database due to age. Identification of all such wells is crucial because each provides an additional pathway for potential fluid or gas migration.

³⁶ Attachments B and G.

³⁷ Attachment H.

³⁸ Attachment D. DCS believes that the impacted well is the Jellick/Lynn well based on formation data, and dates of records and plugging directives that coincide with the blowout at Yasenosky 2. However, due to time constraints associated with the comment period, DCS was unable to submit a request to PADEP that would have obtained records on the blowout prior to the close of the comment period. DCS has included records from DCNR on the Jellick/Lynn well in Attachment D.

³⁹ Attachment E, Well ID 103163.



In addition, G2 appears to try to get around the requirement to identify all wells within a $\frac{1}{4}$ mile of the facility boundary by saying that all residents receive public water.⁴⁰ This does not relieve G2 of the requirement in Section 144.31 to identify all wells, including drinking water wells, located within $\frac{1}{4}$ mile of the *facility property boundary*. All such wells could serve as a potential conduit for gas or fluid migration and must be analyzed. EPA does not appear to have held G2 to this requirement; instead, EPA states that there are *no* drinking water wells in the AOR (i.e., $\frac{1}{4}$ mile of the proposed well).⁴¹ There is no factual basis for this finding.

In addition to the foregoing, G2 failed to provide accurate information on some of the wells it did identify. The status of wells within the $\frac{1}{4}$ or one mile radius, as reported by G2, does not match PADEP records. For instance, the DeRosa 1 well and Spak Unit 1 wells are plugged.⁴² The status of wells – active, inactive, plugged, etc. – is important not just for the purpose of assessing fluid and gas migration pathways, but also because wells that are merely shut-in as opposed to plugged have a different influence on underground pressure levels. DCS has not checked the status of every well listed on G2's application, but such a task must be completed. DCS has included a list of spud wells in Nicholson Township to assist in that effort.⁴³

Further, G2 represents in its application that there are no water wells within a mile of the facility, and that it had checked state records to confirm this fact.⁴⁴ There are actually four water wells within a mile of the facility noted in the PA GWIS system, and despite claiming to have checked such database, these wells are nowhere on G2's maps. Three of the four wells are test wells that were drilled deep, to depths of 2688 feet, 2680 feet, and 8697 feet, with casing that does not extend the entire length of the well. The fourth well is a well listed for domestic use.

D. *Failure to Completely Identify USDWs*

G2 has not properly identified the USDWs to be protected either.⁴⁵ G2 claims that the lowest USDW is the Glenshaw Formation, which it claims ends at around 660

⁴⁰ G2 Application, PDF p.7. It is not clear how G2 determined that there were zero water wells anywhere within $\frac{1}{4}$ mile of the facility boundary, or of the proposed injection well.

⁴¹ EPA Statement of Basis, p.2

⁴² Attachment F, p.9.

⁴³ Attachment F.

⁴⁴ G2 Application, PDF p.10 (note 2).

⁴⁵ G2 Application, PDF p.25. It also appears that G2 has not even checked total dissolved solids ("TDS") data, which is part of identifying USDWs.



feet.⁴⁶ It provides no data or other resources to support any of these claims. The available data again contradicts the Applicant's representations.

The original well records for the Higinbotham #1 well show that the driller hit water at two different depths, the deepest being 945 feet, and noted the water being a 1-inch stream at both depths.⁴⁷ This is not surprising considering that groundwater in Fayette County typically moves through fractures (e.g., bedding planes, faults, other fractured rock).⁴⁸

Groundwater in Fayette County principally moves through fractures and bedding-plane openings in the rock (secondary porosity) rather than through intergranular pores in the rock (primary porosity). . . . A water-bearing fracture in a well will increase the yield significantly, and the depth at which the fracture is encountered is reported by the driller as a water bearing zone.⁴⁹

G2 provided *no* total dissolved solids ("TDS") data for the water found at 945 feet. Thus, it is presently unknown whether the deep water-bearing zone intersected by the Higinbotham #1 well is a USDW. Instead, the Applicant, possibly in an attempt to get around the well record data and the geologic characteristics of the area, says it will cement to a depth of 1310 feet.⁵⁰ However, it provides no basis for 1310 feet being sufficient to protect the surrounding groundwater from contamination, or to prevent water above 10,000 mg/l of TDS from being pushed *into* USDWs.

"Brine has been encountered at depths ranging from 650 to 1,800 feet in oil and gas wells drilled in western Fayette County [where the proposed injection well is located]] – far below the depths of water wells in the county."⁵¹ While the PA Geological Survey publication does not define what it terms "brine," assuming for a moment that such water is *below* the regulatory threshold of 10,000 mg/l TDS, it is entirely possible that a casing depth of 1310 feet is not sufficient to protect the surrounding USDW. Assuming, alternatively, that the water exceeds 10,000 mg/L TDS and is not directly a USDW, the proposed UIC operations risk pushing brine and gas

⁴⁶ G2 Application, PDF p.65.

⁴⁷ G2 Application (Original Well Record for Higinbotham #1 Well), PDF p.18.

⁴⁸ PA Geological Survey, Groundwater Resources of Fayette County, Pennsylvania (Water Resource Report 60), 1988. ("PGS WRR 60"), available at <https://maps.dcnr.pa.gov/publications/Default.aspx?id=157>

⁴⁹ PGS WRR 60, p.12.

⁵⁰ G2 Application, PDF p.65.

⁵¹ PGS WRR 60, p.30.



into USDWs, particularly given the injectivity test results and in the absence of any proper fracture or other analysis.

The only reason G2 appears to choose 1310 feet as the cementing depth for USDW protection is because that depth is where the original 8- 5/8-inch casing (installed in 1987) ends. It appears that the Applicant does not plan to alter or upgrade what was installed in 1987.

Simply because something was done in 1987 is not a sufficient basis for protection of USDWs in 2023. Technology in 1987 was quite different than today, and thus approving such an operation is arbitrary and capricious at best.

E. *No Data or Analysis Sufficient to Show Mechanical Integrity, Including of Existing Well Casing*

Relatedly, neither G2 nor EPA has properly reviewed or assessed the mechanical integrity of the existing well casing from 1987 in the Higinbotham #1 well. Casing standards from 1987 are not what they are today. In addition, it is well-documented that even properly-cemented casings will shrink over time, with circumferential fractures developing and providing pathways for gas to migrate vertically upward along the casing, escaping upward to the surface, or outward from the well into another formation closer to the surface.⁵² Drilling of a wellbore also leaves behind microfractures in the surrounding rock, which complicate any casing job and its ability to bond well to the various formations intersected by the wellbore. Industry and PADEP data have shown a certain percentage of well casings fail immediately; that number only increases with time.⁵³ In other words, cement and steel do not last forever.

40 C.F.R. § 146.8(a) states:

An injection well has mechanical integrity if:

- (1) There is no significant leak in the casing, tubing or packer; and
- (2) There is no significant fluid movement into an underground source of drinking water through vertical channels adjacent to the injection well bore.

⁵² Maurice B. Dusseault and Pawel A. Nawrocki, Why Oilwells Leak: Cement Behavior and Long-Term Consequences, SPE 64733 (2000); see also Anthony R. Ingraffea, Ph.D., P.E., Fluid Migration Mechanisms Due To Faulty Well Design and/or Construction: An Overview And Recent Experiences In The Pennsylvania Marcellus Play, October 2012 ("Ingraffea (2012)"); Ingraffea, et al., Assessment and risk analysis of casing and cement impairment in oil and gas wells in Pennsylvania, 2000–2012, (2014), <https://www.pnas.org/doi/full/10.1073/pnas.1323422111> ("Ingraffea (2014)").

⁵³ Ingraffea (2012), at p.3 (Figure 4); pp.8-9 (Figure 8); Ingraffea, et al. (2014).



The regulations state ways in which G2 could have met these standards.

G2 has met neither of the criteria in Section 146.8(a). First, the data provided by G2 provides no insight into the existing integrity of the casing installed in 1987. Second, although G2 conducted an injectivity test, the pressure loss during that test and possible fluid loss through fractures undermines any determination that there is not or will not be fluid migration into USDWs. Third, G2 has not assessed the ability of the casing that remains downhole to withstand the pressure of repeated waste injection operations. Indeed, it does not appear to have considered casing failure as a potential reason for the pressure loss during the injectivity test. This is especially concerning because G2's requested injection pressures are *higher* than what caused the pressure drop in the injectivity test.⁵⁴ Fourth, G2's failure, as discussed above, to appropriately identify the USDWs here impedes a proper mechanical integrity assessment in accordance with the regulations. This is only exacerbated by its claims that practically the entire ground (including formations it identified as being USDWs) is a confining zone (discussed in the next section).

G2 plans to set the packer at least 10 feet *above* the Balltown Sandstone, making the integrity of the 4- ½ inch production casing from 1987 particularly crucial, in addition to the propagation of fractures around the well. Yet G2's application is devoid of information allowing an assessment of that zone of casing, much less the rest of the well's casing or fractures around the well. It is likewise unclear if the pressure loss during the injectivity test was caused by well casing failure. Casing integrity is crucial and yet G2 has failed to show mechanical integrity in the proposed injection well.

F. *Lack of Confining Zone Data*

G2's incomplete data on wells, fractures, and the geology in this specific area leaves open questions as to whether, to the extent proper confining zones are present, whether they remain competent to ensure that injected wastewater, and/or formation fluid and/or gas do not migrate out of the injection horizon and into USDWs or the surface. As noted earlier, an abandoned unplugged well within ¼ mile of the Higinbotham well is completed into the "Fifth Sand";⁵⁵ the Yasenosky 2 well, which blew out into that nearby abandoned well, blew out via that same formation.⁵⁶ The Higinbotham well intersects these same horizons. Likewise, open hole test wells located within 1 mile of the Higinbotham well, per PAGWIS, appear to intersect these

⁵⁴ G2 Application, PDF p.70.

⁵⁵ Attachment A (JN Johnson well).

⁵⁶ Attachment D ("Fifth is venting out the backside due to blow out of abandoned well").



same horizons and the deepest of the three test wells very likely intersects the Balltown Sandstone.⁵⁷

As for whether there are even proper confining zones present, again G2 fails to convincingly demonstrate that such zones exist above *and below* the injection horizon (Balltown Sandstone). G2 provides no data or analysis for the formations *under* the injection formation, leaving an open question as to whether there is an appropriate confining zone under the injection horizon at all.⁵⁸ G2 vaguely claims, without illustrative data, that the Catskill Formation from a depth of 2000-6000 feet (a range of 4000 feet) is its confining zone, which still does not answer the question. A range of 4000 feet is a very wide margin and instills very little confidence that the Applicant has actually analyzed the surrounding geology to ensure protection of USDWs and the community.

The injection formation, according to the 1987 well records is only about 15 feet thick (3405 to 3420 feet per 1987 well records).⁵⁹ The well was perforated 11 times between 3407 and 3417 feet (which G2 plans to re-perforate (or did for the injectivity test)),⁶⁰ and the injectivity test states the interval thickness as 10 feet.⁶¹ This is a very thin margin. 10 feet of formation fracked 11 times raises substantial questions about fracture propagation beyond the Balltown Sandstone, which G2 has not addressed. With the technology available in 2023, there is no reason that these questions should be left open. At the risk of stating the obvious, this well was developed to draw as much gas as possible out of the ground, with induced and natural fractures aiding that effort. Those same fractures undercut the well's suitability for waste disposal.

G2's application only gets worse from here, because the Applicant openly states that it considers almost *the entire ground* from the depth of the injection well to the surface as a confining zone or a potential confining zone, including coal spoils and even

⁵⁷ Attachment E. Well No. 47741 has a depth of 8697 feet. It is located in between two gas wells that G2 identifies as intersecting the Balltown Sandstone: H. Murphy Unit 1 (051-20500), and Robert W. Honsaker 1 (051-20408) – G2 Application, PDF pp.28-29.

⁵⁸ U.S.G.S. Water Supply Paper 2281, "Subsurface Injection of Liquid Waste With Emphasis on Injection Practices in Florida", 1986, p.3 "For subsurface injection to succeed as a disposal method within the constraints of Federal and State requirements, the injection site and the surrounding region should possess a number of hydrogeologic characteristics," such as "[t]he injection zone is underlain and overlain by confining beds that retard upward and downward movement of native water and liquid waste" Available at: <https://pubs.usgs.gov/wsp/2281/report.pdf>

⁵⁹ G2 Application, PDF p.53.

⁶⁰ G2 Application, PDF p.52, see also PDF p.38.

⁶¹ G2 Application, PDF p.41.



formations that the Applicant itself has identified as USDWs.⁶² This is in addition to other formations (e.g. the Burgoon Sandstone, a.k.a. “Big Injun” Sandstone)⁶³ that are known to provide water in Fayette County.⁶⁴ G2’s application is riddled with these very lackadaisical statements about key geologic and well structure features that are necessary to understand in order to ensure not just regulatory compliance, but also protection of USDWs, public health and safety, and the local community. The fact that EPA is entertaining a permit for this operation is improper given not just each individual issue – fractures, abandoned wells, G2’s spotty application, outrageous claims regarding confining zones, etc. – but also all of these issues together.

G. *No Analysis to Rule out Substantial Risks of Gas or Fluid Migration and/or Blowouts*

As discussed earlier in Section III.A. and III.B., G2 has no data to demonstrate that its operations will not raise substantial risks of gas or fluid migration and/or blowouts. Its omission or failure to even include known water wells and an abandoned, unplugged gas well in its application materials prevented EPA from considering such risks as well. G2 has failed to analyze the risk of its operations pushing gas from the Balltown Sandstone, or formation water (brine or otherwise) into surrounding formations and into USDWs, or otherwise causing blowouts in nearby abandoned wells.

Also, as noted earlier in Section III.B., a blowout occurred in 2008 approximately one mile from the Higinbotham site.⁶⁵ That blowout was the result of fracking reaching an abandoned well.⁶⁶ The Applicant has failed to analyze or quantify these risks in connection with its proposed operations. Migration of gas or fluid in this area also poses an increased risk of surface water contamination due to the proximity of Jacobs Creek and its tributaries.⁶⁷ Also, given the number of tributary channels that receive water and runoff from this particular site,⁶⁸ blowouts or spills are highly likely also to directly contaminate surface water resources.

⁶² G2 Application, PDF p.67.

⁶³ Pennsylvania Geological Survey, Open-File Oil and Gas Report 19-01.1 (Subsurface Lithostratigraphy of the Oil- and Gas-Producing Regions of Pennsylvania), Appendix 1, available at <https://maps.dcnr.pa.gov/publications/Default.aspx?id=985>.

⁶⁴ PGS WRR 60, pp.26-27.

⁶⁵ Attachment D.

⁶⁶ Attachment D.

⁶⁷ See Attachment K.

⁶⁸ See Attachment K.



H. *Need for Wider AOR Due to Complex Geologic Setting and Incomplete Information*

The complex geologic setting (including impacts from fossil fuel development) where G2 proposes to inject oil and gas wastewater merits a wider AOR, once better and more complete information is obtained on geologic and hydrogeologic conditions, nearby oil/gas wells and water wells, and other key features not accounted for by G2 or EPA thus far. There are far too many variables to assume that a ¼ mile AOR is sufficient to protect USDWs, local streams, and the community.

As stated by the Pennsylvania Geological Survey (“PGS”), injection well operations in Pennsylvania pose high risks and costs (particularly compared to other states) relative to the “few reservoirs of adequate permeability and porosity for feasible liquid waste disposal projects. Its structural geology is complex, creating difficulties in geological interpretation of the sub surface and producing a profusion of mechanical interruptions in rock continuity – faults, joints, and fractures.”⁶⁹ In comparison to a particular geologic formation in Illinois, “[t]he well-known reservoirs of Pennsylvania are exceedingly restricted both vertically and laterally, their thickness measured in tens of feet [not thousands] and their lateral extent in tens or hundreds of square miles. Porosities are generally lower by half and permeabilities, even to gas, are characteristically a tenth as great.”⁷⁰

Accordingly, the AOR analysis must be expanded and be substantially more rigorous.

I. *Outdated and Insufficient Data on Wastewater to be Injected*

G2 submitted two sets of data on the wastewater it proposes to inject – one which is a grab sample from 2017⁷¹, and a second set from 2021 labeled as “Central PA Marcellus Production Water”,⁷² which is a fairly broad descriptor and appears to have been analyzed for specific gravity only and not for its content.

⁶⁹ PGS EG3, p.66; see also p.89.

⁷⁰ PGS EG3, p.89.

⁷¹ G2 Application, PDF p.76 *et seq.*

⁷² G2 Application, PDF p.87 *et seq.* The sample also was handed off to the lab by Paul Hart in Indiana, Pennsylvania. Mr. Hart is the Director of Environmental Services for Diversified Oil and Gas.

Mr. Hart was also head of Hart Resource Technologies and PA Brine Treatment (now Fluid Recovery Services), which run or has run several oil and gas wastewater plants in Josephine, Creekside, and Franklin, PA. Researchers found high levels of radium and other oil and gas wastewater pollutants such as bromide in Blacklick Creek downstream of one of the PA Brine facilities.

<http://archive.allegheenyfront.org/story/frack-waste-pollutes-allegheeny-tributary-radiation.html>;



Not surprisingly, G2 also admitted: “Due to this facility being a commercial disposal facility, field and formation names vary. Source water will be produced brine,”⁷³ which essentially means that G2 cannot truly provide a representative sample of what is going to be injected, because oil and gas wastewater varies significantly depending on factors such as: how much flowback is present in the water; the characteristics of the rocks that come in contact with the water, and multiple other factors.

The lack of representative data is both a problem and an indicator of the continued challenges of oil and gas wastewater disposal – challenges that have repeated themselves multiple times over the last decade and a half in Pennsylvania and that range from the practical impossibility of economically and properly treating oil and gas wastewater to spotty recordkeeping. Just this past week, a new study determined that POTWs accepting leachate from landfills accepting oil and gas waste have been discharging radioactive material in their effluent⁷⁴ – which is almost the exact problem that was occurring around 2008-2011.

Pennsylvania has tried or experienced almost every method of disposal of oil and gas waste and wastewater: surface water discharges (POTWs, CWTs); transportation of wastewater to out-of-state injection wells; landfills; dumping on roads under the guise of “dust suppression” or “winter treatment”; “injection well disposal” into a mine void (“Morris Run Borehole”); and illegal dumping, most notoriously into tributaries of Dunkard Creek and the Morris Run Borehole, which coincided with an over 30-mile kill of aquatic life in Dunkard Creek.⁷⁵ Whatever the disposal method, contamination has quickly followed, including contamination (e.g. radiation) that is not easy to remediate either. Now, with an increasing number of injection wells proposed or operating in

<https://pubs.acs.org/doi/abs/10.1021/es402165b>; <https://www.smithsonianmag.com/science-nature/radioactive-wastewater-from-fracking-is-found-in-a-pennsylvania-stream-351641/>.

⁷³ G2 Application, PDF p.70.

⁷⁴ <https://www.alleghenyfront.org/pennsylvania-fracking-waste-radioactive-radium-wastewater-landfill-leachate/>

⁷⁵ <https://ehb.courtapps.com/efile/documentViewer.php?documentID=9071> (noting directives to illegally dump occurring between 2003 and 2009); see also <https://ehb.courtapps.com/efile/documentViewer.php?documentID=9069>; <https://ehb.courtapps.com/efile/documentViewer.php?documentID=9275> (pp.4-5); https://www.earthisland.org/journal/index.php/magazine/entry/what_killed_dunkard_creek; http://www.uppermon.org/news/charleston/WVPB-Discharges_Contributed-16Oct09.html



Pennsylvania – despite the prevailing view for decades that Pennsylvania is generally not suitable for such operations⁷⁶ – the cycle of contamination continues.

This is only made worse by the “large data gaps in oil and gas waste reports in Pennsylvania and surrounding states. The researchers could not find reports for more than 800,000 tons of fracking waste sent to landfills in Pennsylvania, New York, and Ohio.”⁷⁷ The recordkeeping problem runs back years, with even PADEP disclaiming the accuracy of its own databases of oil and gas waste reports.⁷⁸ Bad recordkeeping, including lack of manifesting, can be traced to the many exemptions oil and gas waste/wastewater has from key laws such as RCRA,⁷⁹ and so long as such exemptions remain, tracking wastewater and ensuring its proper disposal at approved facilities will not happen in a way that protects human health and the environment on which our health depends.

J. *Lack of Basis for Denser Fluid to be Injected*

G2 requests approval for fluid with specific gravity as high as 1.23, but its injectivity test was done with less dense fluid of specific gravity of 1.147.⁸⁰ Again, that injectivity test resulted in a pressure loss due to potential fracturing, or opening of, or loss of fluid through, existing fractures. EPA has no basis in the record for granting a permit for G2 to inject *denser* fluid, particularly when there is no data on the density of fluid in the injection horizon or surrounding formations.

⁷⁶ PGS EG3, pp.89-90 (“There are severe geological and man-made limitations on the use of the subsurface for disposal of liquid wastes in Pennsylvania. It is unlikely that subsurface liquid waste disposal will be widely employed in the near future due to the *very high costs of adequate evaluation, operation, and observation which must be required* if such injection is to be done efficiently and safely. Nevertheless there are opportunities, now and in the future, for the disposal of industrial effluents in *relatively small volumes* where the *need justifies the cost*.” (emph. added).

⁷⁷ <https://www.alleghenyfront.org/pennsylvania-fracking-waste-radioactive-radium-wastewater-landfill-leachate/>

⁷⁸

https://files.dep.state.pa.us/OilGas/BOGM/BOGMPortalFiles/OilGasReports/HelpDocs/SSRS_Report_Data_Dictionary/DEP_Oil_and_GAS_Reports_Data_Dictionary.pdf (“While the Oil and Gas Program requires accurate data reported by Operators, the Department of Environmental Protection makes no claims, promises or guarantees regarding the accuracy, completeness or timeliness of the data. DEP will make every attempt to correct any errors discovered but expressly disclaims any liability for errors or omissions related to the data contained within these reports.”)

⁷⁹ See, e.g., <https://stateimpact.npr.org/pennsylvania/2021/07/22/group-says-tighter-radiation-controls-of-drilling-waste-needed/>

⁸⁰ G2 Application, PDF p.70.



IV. Diversified Oil and Gas's Non-Compliance History

Diversified Oil and Gas (“Diversified”), the owner and operator of the Higinbotham #1 well, appears to be the largest owner of so-called “conventional” wells in Pennsylvania, which it has accomplished by buying low-production or other wells from other operators. However, its compliance history displays a lack of attention to environmental responsibility for the wells it has purchased. G2’s relationship to Diversified is not explained in the application. Given the potential connection between the two companies, and Diversified’s non-compliance history, EPA must require clarification on any such relationship between the two companies and, if related, consider Diversified’s violations as part of its review and include Diversified as a co-permittee.

For example, in 2019, PADEP entered into a Consent Order and Agreement with Diversified and two subsidiaries regarding plugging of 1400 abandoned wells.⁸¹ The agreement required Diversified to “either plug or place into production at least 50 wells a year, and to complete this process for all 1,400 wells by 2033,” as well as to put appropriate bonds on abandoned wells it acquires.⁸² At the time in 2019, Diversified owned over 23,000 “conventional” wells in Pennsylvania.

In 2020, PADEP issued a Notice of Violation (“NOV”) to Diversified due to multiple so-called “unconventional” well sites with production tanks so severely corroded that holes were present.⁸³ One inspected well also had a leaking wellhead with gas bubbling up through pooled rainwater.⁸⁴ PADEP required Diversified to address problems at **110** well sites, which Diversified asked to do over the course of two years to three years.⁸⁵ Some of the well sites in the NOV already had outstanding or previous violations.⁸⁶

Such a history requires, at a minimum, closer scrutiny on the proposed UIC operations at the Higinbotham #1 well, including but not limited to the integrity of the existing casing and well structure given the general lack of attention that Diversified appears to devote to such matters on wells that it purchases.

Diversified’s compliance history is also a concern because the relationship, if any, between Diversified and G2 Stem LLC is not identified or described in G2’s application.

⁸¹ Attachment I.

⁸² Attachment I.

⁸³ Attachment J, PDF p.2 *et seq.*; see also id. at PDF pp.8, 28.

⁸⁴ Attachment J, PDF p.8.

⁸⁵ Attachment J, PDF pp.30-32; PDF pp.33-37 (Diversified response letters).

⁸⁶ Attachment J, PDF pp. 33-37.



For instance, Diversified is the entity who had the injectivity test conducted on the Higinbotham #1 well. Diversified is listed on the wastewater data submitted in the application. The wastewater used in the injectivity test came “from Diversified’s nearby conventional and unconventional (Marcellus Shale) producing gas wells,”⁸⁷ suggesting that much of the wastewater to be disposed of at the Higinbotham well may be Diversified’s and an attempt by Diversified to cut its costs of wastewater disposal. Diversified also remains the owner and operator of the existing well. Yet, G2 is the applicant.

If G2 is a subsidiary of, or company related to, Diversified, it is logical to assume that G2’s operations at the Higinbotham #1 well may follow the pattern of Diversified’s past conduct. That further increases the risks of UIC operations at this site, particularly given the issues already discussed in this comment, and makes granting a permit for such operations contrary to law as well as arbitrary and capricious. EPA must clarify the relationship between the two entities before making a permit decision. Further, if G2 is connected with Diversified, and EPA issues a permit, Diversified should be listed as a co-permittee, particularly because it is the actual well owner and may have control over G2 and the proposed UIC operations.

V. Monitoring Wells Necessary to Protect Public from Bearing Costs of Industrial Pollution

One common theme throughout Pennsylvania’s experience with coal mining and oil and gas development has been that communities across the state have been forced to bear the costs of private companies’ pollution. Even in situations where presumption zones apply to try to mitigate the burden on homeowners with water contamination, litigation to force companies and agencies to replace water remains expensive, and many Pennsylvanians have lost their most significant investments – their homes, their land, and often their health – due to fossil fuel damage and pollution.

Pennsylvania remains highly unsuitable for injection wells, and the oil and gas industry enjoys many exemptions from key environmental laws. Thus, to the extent that EPA decides to grant a permit to G2, EPA must require sufficient monitoring wells in order to protect residents against expensive fights over liability for contamination and property damage. EPA must also be willing to act quickly to stop further injection of waste in such a situation, and not wait for the community to be harmed, as happened with Dunkard Creek.⁸⁸

⁸⁷ G2 Application, PDF p.39.

⁸⁸ https://www.earthisland.org/journal/index.php/magazine/entry/what_killed_dunkard_creek



VI. Conclusion

For all the reasons stated in this comment letter, and in the cited and accompanying materials, EPA should deny a UIC permit for G2's proposed operations at the Higinbotham well. To the extent EPA remains inclined to grant a permit, substantial additional information, analysis, and protections for the public and the environment are necessary to prevent harm to residents and the local environment in which they live, as well as more time for public review.

Thank you for your time and consideration of this matter and this comment.

Sincerely,

Lauren M. Williams, Esq.
Greenworks Law and Consulting LLC

*Counsel for Damascus Citizens for
Sustainability*

Enclosures