STATE OF NEW YORK
SUPREME COURT : COUNTY OF STEUBEN

In the Matter of the Application of the SIERRA CLUB; PEOPLE FOR A HEALTHY ENVIRONMENT, INC.; COALITION TO PROTECT NEW YORK; JOHN MARVIN; THERESE FINNERAN; MICHAEL FINNERAN; VIRGINIA HAUFF; and JEAN WOSINSKI,

Petitioners,

For a Judgment Pursuant to Article 78 of the Civil Practice Laws and Rules

-against-

THE VILLAGE OF PAINTED POST; PAINTED POST DEVELOPMENT, LLC; SWEPI, LP; and WELLSBORO AND CORNING RAILROAD, LLC,

Respondents.

AFFIDAVIT IN OPPOSITION TO RESPONDENTS' MOTION TO DISMISS AND/OR FOR SUMMARY JUDGMENT

Index No. 2012-0810CV

State of New York,
County of Ulster, ss.:

PAUL RUBIN, being duly sworn, deposes and says:

1. I am a hydrogeologist and hydrologist with thirty years of professional experience. I earned a B.A. degree from the State University of New York at Albany in 1977 and an M.A. degree in geology with a specialty in hydrogeology from the State University of New York at New Paltz in May, 1983. My professional experience includes work conducted for the New York State Attorney General's Office (Environmental Protection Bureau), Oak Ridge National Laboratory (Environmental Sciences Division), the New York City Department of Environmental Protection, and as an independent environmental consultant as President of HydroQuest. My educational background and professional experience are more fully set forth in my Curriculum Vitae, attached as Exhibit A.

2. Within the broad field of hydrology, I have specialized expertise in both surface water and groundwater hydrology. I have conducted detailed assessments of streams, wetlands,

watersheds, and aquifers for professional characterizations, for clients and as part of my own personal research. I have authored numerous reports and affidavits related to this work and have made presentations to judges, juries, the assembly, the senate, and others. In addition, I have published papers and led all-day field trips relating to this work at professional conferences.

3. More recently, I have been called upon by a number of environmental groups to address hydrogeologic and environmental issues associated with hydraulic fracturing. A synopsis of this work is attached as Exhibit B.

4. This affidavit evaluates the hydrologic consequences of the withdrawal of potable waters of New York State within the primary unconsolidated aquifer referred to as the Corning aquifer. The content and conclusions of this affidavit are based upon generally accepted scientific principles. Issues that are raised are based upon significant research and my geologic and hydrogeologic expertise.

5. For the reasons described below, I am of the opinion that, before the Village of Painted Post or any of the other individual municipalities drawing on the Corning aquifer for their municipal water systems are permitted to engage in water exports from the aquifer, hydrogeologic testing needs to be conducted on production wells in the aquifer to determine the safe yield of the aquifer and an inter-municipal drought management plan needs to be adopted by the municipalities drawing on the aquifer so that there is agreement about how withdrawals will be restricted in a time of drought.

6. Prior to reaching the conclusions provided in this affidavit, I reviewed a number of documents including the Village of Painted Post Full Environmental Assessment Form dated 2-23-12, an affidavit of Mr. William R. Gough, Stearns & Wheler, LLC 2002 Chemung River Valley Water Study, the Full Environmental Assessment Form (EAF - Village of Painted Post: Lease Agreement for Transloading Facility Site; Lease of 11.84 acres to Wellsboro & Corning Railroad to transport approximately one million gallons of potable water daily; 2-23-12), the Surplus Water Sale Agreement between the Village of Painted Post and SWEPI LP, the affidavits

of Eugene Stolfi, Jean Wosinski, Larry Smith and Robert M. Drew, the 2011 Hunt Engineers report, other documents, and assorted gas industry related material.

7. A key issue central to the planned sale of Corning aquifer water by the municipality of Painted Post is whether there is adequate water available from existing municipal wells to meet existing water demand with sufficient excess to sell. There is no indication in the documents I reviewed that the Village of Painted Post conducted the pumping tests and modeling studies needed to confirm the safe yield of their production wells in a time of drought or otherwise. This is important because the sufficiency of water quantity has not been demonstrated, nor have potential adverse water quality impacts been assessed.

8. A limited pumping test is mentioned in one sentence (page 2) of the Nov. 11, 2011, Hunt Engineering Report and referenced in the affidavit of Robert Drew, but this test cannot be evaluated because no data, no graphs, no analysis and no information is provided. Similarly, Appendix D provides no hydrogeologic data that would be needed in assessing safe yield, just differences in pressures in water distribution lines. The affidavit of Robert M. Drew sheds no additional light on the safe yield of the aquifer at any location because, again, no data is provided. Drew states:

> "*...Hunt also at the insistence of the Railroad and the Village undertook an extensive study to insure that the withdrawals associated with the sales of surplus water would not have adverse impacts on the Village Water System and its users.*"

I was not able to find any aquifer test data or information of this kind in the November 11, 2011 Hunt report. Relative to water availability, the Drew affidavit is hollow and provides no supporting hydrogeologic documentation that could be evaluated by a professional hydrogeologist. Furthermore, in his affidavit, Larry E. Smith refers to both Drew's affidavit and the Hunt report as documenting "*... a comprehensive study to evaluate whether the sale of surplus water could have any material negative impact on the Village System, including on users of it and it set forth the results of that analysis in a report dated November 11, 2011 ...*" It is interesting to see Smith seems to cross-reference the Drew affidavit and Hunt report to somehow lend

legitimacy to the notion that adequate water was found via a "comprehensive study" that is not in the Hunt report or, apparently, anywhere else. Larry Smith, in paragraph 6 of his affidavit, provides numbers for the "*authorized production capacity*" of three Village wells. These are, for all intents and purposes, basis-less numbers with NO supporting data, graphs, analysis or information. The interplay presented between the Smith and Drew affidavits and the Hunt report has no hydrogeologic or scientific merit whatsoever relative to well or aquifer yield. Simply put, they should be discarded as being grossly misleading and without provision of any scientific information that might be viewed or analyzed.

Although Mr. Gough and Mr. Foster assert in their affidavits that the Village has data to support its claim of no harm, they do not provide the data that would back up their assertions. In the absence of such data there is but one rationale conclusion that a professional hydrogeologist can make relative to the extraction of large volumes of aquifer water – unless substantiated by analysis of rigorously collected, reproducible, drawdown and recovery data, there is no justifiable reason to permit its extraction. To do so would jeopardize the resource with possible adverse environmental and water availability impacts.

9. The 2002 Stearns & Wheler report repeatedly points out that more data is needed to assess individual well yield. The need for rigorous aquifer drawdown and recovery testing is addressed below. It would not be scientifically prudent to rely solely on past, long outdated, permit conditions to insure continued adequate water yield.

10. Sale of large quantities of groundwater should be based on the rigorous assessment of aquifer test data that may be impartially reviewed and analyzed by professional hydrogeologists. Respondents provided an affidavit of geologist William R. Gough dated August 1, 2012. Mr. Gough informs the court that he has knowledge and experience with groundwater projects in the Chemung River Basin and that his knowledge of Village of Painted Post well characteristics and yields "*...confirm that Wells No. 2, 3 and 4 are prolific producing wells with high yields.*" These are only words with no quantifiable data provided to substantiate the statement made. Mr. Gough also states that these three wells, on average, produce less than 20%

of their combined permitted capacity which is stated as being in excess of 4,000,000 gallons per day (gpd). Assorted, but unidentified, reports are referred to that " ... ***indicate*** (emphasis added) *that the total overall average daily withdrawal rates in Corning are approximately one-half of such aquifer's sustainable yield even during a severe drought.*"

11. There is nothing in the record to show that in approving the sale of up to 1.5 million gallons per day (mgd) from the Corning aquifer, the Village of Painted Post took any steps to assess potential adverse environmental impacts of multiple sales by other municipalities, industries, or private individuals who may also decide to sell Corning aquifer water. Approval by a municipality to sell water from a single, jointly used water source (i.e., the Corning aquifer), should not be conducted in isolation. The impact of water sale by multiple sellers must first hydrogeologically assess water quantity available to each municipality with existing or new wells. In this manner decisions can be made that will not unduly allow one or multiple parties to deplete the Corning aquifer beyond its safe yield at the expense of others. Potential adverse cumulative impacts should be addressed prior to selling any surplus water. The Corning aquifer services many public and private parties. For one municipality to issue a negative SEQRA declaration relative to significant water extraction on a segment of a water supply needed by many clearly does not address impacts to the aquifer as a whole or relative to the cumulative demand of its many water users. A full environmental review of the impacts on the aquifer is needed.

12. Neither the Village of Painted Post nor Mr. Gough provide any of the standard hydrogeologic pumping drawdown and recovery data required by hydrogeologists to characterize water availability and make informed water demand management decisions. No current groundwater studies were conducted. There is no data supportive of conclusions made by Mr. Gough. This supports the need to conduct well specific hydrogeologic testing. Unfortunately, Mr. Gough's affidavit does <u>not</u> provide any factual aquifer drawdown and recovery test data, semi-logarithmic graphs of drawdown vs. time with projected 180-day aquifer drawdown, assessment of overlapping cones of depression that might substantially lower the safe yield of the aquifer, assessment of aquifer coefficients of transmissivity (generally – the rate at which water

flows through an aquifer) and storage (generally – indicates how much water can be removed by pumping), hydraulic conductivity (i.e., coefficient of transmissivity divided by aquifer thickness), and technical analyses to the court such that any of his statements might be independently evaluated by expert hydrogeologists. Safe yield is defined in the Groundwater Foundation's Glossary of Groundwater as: "*The annual amount of water that can be taken from a source of supply over a period of years without depleting that source beyond its ability to be replenished naturally in 'wet years'*." The coefficients of transmissivity and storage, for example, are especially important because they define the hydraulic characteristics of a water-bearing formation. Without semi-log plots of drawdown vs. time, hydrogeologists cannot make well-informed decisions regarding long-term water availability and safe yield. Mr. Gough neither provides nor discusses any of this critical information used by professional hydrogeologists. This complete lack of data, any related hydrogeologic analyses, bolstered only with a supporting statement that uses the word "*indicate*" does not provide the court with scientifically defensible proof of the safe yield of the Corning aquifer or a hydrogeologically documented water quantity that might be safely extracted each day, day after day. Simply put, Mr. Gough failed to provide any hydrogeologic data to support his claims. Whether the water quantity claimed is available, or not, cannot be determined based on the lack of data in Mr. Gough's affidavit. As such, Mr. Gough's affidavit should be dismissed based on the lack of provision of any supportive or substantive data and information.

13. While it is true that unconsolidated glacial aquifers are typically high yielding, professional hydrogeologists, the New York State Department of Environmental Conservation (NYSDEC), and the New York State Department of Health recognize that documentation of water availability or its safe yield, as required for major development projects, must be based on current pumping test data (i.e., aquifer tests), not many decades old information. Relative to Painted Post, the Stearns & Wheler, LLC 2002 Chemung River Valley Water Study states:

> *"The Painted Post wells and storage tanks are numbered and labeled on Figure 3-1 as Well Nos. 1, 2, 3, and 4. Well No. 1, as shown, is an abandoned well. Well No. 2 has an approximate capacity of 0.58 mgd and is used only as a standby source of water. Well No. 3, with a capacity of 0.73 mgd, and Well No. 4, with a capacity of 1.5 mgd, are the main sources of supply for the village's water system."*

14. Technical support for these numbers appears to be lacking in the study. In fact, as documented below, the Stearns & Wheler study repeatedly states that adequate information is not available to have confidence in individual production well capacity. The sale of any Painted Post/Corning aquifer water should be premised on current aquifer test information and analysis, not on long antiquated information that is not available for review or standard hydrogeologic analysis.

15. NYSDEC provides detailed technical guidance in their *Recommended Pumping Test Procedures for Water Supply Applications* (most recently dated March 2011; Appendix 10, TOGS 3.2.1). This test procedure, currently required by the State of New York for assessment of sufficiency of water quantity for major development projects, should be required of major production wells that tap the Corning aquifer. To rely upon antiquated aquifer test data for the major water withdrawal quantities projected (to 1.5 million gallons per day [mgd]) would not be prudent.

16. The magnitude of planned water withdrawals from the Corning aquifer is analogous to that typically attendant to major development projects anywhere in New York State. As such, the lead agency should have mandated the Respondents to assess all aspects of the project via the standard SEQRA Environmental Impact Statement process. Because water supply is crucial to most major projects, SEQRA related approval of any water supply application, project applicant's *"must determine that the proposed well or wells will adequately meet the needs of the applicant without adversely affecting others who may rely on the same aquifer."* Thus, NYSDEC TOGS 3.2.1 recommends that *"[t]he pump test must be performed at or above the pumping rate for which approval will be sought in the water supply application. If multiple wells are to be pumped simultaneously to achieve the necessary yield, the pump test should incorporate such a*

pumping plan." Painted Post should require that project production wells be pumped simultaneously to assess overlapping cones of depression and potentially reduced water availability. The magnitude of planned Village of Painted Post water withdrawals should have spurred the Village to require this testing.

17. Knowledge of the safe yield of the Corning aquifer does not alone provide sufficient information upon which to approve or disapprove the Respondents' desired daily water withdrawals of up 1.5 mgd as allowed in the Surplus Water Sale Agreement between the Village of Painted Post and SWEPI LP. Other key factors that should be evaluated include current cumulative use and projected future use, as well as potential adverse impacts associated with repeated drought years. While some of this information is addressed in the 2002 Stearns & Wheler study, their own numerous caveats make it clear that much additional data and modeling work is needed before specific water withdrawal recommendations can be made beyond that of a broad regional nature. There is no hydrogeologic data available to support any stated Painted Post aquifer capacity or excess capacity numbers. Thus, the sale of any quantity of "surplus" water is not based on available hydrogeologic data or its interpretation. Furthermore, the Respondents failed to address the implications of the Recommended Standards for Water Works (aka, the 10 States Standards) relative to surplus aquifer water withdrawal. These Standards require that "*The total developed groundwater source capacity, unless otherwise specified by the reviewing authority, shall equal or exceed the design maximum day demand with the largest producing well out of service.*" .

18. The Stearns & Wheler, LLC 2002 Chemung River Valley Water Study discusses drought related issues relative to the Corning aquifer. As stated in the report:

> "*In the late 1990s, industrial production in the valley was at a peak and additional growth was anticipated. Due to this growth, and the fact that the 1990s had experienced two extended dry periods (1991 and 1999), the communities recognized that a better understanding of the valley's ability to support growth from a water supply perspective was needed.*"

19. Key target information sought by this study was the development of a drought management plan and the determination of the safe yield of the Corning aquifer for the four communities involved in the study (Towns of Erwin and Corning, City of Corning, and the Villages of Painted Post and Riverside). Table 2-1 of the study shows a 2001 maximum daily water demand of these communities of 4.39 mgd for a service area population of 19,570 people. Table 2-2 compares the 2002 population of the involved communities (20,720) with the projected 2012 population (21,220). Table 2-3 shows 2002 and projected 2012 maximum day water production (i.e., municipal water use) for the study area communities (4.55 mgd and 4.57 mgd, respectively). Based on available information, the study estimated that maximum daily 2012 industrial water use that would also draw from the Corning aquifer as 6.0 mgd. Thus, adding these values together, the total estimated 2012 maximum daily water withdrawal from the Corning aquifer was projected to be on the order of 10.6 mgd. Because the Respondents have not provided any rigorously collected, well-specific, drawdown and recovery data, it is not possible to know what the actual safe yield is of the Corning aquifer.

20. As part of the Chemung River Valley Water Study a partial modeling study was conducted that did not have all the desired model inputs desirable and did **not** provide the scientific basis to assess aquifer water level decrease and depletion as a result of pumping individual or multiple village or town production wells. The study report addressed this issue:

> "Where specific data was not available, literature values for aquifer characteristics and professional judgment were used to establish parameters essential to the model. Then, the CAAM was used to evaluate the groundwater levels and **potential** [emphasis added] induced infiltration on a regional scale. It is important to note that the CAAM [Corning Area Aquifer Groundwater Flow Model] was developed and designed to make assessments on regional groundwater flow issues (such as basin recharge and estimated ground water level under drought conditions). **The CAAM was not structured to make accurate assessments on the impact that pumping from an individual production well would have on a local scale (village or town)** [emphasis added]. To make these types of assessments, the CAAM would have to be updated and recalibrated as discussed in section 6.4 in this report. ... Model input information not directly listed in the 1988 model report, such as stream stage at river nodes or the

> top and bottom of geologic units, **was estimated** [emphasis added] based on data presented in the report. ... The CAAM was reconstructed utilizing the same underlying **assumptions** [emphasis added] and boundary conditions outlined in the above-referenced modeling report. ... As presently constructed, the CAAM developed in 2002 and calibrated to concur with the SRBC model of 1988 is of sufficient complexity to provide **general information** [emphasis added] on how the aquifer system functions at a regional scale. **This model will provide an excellent framework for future area-specific (town, village, city) models and hydrogeologic investigations. ... The CAAM is not able, as currently constructed, to make assessments of potential well yield on a local scale without further refinement.** [emphasis added]"

21. Models are only as good as the data used to construct and run them. As more and more estimates and assumptions are input into models, the less reliable they are. Often, even one incorrectly defined parameter, such as aquifer recharge/infiltration, can significantly alter model results, interpretation, conclusions, and recommendations. Real, field-collected, data is needed to calibrate and effectively run models. The Chemung River Valley Water Study had budgetary constraints that limited calibration of the revised CAAM model version (CAAM02) to new simulations that were compared with and "*adjusted*" (i.e., altered) to best mimic earlier modeling results (CAAM88), thereby relying on model calibration work detailed in Ballaron's (1988) model report. Clearly, the data and assumptions used in the Ballaron work should be carefully reviewed as they ultimately form the basis of evaluating induced infiltration under drought conditions. Section 6.4 of the Chemung River Valley Water Study addresses many recommended model updates that would improve the reliability and usefulness of the CAAM02 model, including drought simulation, thereby questioning model input information/assumptions used in the 1988 model they ran simulations to mimic before drawing conclusions of their own. As noted by Stearns & Wheler, additional hydrogeologic data is needed to evaluate the effect of pumping on river stage and discharge (i.e., critical information that should be collected and analyzed prior to considering daily sale of large quantities of Corning aquifer water to gas companies):

> "If the CAAM is to be used in the future to evaluate management alternatives (such as well spacing) to assess the effect of pumping on river stage and discharge or to delineate recharge areas of production wells, the model will need to be updated and **additional hydrogeologic data will need to be collected** [emphasis added]. ... The use of the STR1 (a recommended model replacement package instead of the one used) allows the model to simulate the interaction between groundwater and surface water in a much more realistic manner, **especially when simulating drought conditions** [emphasis added]. "

22. Assorted Chemung River Valley Water Study model simulations and analyses suggest that 19.5 to 24.7 mgd of groundwater could be withdrawn from the existing production well network without excessive dewatering during periods of drought and while allowing sufficient river flow to provide for downstream wastewater assimilative capacity. However, the study concludes, based on their CAAM02 groundwater model, that the sustainable long-term yield of the aquifer in the modeled area is estimated to be 19.5 mgd. The study also concluded that during sustained drought conditions, wells within the valley are recharged primarily from the river system and "*At a total withdrawal from the aquifer of 10.2 mgd, 6.3 mgd of infiltration is induced from the river.*" The study itself questions some of the assumptions used in model development and suggests numerous upgrades. These values are a rough estimate that requires refinement. Determination as to whether there is sufficient groundwater available in the Painted Post portion of the aquifer for outside sale would require aquifer testing. If this has already been done in Painted Post, then hydrogeologic evaluation of the data is needed. An interesting question might be posed since the water commonly shared from the Corning aquifer is used by many (i.e., by the Towns of Erwin and Corning, the City of Corning, the Villages of Painted Post and Riverside, many industrial users, and perhaps others), is whether any one or more of these public entities should be able to sell their common water supply without equally compensating the other users. Does any individual town or industry have ownership rights that allow them to solely profit from the sale of a commonly used natural resource? Also, what are the hydrologic implications of selling water when the actual safe yield of the aquifer has not been determined based on any publicly available or current aquifer testing data?

23. Groundwater professionals recognize that specific assessment of aquifer drawdown, depletion, and recovery requires aquifer specific pumping test information (i.e., drawdown and recovery data obtained from pumping and monitoring/observation wells). Instead of investing in an office-based modeling exercise laced with numerous assumptions and no rigorous means of calibrating the model (unless all or most of Stearns & Wheler's Recommended Updates are conducted; Section 6.4), it would have been beneficial to have conducted a number of pumping/aquifer tests so that actual aquifer characteristics and safe yield could have been determined based on real, rigorously collected, and reproducible drawdown and recovery data. It is this defensible data that should form the foundation of any determination to approve the sale of water based on potential excess aquifer water availability. The Stearns & Wheler report mentions pumping tests. If well-run pumping tests were conducted, this information should be evaluated prior to considering an approval to sell Corning aquifer water.

24. There may be recent, unconfirmed, evidence indicating that the Corning aquifer may have significant safe yield restrictions. John Marvin, in his affidavit, reports that his daughter heard that train cars have stopped running with the previous frequency because the water table dropped and the desired yield was not available, presumably from over-pumping the aquifer. While this is hearsay at this time, it does raise the concern of safe yield and adverse impact to the aquifer. Clearly, this specific issue needs to be investigated. If confirmed, all efforts and permits oriented toward unnecessary extraction of Corning aquifer water (i.e., for private gas industry use and profit) should be rescinded.

25. Stearns & Wheler (2002) conducted a detailed drought analysis complete with recommendations and management plan. As they make clear, additional information is required to better evaluate drought conditions and acceptable water withdrawal quantities. Model results may not adequately address actual worst case drought scenarios. An assessment should be conducted of past water restrictions, the flow and wetted perimeter of the Chemung River throughout future drought conditions, and actual aquifer characteristics based on aquifer test data.

These and other factors are critical in the assessment of safe yield and in determining how much, if any, water should be sold to gas companies.

26. In addition, it would not be prudent to sell large quantities of Corning aquifer water in the absence of an inter-municipality drought management plan, such as that proposed by Stearns & Wheler in 2002. Excessive pumping has the potential of over extending the aquifer such that water demand might, at times, not be met.

27. In the ten years since completion of the 2002 Stearns & Wheler study, the municipalities that rely on the Corning aquifer have not adopted a drought management plan. With no safeguard- threshold criteria in place, excessive aquifer water withdrawal could adversely impact system users, the surficial ecosystem, and not leave sufficient water to assimilate downstream wastewater effluent, especially during periods of drought.

28. The daily extraction of large quantities of groundwater from the Corning aquifer is likely to increase the flow and recharge of groundwater to it from the up-gradient watershed area. This may, in turn, increase the rate of contaminant influx from up-gradient chemical-laden gas wells (existing and new), thereby degrading water quality in the Corning aquifer.

29. The measurement of total dissolved solids (TDS) by Eugene Stolfi and Jean Wosinski (see Stolfi and Wosinski affidavits) provides a strong indicator that extraction of large quantities of groundwater from the Corning aquifer will result in regular degradation of aquifer water quality by reducing natural dilution. TDS reflects the total concentration of dissolved material in water. TDS is widely used in evaluating water quality as it provides a convenient means of comparing waters with one another. It may be comprised of weathered mineral products from the breakdown of bedrock and soil or from a mix of naturally occurring minerals (e.g., cations, anions) and unnatural chemicals (e.g., toxic metals such as barium, cadmium, lead and copper; salts; industrial waste; sewage; fertilizers; pesticides; nitrate), sometimes stemming from contaminant sources. TDS reflects a waters' purity and influences the degree of treatment that may be required prior to distribution. High TDS concentrations in a public water distribution

system may indicate that the quality of the water purification system requires modification. The large magnitude of change in the Stolfi and Wosinski data documents significant change and decreases in TDS concentrations associated with precipitation events. Their testing of municipal and some private water supplies reveals numerous important points, many of which are discussed below.

30. It is common for municipal Corning aquifer water to have TDS concentrations near or above the EPA secondary maximum contaminant level (MCL) of 500 mg/l for drinking water (to at least 870 mg/l in the City of Corning municipal supply; Stolfi affidavit). High TDS levels provide great cause for health concern that warrants immediate investigation, possibly with warnings to users. When assessing the cause of high TDS levels, it is important to fully determine all the chemical parameters that together contribute to these levels. For example, parameters such as iron and manganese may comprise a portion of the total dissolved solids, while other portions may be due to the presence of unnatural contaminants. High TDS is an indicator of a problem. Here, it is a warning that many comprehensive water quality analyses are needed to responsibly and fully assess the cause of MCL exceedences.

31. The presence of high TDS levels document that there is already a water quality problem within the Corning aquifer. Large water withdrawals will exacerbate this problem by reducing the beneficial effect of dilution. Increased aquifer recharge is associated with precipitation events, increased infiltration and decreased TDS concentrations.

32. Dilution of aquifer water by direct infiltration of river water, and possibly up-gradient groundwater associated with rain events, significantly reduces TDS concentrations in the Corning aquifer. Withdrawal of large quantities of Corning aquifer groundwater will lessen this dilution effect. While TDS themselves have an EPA secondary MCL standard that is regularly exceeded, perhaps the larger questions are: what chemicals in the groundwater are the cause of elevated TDS concentrations (TDS is typically considered an indicator parameter used to determine if additional water quality testing is warranted), are they toxic, do they bioaccumulate, do they pose long-term chronic health concerns, and do they have adverse synergistic medical

effects with other chemicals that contribute to TDS concentrations. It would not be prudent to permit large unnecessary water withdrawals in the absence of this information.

33. Reduced TDS concentrations in Corning aquifer water closely associated with precipitation events document that Corning aquifer water is Groundwater Under the Direct Influence of Surface Water (GWUDI). Groundwater that is isolated from direct recharge of surface water exhibits relatively consistent water chemistry with low variability. In contrast to this, variable TDS concentrations measured in Corning aquifer municipal water reveal a lack of consistent water chemistry. The magnitude of the change in TDS concentrations within municipal water systems tapping the Corning aquifer coincident with or following precipitation events demonstrates rapid and direct recharge/infiltration from surface river water directly into the underlying Corning aquifer. This establishes that there is a direct hydrologic connection between surface water and any contaminants present in it and the underlying unconsolidated and highly permeable Corning aquifer. Thus, groundwater within the Corning aquifer is Groundwater Under the Direct Influence of Surface Water (GWUDI). Extraction of groundwater via pumping will, as occurs with infiltration of river water, induce downward infiltration of overlying river water. While the dilution effect may have value relative to TDS concentrations, this direct hydrologic link is the great fear of health departments and water supply distributors because contaminants may be quickly pulled into the water supply. This makes GWUDI aquifer water particularly vulnerable to dangerous biologic contaminants including e-coli, fecal coliform, cryptosporidium, and giardia, as well as spills and upstream waste discharges. Water extraction for gas industry profit unnecessarily increases water quality risk to a large population. The fact that Corning aquifer water is clearly under the direct influence of surface water is cause alone to never permit the unnecessary extraction of Corning aquifer water.

34. Another important issue that needs to be addressed in the environmental impact analysis is water quality protection. The Surplus Water Sale Agreement between the Village of Painted Post and SWEPI LP make it clear that the intended water use is for gas extraction activities: " ... *use and disposal of the water purchased hereunder and used in SWEPI LP's oil and*

gas extraction activities ..." The addition of toxic chemicals to Corning aquifer water will create polluted water that may move with regional groundwater flow systems and endanger the health, safety and welfare of the people of New York State and Pennsylvania.

35. The use of water from the Corning aquifer to hydrofrack gas wells around Wellsboro, Pennsylvania may degrade and irreparably harm the quality of local aquifers and adversely impact the health of residents in those watersheds. If some of this water is used for the hydraulic fracturing of gas wells in the watershed up-gradient of Painted Post along the Tioga River, toxic additive chemicals will flow with the groundwater flow system and rise upward into the Corning aquifer where all water users will then ingest them, leading to the need for a health clinic such as that now operating in Washington County, PA for individuals with toxic gas field chemicals in their blood streams and with related ailments.

36. Ongoing and massive water use by the gas industry is adversely impacting the quantity of non-renewable freshwater resources available for consumption. As more and more wells and gas fields are exploited, more and more of earth's finite freshwater is removed from potential use as tens of thousands of wells are hydrofracked. Because it is difficult to relate to the quantities of water involved, a look at the singular planned Painted Post water withdrawal is warranted. By way of comparison, the quantity of daily water extraction/withdrawal planned for gas well hydraulic fracturing (to 1.5 million gallons per day, a billion gallons in less than two years) by the Village of Painted Post may be compared to the volume of New York State lakes. For example, three popular tourist lakes located atop the Shawangunk Mountains in east-central NYS provide excellent comparisons. These lakes, Mohonk (17 acres), Minnewaska (33 acres) and Awosting (93 acres) have approximate volumes of 182 million, 280 million, and 686 million gallons, respectively. Assuming an equivalent daily water withdrawal of 1.5 million gallons, the time required to drain these lakes would be 121 days, 187 days, and 457 days, respectively (0.33 to 1.25 years). These values provide valuable insight into the magnitude of planned water use by just one gas company from a single water source. The Village of Painted Post should recognize that this quantity of drinking water, a non-renewable resource, will regularly and forever be

degraded when toxic and carcinogenic contaminants are added to it for hydraulic fracturing. As such, a full evaluation of the groundwater, from cradle to grave, should be conducted as part of the EIS process. This should include an assessment of water quality statutes and case law specific to degradation of State and Federal natural resources, including an evaluation of the health risks that could result from the sale of Corning aquifer water.

37. There is substantial evidence that toxic hydraulic fracturing fluids injected thousands of feet underground WILL move within regional groundwater flow systems, only to surface in valley bottom settings where our major population centers and aquifers are. It is critically important that this cycle be understood and factored into water sale, distribution, use, and health-based decisions. The extensive joint/fracture network present in the Appalachian Basin is significant from both a gas production standpoint and in terms of an interconnected fracture network capable of serving as contaminant transport pathways. A detailed discussion of groundwater flow paths involved is very much needed. Natural gas and contaminant transport pathways between deep gas horizons and freshwater aquifers are well documented. They include faults, joints, fracture zones, failed cement sheaths and casing material and poorly or not plugged wells. A key problem is not so much the leakage of contaminants through the shale, but leakage along vertical fractures produced or enlarged by fracking, into adjacent high-permeability beds. From there, the groundwater flow is concentrated and relatively rapid. Most fractures remain unidentified.

38. It is important to recognize that toxic contaminants added to water supplied by Painted Post will move with the groundwater flow system to down gradient receptors. Unfortunately, many homeowners in gas fields have had their well water contaminated such that it is NOT fit to drink and or for bathing. Homeowners in Washington County, PA gas fields, for example, and elsewhere report that assorted medical problems occurred after installation of gas wells (e.g., headaches, stomach cramps, blotches on their skin; pers. comm. to HydroQuest). Some or all of these symptoms are consistent with those impacting residents in Washington County, PA gas field area (toxicologist Dr. David Brown, pers. comm. to HydroQuest). It is

unlikely that water treatment systems are capable of reliably removing elevated and proprietary chemicals from some contaminated groundwater. As a professional hydrogeologist, I would never drink or bathe in gas field contaminated water. Given the vast quantity of known and unknown proprietary chemicals that may contaminate homeowner water supplies on any given day, I would not consider it safe to ingest any gas field well water having been shown to have elevated chemical concentrations.

39. Hydrogeologically, slow groundwater flow rates need to be considered. Some contaminants may arrive rapidly via fractures, while others may arrive over decades or centuries. Contaminants we see in the early years following drilling may only reflect the first arrivals. Thereafter, contaminant levels will rise slowly to a peak and then subside slowly. In time, these contaminants will reach down gradient and then down valley locations where larger population centers commonly use groundwater for supply purposes. While chemical concentrations may not always exceed MCLs, long-term chronic exposure to numerous unknown and untested chemicals presents a great health risk (e.g., Dr. David Brown and Dr. Katherine Nolan, pers. comm. to HydroQuest). No standards exist and no testing has been conducted for many of the toxic and carcinogenic chemicals injected underground during the hydrofracking process

40. Clearly, the full breadth of potential adverse environmental impacts associated with the sale and distribution of Corning aquifer water need to be considered when evaluating the potential sale of surplus groundwater.

41. Again, approval of sale of Painted Post groundwater to gas companies will, knowingly, place the health of receptor residents in PA at risk.

42. Because groundwater flow rates are slow, chemical exposure is likely to continue for decades, centuries, or far longer.

43. For the reasons described above, I am of the opinion that, before individual municipalities drawing on the Corning aquifer for their municipal water systems are permitted to engage in water exports from the aquifer, hydrogeologic testing needs to be conducted on production wells in the aquifer to determine the safe yield of the aquifer and an inter-municipal

drought management plan needs to be adopted by the municipalities drawing on the aquifer so that there is agreement about how withdrawals will be restricted in a time of drought. In addition, the issues of water quality as related to large scale pumping and Groundwater Under the Direct Influence of Surface Water (GWUDI) need to be comprehensively addressed.

44. This report is based on information available to me at this time. Should additional information become available, I reserve the right to determine the impact, if any, of the new information on my opinions and conclusions and to modify or supplement this report if necessary.

I state all of the foregoing with a reasonable degree of scientific certainty.

Paul A. Rubin

Sworn to before me this 19th day of December 2012.

Sandra J. Girard
Notary Public, State of New York

SANDRA J. GIRARD
Notary Public in State of N
Ulster County 01GI6208549
Commission Expires Nov. 17 2013

Exhibit List

Exhibit A - Paul Rubin Resume

Exhibit B - HydroQuest Gas Drilling Related Work

Paul A. Rubin
909 County Rt. 2; Accord, New York 12404 (845-657-8111)
E-mail contact: hydroquest@yahoo.com

EDUCATION:

M.A. - Geology, May 1983, State University of New York at New Paltz. Major fields of study: Hydrogeology, Water Quality and Pollution, Structural Geology, Photogeologic Interpretation. Thesis topic: *Hydrogeology and Structure of the Shawangunk Mountains, Ulster County, NY.*
B.A. - Anthropology, minor Geology, May 1977. State University of New York at Albany.

SPECIAL SKILLS:

Environmental Protection; Hydrologic and Geologic Characterizations; Land Use Planning & Characterizations; SEQRA reviews; Expert Testimony and Litigation Background; Surface Water and Groundwater Quality Evaluations; Sediment Transport; Evaluation of Remedial Technologies; Geotechnical Assessments; Hydrologic Investigations; Aquifer Testing and Analysis; Karst Hydrology; Rosgen Stream Analyses; Flood Return Analyses; GIS Map Making and Analyses; Photogrammetric Analyses; Affidavit and Report Preparation; Land Protection; Educator; Public Speaking; Public Relations; Research Skills; Strategy Development; Leadership.

EXPERIENCE:

HYDROLOGIST/ HYDROGEOLOGIST:

1993 - Present

Independent Consultant. Stone Ridge, New York. Consulting firm: *HydroQuest.*
Provide hydrologic, geologic and land use technical consulting services to environmental groups, Towns, business associations, law firms, and individuals. Assist groups in identifying issues and developing strategies designed to protect groundwater and surface water resources, community character, and wildlife habitat.

***HydroQuest* work includes SEQRA reviews, review and fatal flaw analyses of consultant reports and environmental impact statements (EISs); environmental scoping report preparation; direction and oversight of heavy equipment operators for field excavation work for well placements, contaminant characterization, and geologic investigations; technical coordination of scientific case development for environmental groups and attorneys; field characterizations; stream and wetland evaluations; geotechnical analyses; hydrologic and geologic mapping; water quality assessments; watershed delineations; viewshed analyses; slope analyses; aquifer analyses; hydrogeologic analyses; regulatory assessments; GIS map preparation; public presentations; technical presentations to judges; coordination work with attorneys and Technical Committees; direction and coordination of sub-contract work as needed; strategy development; panel member at Town meetings with legislators; press interactions; report and affidavit preparation. Recently authored many major reports and affidavits on gas drilling & hydraulic fracturing (see supplemental resume).**

Recent project work examples include oversight and analysis of well field pumping tests (for multiple groups including NRDC, NYPIRG, Riverkeeper, and Trout Unlimited) designed to assess impacts on groundwater and surface water stemming from a planned large-scale Catskill Mountain resort; assessment of a town's water quality problem with corrective recommendations; initial hydrogeologic assessment of a spring water source being considered for bottled water use; hydrogeologic-aquifer analysis of a groundwater supply proposed for a Shawangunk Ridge retreat center; SEQRA assessments; and technical presentations and testimony before administrative law judges.

KARST HYDROLOGIST

Howe Caverns, Inc. Cobleskill, New York. 2nd largest natural tourist attraction in NYS

2004 - April 2007 **Conducted hydrologic and geologic research, produced professional GIS maps and figures, developed educational programs and materials, developed new tourist route, trained guides, provided land use assessments and recommendations, advised the Board of Directors on land use concerns including potential water quality degradation and potential blast-related impacts to cave. Developed and proposed revenue generating strategies. Coordinated with outside educational institutions, professional geologists, learning institutions, and scout groups. Formerly worked in this position half-time prior to change in ownership.**

INSTRUCTOR:

Jan. 2001- Dec. 2004 **SUNY Ulster, Stone Ridge, New York.**
Taught ArcGIS, Environmental Geology, Geology, Hydrology, Geography, and Crime Analysis. Coordinator of a Geographic Information Systems certificate program. Developed, obtained, and completed a NYSDEC grant to assess assorted hydrologic and environmental aspects of the Black Creek watershed in Ulster County. Supervision and oversight of numerous professional adult "students", directed GIS-based technical presentations, and coordinated and produced grant products.

College of the Atlantic, Bar Harbor, Maine.
Taught a two week graduate level summer field hydrology and environmental science course for several years, including Rosgen stream assessment.

HYDROLOGIST:

New York City Department of Environmental Protection (NYC DEP), Division of Drinking Water Quality Control, Shokan, New York.

April 1993- Jan. 2001 **Conducted research and field studies designed to assess the water quality of watersheds. Responsible for directing geologic research designed to assess the sources, geomorphic context and best management practices (BMPs) related to sediments causing turbidity water pollution problems. Hydrologic and geologic work included geologic mapping of glacial sediments, field evaluation of stream channel armoring, morphologic characterization of stream channels (including Rosgen analyses), bedload transport studies, assessment of critical shear stresses, particle size analysis, stream gauging, water quality sampling and trend analysis, chemical and sediment loading calculations, graphic production, report preparation and technical presentations. Assisted other governmental divisions in evaluating lands for possible purchase, conducted geotechnical assessments of structurally unstable stream reaches, evaluated BMP designs. Supervised several Research Assistants.**

RESEARCH SCIENTIST:

Martin Marietta Energy Systems, Inc. April 1993 under contract with the U.S. Dept. of Energy; Oak Ridge National Lab; Environmental Sciences Division, Oak Ridge, TN.

Aug. 1991- April 1993 **Responsible for hydrogeologic evaluation of groundwater issues (e.g., characterization, monitoring network setup, data analysis, remedial design evaluation) at multiple Oak Ridge Reservation hazardous waste sites. Developed and documented conceptual model of carbonate and shallow storm flow systems comprising pathways of rapid contaminant transport. Work also involved characterization of hydrologic and geochemical trends**

RESEARCH SCIENTIST continued:

and thermal infrared photo analysis. Presented results of research at conferences, as well as to DOE management and State and Federal officials. *Served in a Resource Management Organization as the hydrologic lead for the Environmental Sciences Division.*

HYDROGEOLOGIST:

New York State Attorney General's Office; Environmental Protection Bureau, Albany, New York.

Feb. 1983-Aug. 1991 **Responsible for the design, protocols, coordination, implementation, evaluation, characterization and remediation of many major water and soil contamination sites throughout New York State (e.g., Love Canal, Superfund sites). Designed, performed and supervised chemical field sampling at hazardous waste sites. Evaluated geotechnical and chemical data sets.**

Primary responsibilities included coordination of multiple companies along with their respective legal and scientific consultants. Worked with all parties involved to produce test plans and consent decrees to facilitate site remediation. Responsible for the management of the testing, site characterization and technical assessment. Worked with attorneys on summary judgment motions, complaints, trial preparation and depositions. Attorney General's spokesperson at public meetings. Expert witness at SEQRA hearings. Testimony given before the Assembly Standing Committee on Environmental Conservation and Grand Jury. Worked with DOL staff and attorneys to develop office initiatives (e.g., Racketeering; bottled water contaminants). Initiation, development and drafting of legislation.

Supervision of personnel: expert witnesses, consultants, research assistants, interns. Responsible for selection, job descriptions, work schedules, and products.

HYDROGEOLOGIST:

Stone & Webster Engineering Corp., Geotechnical Division, Boston, Massachusetts.

Oct. 1981-Feb. 1983 **Directly responsible for the planning, preparation, execution, and analysis of pumping tests and a fluid sampling program designed to investigate deep basin groundwater characteristics for the siting of a nuclear waste repository within the Permian Basin of the Texas panhandle. Planned, managed, coordinated, directed, and provided oversight of field operations of a multi-million dollar project. Sub-contractors included Halliburton, Schlumberger, and others.**

ACTIVITIES:

Hiking, geologic and hydrologic research, and exploration. Former Captain: Albany-Schoharie County Cave Rescue Team. Made a Fellow of the National Speleological Society in recognition of karst research and water resource protection.

PUBLICATIONS & REPORTS **Over 50 technical publications and over 100 reports and affidavits, many for private clients, environmental groups, towns, and law firms. Projects include land, wetland, water quality, and species protection; aquifer and watershed characterization; mine proposals; development proposals; contaminant assessments; stream hydrology grant work; and flood risk. Some reports are confidential. Leader of geology conference field trips for groups including the New York State Geological Association, the American Institute of Professional Geologists, the Hudson-Mohawk Professional Geologists' Association, the National Ground Water Association, the National Speleological Society, and the International Association of Geochemists and Cosmochemists.**

ADDENDUM - SELECTED PUBLICATIONS

SELECTED PUBLICATIONS FROM PROFESSIONAL AND PERSONAL RESEARCH

Rubin, P.A., 2009, ***Geological Evolution of the Cobleskill Plateau; New York State, USA,*** in Veni et al. (eds), Proceedings of the Speleogenesis Symposium of the 15th International Congress of Speleology (joint National Speleological Society & Union Internationale de Speleologie); Symposium: Speleogenesis in Regional Geological Evolution and its Role in Karst Hydrogeology and Geomorphology, Kerrville, Texas. Proceedings, Volume 2, Symposia Part 2, pages 972-978 (published July 2009).

Palmer, A.N. and Rubin, P.A., 2007, ***Karst of the Silurian-Devonian Carbonates in Eastern New York State, with emphasis on the Cobleskill Plateau.*** Guidebook for the Hudson-Mohawk Professional Geologists' Association Spring 2007 Field Trip, *"Carbonate Geology of the Howes Cave Area, Schoharie County, New York"*, p. 17-35, Trip coleader with Arthur Palmer (April 28, 2007).

Rubin, P.A., Burmeister, K.C. and Folsom, M., 2006, ***Karst Resource Management: groundwater protection and developmental considerations in the Kingston-Rosendale aquifer system***; Ulster County, N.Y., Poster Presentation at the 2005 National Cave and Karst Management Symposium. Report prepared for Scenic Hudson.

Stokowski, S., Rubin, P.A. and Guenther, B., 2006, ***History of resource management: conflict and resolution, Howes Cave, N.Y.***, in Rea, G.T., (ed), Proceedings of the 2005 National Cave and Karst Management Symposium.

Rubin, P.A and Stokowski, S., 2004, ***Karst, Caves, and Quarries***. Guidebook paper for ***the*** American Institute of Professional Geologists (AIPG), Annual Meeting. Field trip co-leader.

Rubin, P.A. and Washington, G., 2004, ***Water quantity and quality considerations specific to development on the flank of the Shawangunk Mountain Ridge, Southeastern NYS.*** Abstracts Northeast Natural History Conference VIII. N.Y. State Museum Circular 66: p. 53.

Rubin, P.A., Adickes, D.M., Cunningham, T., Davidson, D., Hurld, J. Kiyan, J.R., Preuss, P., Ramsay, W., Schultz, B. and Washington, George, 2004, ***Application of GIS technology to assess visual impacts of development: Shawangunk Ridge case study, southeastern NYS.*** Abstracts Northeast Natural History Conference VIII. N.Y. State Museum Circular 66: p. 52-53.

Adickes, D.M., Preuss, P., Rubin, P.A., and Thompson, J., 2004. ***GIS assessment and study of rare and threatened avian species living in the Shawangunk Mountains in Southeastern NYS.*** Abstracts Northeast Natural History Conference VIII. N.Y. State Museum Circular 66: p. 38.

Kiyan, J.R., Washington, G., and Rubin, P.A., 2004, ***GIS visual impact analysis of a proposed housing development below Minnewaska State Park Preserve in the Shawangunk Mountains of the Mid-Hudson Valley in New York State.*** Abstracts Northeast Natural History Conference VIII. N.Y. State Museum Circular 66: p. 47.

Cunningham, T., Davidson, D., Hurld, Rubin, P.A., and Ehrensaft, P., 2004, ***Using GIS technology to project various land-use and economic scenarios for the northern Shawangunk Ridge area; Southeastern NYS.*** Abstracts Northeast Natural History Conference VIII. N.Y. State Museum Circular 66: p. 41-42.

Palmer, A.N., Rubin, P.A., Palmer, M.V., Engel, T.D., and Morgan, B., 2003, ***Karst of the Schoharie Valley, New York.*** Guidebook for the New York State Geological Association Diamond Jubilee Field Conference (75th Annual Meeting), p. 141-176, Trip coleader.

Rubin, P.A., Morgan, B., and Palmer, A.N., 2003, ***Howe Caverns resource protection: hydrology and land-use analysis; Schoharie County***, New York State. Abs. Northeastern Science Foundation Silver Jubilee Anniversary Symposium, Proceedings volume, p. 25-26.

Rubin, P.A., Hubsch, R., Albrechtsen, C.A., Black, G., Folsom, M., Keller, J., Morgan, B., Ortega, A., Rodden, M., Schultz, B., Terzella, D., and Washington, G., 2003, ***Watershed management and protection planning based delineation of critical environmental areas via GIS analysis***. Abs. Northeastern Science Foundation Silver Jubilee Anniversary Symposium, Proceedings volume, p. 13.

Hubsch, R., Morgan, B., Black, G., Folsom, France, N., Keller, J., Ortega, A., Post, J., and Rubin, P.A., 2003, ***Development of a GIS-based land-use coverage: Black Creek and Swarte Kill watersheds, southeastern New York State***. Abs. Northeastern Science Foundation Silver Jubilee Anniversary Symposium, Proceedings volume, p. 9-10.

Rubin, P.A., Waines, R., Washington, G., Ortega, A., Albrechtsen, C.A., Hubsch, R., Folsom, M., Keller, J., Morgan, B., and Schultz, B., 2003, ***Hydrology and geology of the Swarte Kill and Black Creek basins, eastern New York State***. Abs. Northeastern Science Foundation Silver Jubilee Anniversary Symposium, Proceedings volume, p. 12.

Rubin, P.A., Engel, T., Nardacci, M. and Morgan, B.E., 2002, ***Geology and paleogeography of Mount Desert Island and surrounding area, Maine.*** Guidebook paper National Speleological Society annual meeting, Camden, Maine, p. 47-91, Trip leader.

Rubin, P.A., Schultz, B. and Haberland, P., 2002, ***Hydrologic, land use, and historic concerns relative to the Rosendale mining industry.*** Abs. National Speleological Society annual meeting, Camden, Maine, p. A-27.

Rubin, P.A. and Morgan, B., 2002, ***Relict sea caves record temporary coastal stillstands.*** Abs. National Speleological Society annual meeting, Camden, Maine, p. A-26-A-27.

Morgan, B., Albrechtsen, C., Dido, R., Hubsch, R., Rubin, P.A., Sheeley, D., Skerritt, F. and Vaeth, L., 2002, ***Development of a GIS-based land-use coverage: Black Creek Watershed, Southeastern NYS.*** Abs. Northeast Natural History Conference VII. N.Y. State Museum Circular 64: p. 50-51.

Hubsch, R., Albrechtsen, C., Dido, R., Morgan, B., Rubin, P.A., Sheeley, D., Skerritt, F., Terzella, D. and Vaeth, L., 2002, ***Critical environmental area delineation in the Black Creek Watershed, NYS via GIS analysis.*** Abs. Northeast Natural History Conference VII. N.Y. State Museum Circular 64: p. 51.

Sheeley, D.A. and Rubin, P.A., 2002, ***Land-use preservation scenarios in the Black Creek Watershed using GIS; NYS.*** Abs. Northeast Natural History Conference VII. N.Y. State Museum Circular 64: p. 51.

Schultz, B., Rubin, P.A. and Haberland, P., 2002, ***GIS-based historic inventory of early cement district industrial artifacts: Southeastern NYS***. Abs. Northeast Natural History Conference VII. N.Y. State Museum Circular 64: p. 40.

Rubin, P.A. and Morgan, B., 2002, ***Geomorphic reconstruction of emerged and submerged coastlines using GIS technology, Mount Desert Island, ME.*** Abs. Northeast Natural History Conference VII. N.Y. State Museum Circular 64: p. 39.

Rubin, P.A. and Privitera, J.J., 1997, ***Engineered and*** **unregulated degradation** ***of karst aquifers: Two case studies in New York State, USA.*** *In* The Engineering Geology and Hydrogeology of Karst Terranes, Beck & Stephenson (eds), Proceedings of The Sixth Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst; Balkema, Rotterdam; p. 467-476.

Rubin, P.A., Engel, T., and Nardacci, M., 1995, ***Geomorphology, paleoclimatology and land use considerations of a glaciated karst terrain, Albany County, New York.*** Guidebook for joint meeting of the New York State Geological Association (67th Annual) and the American Association of Petroleum Geologists. Trip leader, p. 81-107.

Rubin, P.A., 1995, ***The geology of Clarksville Cave, Albany County, New York.*** Guidebook for joint meeting of the New York State Geological Association (67th Annual) and the American Association of Petroleum Geologists. Trip leader, p. 251-273.

Rubin, P.A., 1995, ***The geology of Cherokee Caverns; Tennessee. In*** Karst Geohazards (ed. by B. Beck), Proceedings of: The Fifth Multidisciplinary Conference on Sinkholes and the Engineering and Environmental Impacts of Karst; Sponsors include the National Ground Water Association and the American Society of Civil Engineers, Gatlinburg, TN, p. 541-547.

Rubin, P.A., 1994, ***Paleohydrology of the Kämper Avenue area; Mammoth Cave National Park, Kentucky.*** Mammoth Cave National Park's Third Science Conference; Sponsored by Mammoth Cave National Park and The Cave Research Foundation, Mammoth Cave National Park, Kentucky, p. 265-279.

Rubin, P.A., Zerr, B., Davies, G.J., Lemiszki, P.J., Neuhoff, P.S., and Aiken, J., 1993, ***Preliminary hydrogeologic studies in carbonate aquifers of the Oak Ridge Reservation, Tennessee.*** Abs. Fourth Annual Walker Branch Watershed Research Symposium, Oak Ridge, TN, p. 15-16.

Davies, G.J., Rubin, P.A., and Quinlan, J.F., 1993, ***Indirect observation of the rapid-flow and slow-flow components of recharge to the Knox aquifer, Oak Ridge, Tennessee.*** Abs. Fourth Annual Walker Branch Watershed Research Symposium, Oak Ridge, TN, p. 17.

Rubin, P.A., Lemiszki, P.J., and Poling, R.S., 1992, ***Strategy for definition and protection of East Tennessee karst groundwater basins.*** Tennessee Water Resources Symposium (5th, Nashville, TN., Oct. 1992), Proceedings. American Water Resources Association, Nashville, TN, p.7-10.

Rubin, P.A. and Lemiszki, P.J., 1992, ***Structural and stratigraphic controls on cave development in the Oak Ridge area, Tennessee.*** Tennessee Water Resources Symposium (5th, Nashville, TN., Oct. 1992), Proceedings. American Water Resources Association, Nashville, TN, p. 111-117.

Rubin, P.A., Lietzke, D.A., and Schmidt, V.A., 1992), ***Aspects of the geomorphology of Oak Ridge, Tennessee.*** Abs. National Speleological Society Convention, Salem, IN.

Rubin, P.A., 1992, ***Strategy for aquifer and stream protection in karst terranes.*** Abs. The New York Natural History Conference II, New York State Museum Circular 54, p. 61, Albany, New York.

Rubin, P.A., 1992, ***Karst hydrology of Oak Ridge, Tennessee.*** Abs. Third Annual Walker Branch Watershed Research Symposium, Oak Ridge, TN, p. 34.

Rubin, P.A., 1992, ***Land-use planning and watershed protection in karst terranes.*** Hydrogeology, Ecology, Monitoring, and Management of Ground Water in Karst Terranes Conference (3rd, Nashville, Tenn., Dec. 1991), Proceedings. National Ground Water Association, Dublin, Ohio, p. 769-793.

Rubin, P.A., Ayers, J.C., and Grady, K.A., 1992, ***Solution mining and resultant evaporite karst development in Tully Valley, New York.*** Hydrogeology, Ecology, Monitoring, and Management of Ground Water in Karst Terranes Conference (3rd, Nashville, Tenn., Dec. 1991), Proceedings. National Ground Water Association, Dublin, Ohio, p. 313-328.

Palmer, A.N., Rubin, P.A., and Palmer, M.V., 1991, ***Interaction between karst and glaciation in the Helderberg Plateau, Schoharie and Albany Counties, New York.*** Guidebook for New York State Geological Association Annual Meeting, Oneonta, New York, p. 161-190.

Palmer, A.N., Palmer, M.V., Porter, C.O., Rubin, P.A., and Mylroie, J.E., 1991, ***A geological guide to the karst and caves of the Helderberg Mountains, Schoharie and Albany counties, New York.*** Guidebook paper for National Speleological Society annual meeting, Cobleskill, New York, p. 105-167.

Rubin, P.A., 1991, ***Modification of preglacial caves by glacial meltwater invasion in East-Central New York.*** Appalachian Karst Symposium, Proceedings. National Speleological Society, Radford, Virginia, p. 91-100.

Rubin, P.A., 1991, ***Flow characteristics and scallop forming hydraulics within the Mill Pond Karst Basin, East-Central New York.*** Appalachian Karst Symposium, Proceedings. National Speleological Society, Radford, VA., p. 101-108.

Rubin, P.A., 1991, ***Emerged sea caves and coastal features as evidence of glacio-isostatic rebound, Mount Desert Island, Maine.*** Appalachian Karst Symposium, Proceedings. National Speleological Society, Radford, Virginia, p. 75-83.

Rubin, P.A., 1983, ***Structural geology and geomorphology of the Shawangunk Mountain caprock, Southeastern New York.*** Abs. Geol. Soc. Amer. N.E. Ann. Mtg., Kiamesha Lake, New York; and Abs. Mohonk Research Associates Conference, Mohonk Lake, New York.

Rubin, P.A. and Briedis, J., 1982, ***Acid precipitation and volcanism linked to Mesozoic dinosaur extinction.*** Abs. Geol. Soc. Amer. Ann. Mtg., New Orleans, Louisiana.

Rubin, P.A., Smiley, D., and Egemeier, S.J., 1981, ***Acid precipitation in the Shawangunk Mountains, Southeastern New York.*** Abs. AMS/CMOS International Conference on Long-Range Transport of Airborne Pollutants, Albany, New York; and Abs. Geol. Soc. Amer. N.E. Ann. Mtg., Bangor, Maine.

Rubin, P.A., 1981, ***New Aspects of the stratigraphy and structure of the Shawangunk Mountains, Southeastern New York.*** Abs. Geo. Soc. Amer. N.E. Ann. Mtg., Bangor, Maine.

Egemeier, S.J., Liff, C.I., Smiley, D., and Rubin, P.A., 1981, ***The safe yield of the "sky" lakes of the Shawangunk Mountains of Southeastern New York.*** Abs. Geol. Soc. Amer. N.E. Ann. Mtg., Bangor, Maine.

Exhibit B

Paul A. Rubin

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E-mail contact: hydroquest@yahoo.com

Most HydroQuest reports, figures, and Fact Sheets referenced at assorted web pages below may be viewed at: http://hydroquest.com/Hydrofracking/

Paul Rubin/HydroQuest Gas Drilling Related Reports, Presentations, Affidavits, Meetings & Interviews:

Oct. 2011 to Present – Advancing hydrogeologic and chemical characterization of hydrofracturing related groundwater contamination cases in support of active, high-profile, litigation with a number of law firms. Work involves site field work, groundwater sampling, hydrogeologic characterization, mediation sessions, technical guidance, and affidavit and report preparation. Many settlement agreements have been completed in Dimock, PA cases.

November 2012 – Constructing an affidavit detailing hydrologic problems associated with selling aquifer water to the gas industry for use as hydraulic fracturing water for a location in New York State. For Sierra Club and others. Affidavit is in opposition to Respondents' motion to dismiss and/or for summary judgment relative to the sale, distribution, and planned use of potable waters of New York State as naturally occurs within a primary unconsolidated aquifer. .

October 17, 2012 – Report preparation: *Hydrogeologic Concerns Regarding Hydraulic Fracturing within the Muskingum River Watershed in Eastern Ohio with Justification & Recommendations in Support of a Drilling Moratorium within Reservoir Watersheds and Statewide Legislation Banning Hydraulic Fracturing* for South-east Ohio Alliance to Save Our Water; 42 pages with 10 figures (includes earthquake probability analyses). Technical guidance provided on an ongoing basis.

September 15, 2012 – Report preparation: *Bedrock Geology of the Marcellus and Utica Shales in the Town of Marbletown, Southeastern New York State with Justification & Recommendations in Support of Legislation Banning Hydraulic Fracturing* for Stand for Land; 15 pages with figures including GIS maps.

September 6, 2012 – Invited speaker before full Dutchess County Legislature, NYS. Topic: *Hydraulic Fracturing Brine Prohibition Act.* Written technical supportive statement provided in advance on 8-17-12.

August 14, 2012 – Fact Sheet constructed. Topic: *Key Reasons to Ban Hydraulic Fracturing in NYS.* Provided to NYS DEC and NYS Governor's office by HydroQuest in support of postponing hydraulic fracturing decision in NYS (2 pages with numerous references).

August 13, 2012 – Hydrogeologist educator at meeting with NYS Governor Cuomo's executive staff (Robert Hallman, NYS Deputy Secretary of Environment, Basil Seggos, NYS Assistant Deputy Secretary of Environment and DEC official) to discuss the independent science on hydrofracking in support of a ban on hydraulic fracturing in NYS (hosted by Grassroots Environmental Education at the Capitol in Albany). Fact Sheet and hydrofracking related material provided.

June 26, 2012 – Report preparation: *Hydrogeologic Implications of Using Partially Treated Landfill Leachate in the Hydraulic Fracturing Process for the Delaware Riverkeeper Network*; Report addresses a first attempt by the gas industry to use partially treated landfill leachate as fracking water in PA. This would be an extremely poor precedent that would increase contaminant loading to regional aquifer flow systems; 14 pages.

June 12, 2012 – Report preparation: *Hydrologic and Environmental Rationale to Bury Gas Pipelines using Horizontal Directional Drilling Technology at Stream and River Crossings* for the Delaware Riverkeeper Network; Transcontinental Gas Pipeline Company, LLC - Brandywine Creek case example used; 14 pages plus 2 figures and flood return analysis.

May 30, 2012 – Panel Member/Speaker in PA. Topic: *PA House Bill No. 1950 (Act 13) – Hydrogeologic Considerations with Implications for Degradation of Groundwater and Surface Water Quality in Berks Co., PA.*

April 25, 2012 – Testified before the NYS Senate in Albany, NY. Topic: *Hydrogeologic Justification for Banning Hydraulic Fracturing throughout New York State and the Delaware River Basin* (Testimony and report provided at the Senate Democratic Conference Public Hearing on Fracking Legislation in Albany, New York by HydroQuest and Mid-Hudson Geosciences)

April 19, 2012 – Panel Member/Speaker in PA. Topic: *PA House Bill No. 1950 (Act 13) – Hydrogeologic Considerations with Implications for Degradation of Groundwater and Surface Water Quality in the Newark Basin, Bucks Co., PA.*

April 17, 2012 – Testified before the Ulster County NY Legislature on adverse contaminant transport issues related to proposed spreading of hydraulic fracturing derived brine wastes on roads. Testimony and official statement provided in support of legislation designed to ban brine dispersal to groundwater aquifers and waterways.

January 23, 2012 - Speaker at Press Conference. Topic: *Fracking, Aquifers and Earthquakes are Connected.* Conference held in Albany, NY in Legislative Office Bldg. press room before multiple TV stations and other press entities. Open discussion, Q&A, and initial presentation shared with Dr. Arthur N. Palmer, hydrologist. Press conference sponsored by Schoharie Valley Watch and Sustainable Otsego. This press conference preceded a major anti-fracking rally in the capital area that called for a legislative ban on hydraulic fracturing.

January 23, 2012 – Assemblyman Office Meeting. Private meeting between Paul Rubin and Dr. Arthur Palmer and representatives of Assemblyman Robert K. Sweeney's [Chairman of the New York State Assembly Standing Committee on Environmental Conservation] office. Sweeney requested the meeting to address questions they had relating to local and regional groundwater flow as related to transport of hydrofracking contaminants.

January 17, 2012 – Report completed on the *Planned Quarry Road Mine – Karst Hydrology & Gas Drilling Concerns; Perryville, New York* for the Sullivan Citizens Alliance (Chittenango, NY). Report details concerns relative to the karst hydrology and potential environmental impacts associated with a proposed Oot Quarry application (19 pages plus 7 figures with GIS maps).

January 10, 2012 - *Aquifer & Karst Protection Considerations in Schoharie and Other New York State Counties* (Comments on the NYS High-Volume Hydraulic Fracturing 2011 revised draft SGEIS). Technical report that addresses the need for tracer addition to fracking fluids, vulnerability of karst terrains, limitations of well bore sealant materials, aquifer protection and other issues. In addition, analyses are provided in support of an empirically-based 2,100 foot setback distance from well arrays, the high probability of well bore sealant material failure from earthquake events, and a flood return analysis supporting no well pads within 500-year floodplains. Documentation was provided in support of NYSDEC withdrawing their revised draft SGEIS on gas drilling regulations. [Full report, related figures and analyses may be viewed at: http://hydroquest.com/Schoharie/]

December 2011 – Contributor to *Protecting Pennsylvania Communities from the Shale Rush: A Handbook for Local Residents and Officials* by Delaware Riverkeeper Network, 76 pages.

December 6, 2011 – Speaker at Press Event. Topic: *Technical Justification in Support of Requiring Cabot to Immediately Resume Water Deliveries to Adversely Impacted Residents of Dimock, PA* [Public statement made at a press event held in Dimock, PA on Dec. 6, 2011 with associated 5-page technical statement]

November 23, 2011 – Authored an affidavit in support of Dimock, PA Petitioners' Petition for Temporary Supersedeas requesting that the Pennsylvania Environmental Hearing Board restore the *status quo* to conditions prior to the Pennsylvania DEP's determination that Cabot Oil and Gas Corporation may cease supplying affected residents of Dimock, PA with temporary potable water due to Cabot's compliance with paragraph 6 of the December 15, 2010 Consent Order and Settlement Agreement, Section 208 of the Oil and Gas Act and related environmental regulations. The affidavit addresses geologic and hydrogeologic factors governing water quality degradation of homeowner wells. The affidavit is Exhibit J of a legal petition filed by the law firm of Napoli Bern Ripka Shkolnik & Associates, LLP.

November 17, 2011 – Presented a Power Point presentation in West Virginia at a Special Meeting of the County Commission before commissioners, town and planning board members, the public, and the press titled: *Hydrofracking, Karst Vulnerability and Degradation of Water Resources*. The final recommendation provided was to enact a temporary moratorium to be followed by a permanent statewide ban on hydraulic fracturing.

November 15, 2011 – Drafted a 10-page report on behalf of Damascus Citizens for Sustainability addressed to the Division of Municipal and Residual Waste, Bureau of Waste Management's Special Conditions General Permit WMGR064 addressing hydrologic issues associated with *Natural Gas Brine Dispersal on Roadways and the Risk of Surface and Groundwater Contamination*.

October 15, 2011 – Led an all day field course addressing *Hydrology & Hydrofracking* for The Heldeberg Workshop based near Albany, New York. The course was designed for teacher development and 8 credit hours of in-service credit. Abridged course description: A hands-on field look at aquifers that supply our wells and streams with pure water. While touring local nature preserves, take a close look at the major aquifer types (unconsolidated, fractured bedrock, karst) and join in discussions of how groundwater and contaminants move in them, how freshwater aquifers are physically separated from deep, saline, waters and how they provide the sustained base flow to our streams. Hydraulic fracturing (hydrofracking) will be extensively discussed, inclusive of means of methane and contaminant movement from gas-rich shale beds to explosive flares at kitchen taps.

October 2011 - January 2012 – Developing an affidavit for a legal challenge designed to force the Delaware River Basin Commission (DRBC) and the Army Corps of Engineers to follow federal environmental laws and do a comprehensive environmental impact study before they issue their draft gas rules as final and before any drilling starts. The affidavit will address numerous hydrogeologic/technical issues and will detail likely "irreparable harm" to freshwater aquifers and streams should gas drilling under the proposed regulations be advanced. The affidavit will be filed in federal court by the Delaware Riverkeeper Network.

October 6, 2011 – Presented expert testimony to the New York State Assembly Standing Committee on Environmental Conservation in Albany, NY. Testimony subject: *Protection of Freshwater Aquifers: Hydrogeologic and Seismic Threshold Requirements*. Received a personal thank you letter from Robert Sweeney, Chairman of the Assembly ECC.

September 8, 2011 – Freedom from Fracking plenary conference speaker for the Delaware Riverkeeper Network at a conference in Philadelphia, PA called Shale Outrage. Plenary talk topic: *Gas Wells & Hydraulic Fracturing: A Means to Long-Term Aquifer Degradation.*

September 8, 2011 – Freedom from Fracking workshop conference presenter for the Delaware Riverkeeper Network at a conference in Philadelphia, PA called Shale Outrage. Talk and workshop topic: *Our Aquifers, Our Drinking Water: Casualties of Gas Development.*

September 6, 2011 – Panel Presenter: Provided expert testimony before the Citizens Marcellus Shale Commission (Southeastern Pennsylvania Hearing in Philadelphia) detailing hydrogeologic thresholds that must be met in order to safeguard freshwater aquifers in perpetuity.

September 2011 – Completed a second two-sided Environmental Fact Sheet for the Delaware Riverkeeper summarizing 1) key short and long-term risks to groundwater quality in Delaware River Basin aquifers stemming from gas drilling in a seismically active region, and 2) a recommended preliminary hydrologic test procedure designed to reduce contamination of homeowner wells proximal to proposed gas wells. Fact Sheet title: *What the experts have to say about ... Natural Gas Drilling, Seismic Risk & Aquifer Degradation.*

July 8, 2011 - Preparation of a report for the Sierra Club (Pennsylvania Chapter) on the Underground Injection Control Permits Issued by the Environmental Protection Agency for Bittinger Wells #1 and #4 for disposal of fracking-related waste. This work entailed review of technical material, preparation of graphics, and collaboration with Katherine Beinkafner (Mid-Hudson Geosciences). The report and thirteen related graphics may be viewed at: http://hydroquest.com/Bittinger/.

June 8, 2011 – Presentation at a special joint meeting of the Town of Sullivan Town Council, Zoning Board of Appeals, and Planning Board in Chittenango, New York (Madison County). Power Point presentation title: *Hydrologic Considerations Relative to Mining in a Karst Terrain & Contaminant Risks to Fresh Groundwater Supplies Stemming from Hydraulic Fracturing.*

June 2011 – Constructed a two-sided Environmental Fact Sheet for the Delaware Riverkeeper summarizing key long-term risks to groundwater quality in Delaware River Basin aquifers, as well as other aquifers throughout the world, stemming from gas drilling. Fact Sheet title: *What the experts have to say about ... Natural Gas Drilling & Aquifer Protection.* The Aquifer Protection Expert Fact Sheet may be viewed and downloaded at: http://hydroquest.com/DRBCfigures/.

April 9, 2011 - Prepared comments on the DRBC draft Natural Gas Development Regulations; Article 7 of Part III – Basin Regulations on behalf of the Delaware Riverkeeper Network, 72 pages with an additional 21 figures. The report and related figures, plus a related summary June 2011 Aquifer Protection Expert Fact Sheet, may be viewed and downloaded at: http://hydroquest.com/DRBCfigures/.

April 2, 2011 - Interviewed by Sabrina Artel for a radio talk show. This is part of her Frack Talk - The Marcellus Shale Water Project. Items discussed included flaws in current gas drilling technology that will lead to widespread groundwater contamination in gas fields, failure mechanisms in "*protective*" cement sheaths and steel casing, life of production wells vs. life of aquifers, and seismic risk in the Delaware River Basin.

February 18, 2011 – Delivered a Power Point presentation for Delaware Riverkeeper as part of a day-long webcast workshop on Translating the DRBC Gas Rules. Talk title: *How the draft rules address hydrogeologic impacts of gas development.*

February 10, 2011 - Representative of several Towns (Highland, Lumberland et al.) at a special work session of the Upper Delaware Council's project review committee. Assisted the UDC in their review of the DRBC's Draft Natural Gas Development Regulations in Narrowsburg, New York.

November 15, 2010 – Prepared a report on behalf of the Delaware Riverkeeper Network and the Damascus Citizens for the Sustainability for the Delaware River Basin Commission Consolidated Administrative Hearing on Grandfathered Exploration Wells. (22 pages, plus 10 figures and 3 addenda). The report and 10 related figures may be viewed and downloaded at: http://hydroquest.com/Riverkeeper/.

September 11, 2010 – Provided comments on the Scope of the Proposed EPA Study of Hydraulic Fracturing. Prepared on behalf of Otsego 2000; 14 pages with 7 figures. The report and figures may be viewed and downloaded from the Otsego 2000 web page: [http://63.134.196.109/documents/HydroQuestEPAComments9-11-10withfigures.pdf].

December 30, 2009 - Provided significant geologic and hydrologic input into a 45-page letter authored by Zarin & Steinmetz, attorneys for Otsego 2000. The letter provides extensive comments on the Draft Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Program: Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low Permeability Gas Resources ("DSGEIS"). The letter may be viewed and downloaded at: http://63.134.196.109/documents/DSGEISCommentLtr123009.pdf.