HydroQuest

414 E. Kerley Corners Rd.
Tivoli, New York, 12583
845-657-8111
hydroquest@yahoo.com

April 25, 2016

Comments of Paul A. Rubin of HydroQuest regarding the January 26, 2016 Remedial Action Work Plan (RAWP) for 109-125 Marbledale Road, Tuckahoe, New York, at Brownfield Cleanup Program Site #C360143 (a.k.a. Former Marble Quarry Landfill Site) prepared by HydroEnvironmental Solutions, Inc.

Hydrology

The RAWP and geologic conclusions recently provided by NYSDEC forward the concept that there is no concern regarding the potential for offsite contaminant migration. For example, section 1.2 of the RAWP (page 1) states:

> "*The bottom of the Landfill still consists of marble rock and therefore likely acts as an impediment to off-site … flow of contaminated landfill groundwater*."

Section 2.3 Summary of Groundwater Contamination and Potential Risk (page 5) further seeks to validate the erroneous concept that groundwater and offsite transport of contaminants is not of concern.

> " *… based on the depth of groundwater (greater than 18 ftbg) and the proposed development which will not intersect the water table, the Human Health Evaluation supported a determination that groundwater was not an environmental medium of concern*."

This RAWP quote and follow-up discussion is provided to correct this flawed assumption. Contrary to what is suggested in the RAWP (section 4.1 Description of Remedial Alternatives) there is NO remedial alternative presented that is protective of human health and the environment offsite, including the Alternative B remedy. This is because every remedial option presented fails to account for groundwater flow into, through, and down-gradient of the Marbledale quarry chemical waste site.

HydroQuest has previously discussed three groundwater flow vectors at and beyond the Former Marble Quarry Landfill Site. These are through unconsolidated fill and soil media, fractured bedrock (i.e., interconnected joint sets), and through solution conduits within the Inwood Marble. These are discussed in two HydroQuest reports (October 20, 2015 Addendum to HydroQuest Report of September 15, 2015: Additional Karst Aquifer Discussion; September 15, 2015 Hydrogeologic Considerations Relative to the Proposed Conditioned Negative Declaration for the 109-125 Marbledale Road Brownfield Development; Tuckahoe, New York). These reports and the figures within them are hereby incorporated by reference.

Rapid groundwater flow through conduits is typical in karst terrains, such as that present in the Inwood Marble which extends north and south of Brownfield Cleanup Program Site # C360143. Based on geologic findings from the Kings Electronics site that was first presented to the public at a meeting in Tuckahoe on April 14, 2016, NYSDEC concluded that no karst existed at the Marbledale quarry site and, therefore, no contaminants could be transported offsite through non-existent solutional conduits. As detailed below, this is not correct. This is important because the underlying premise of NYSDECs potential approval of the RAWP is that the remedial actions proposed will remove possible offsite contaminant exposure. This simply is not true.

As depicted on the HydroQuest geologic map which portrays area mapping by field geologists (see HydroQuest report of 9-15-15; Bedrock Geology), a narrow, elongate, carbonate (i.e., marble) band extends from the north-northeast near Scarsdale to the south-southwest beyond Bronxville. NYSDECs conclusions fail to acknowledge the well-known geology of the area and the downhole camera geologic findings from the sites' deep well.

Page 3, second paragraph in the Results section, of the June 1, 2000 Leggette, Brashears & Graham, Inc (LBG); Summary of Remedial Investigative Findings, Kings Electronics Co., Inc. describes a downhole television inspection of the deep supply well (page 3) and states:

> "*The bedrock formation penetrated by the well borehole appeared to be a fractured metamorphic formation, consisting of Manhattan Schist (the mapped bedrock formation of the site), or possibly Fordham Gneiss*."

At the April 14 meeting, NYSDEC stated that the 555-foot deep Kings Electronics well found "*no marble*" and only some fractures at depth. Based on this, NYSDEC concluded that the HydroQuest hydrologic model depicted on the next page is not correct. NYSDEC continued and stated that the "*marble is probably not continuous*". Statements that contradict the work of recognized geologists without providing rigorous supporting documentation have no place in important RAWP decisions. NYSDEC further stated at the April 14 meeting that there is "*no significant indication that contaminated groundwater is migrating offsite.*" This is not surprising because they did no offsite testing.

The hydrologic flow regime presented on the following page is well-supported based on known, mapped, bedrock geology, physical features present in the area, and accepted hydrogeologic principles of groundwater flow through porous, fractured and karstic media (Figure 1). Figure 2 depicts an impossible hydrogeologic scenario whereby no groundwater or offsite contaminant transport can occur. While NYSDEC may believe that there is "*no significant indication that contaminated groundwater is migrating offsite*", the laws of physics and hydrogeology dictate that this **must** be occurring. Figure 3 illustrates the location of the valley axial profile line used to construct Figures 1 and 2.

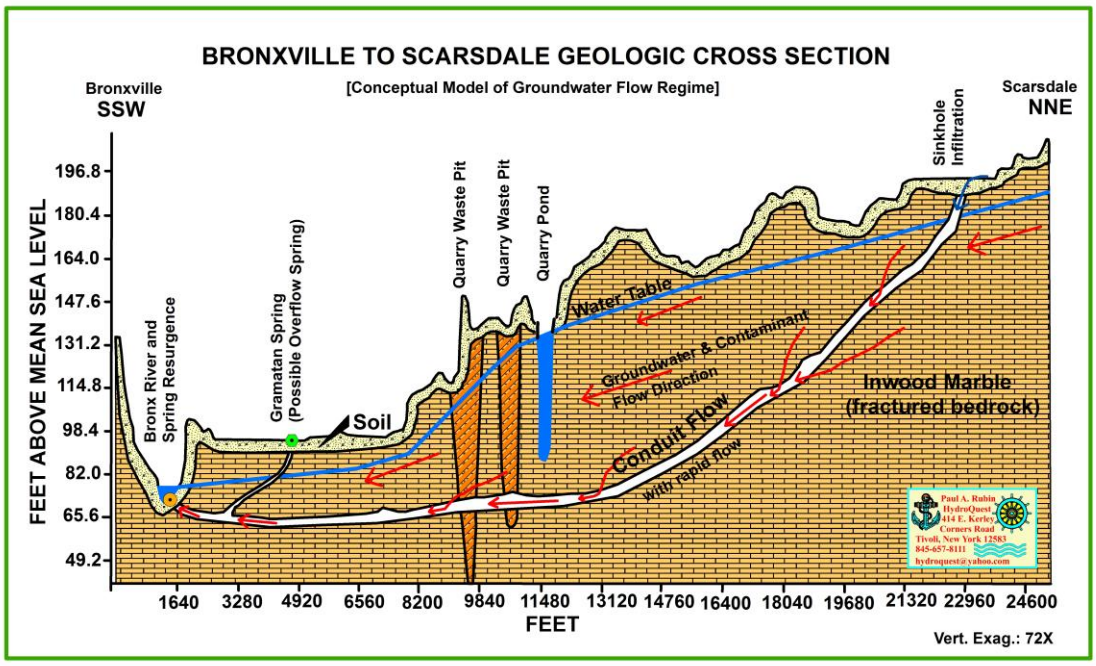


Figure 1. Bronxville to Scarsdale Geologic Cross Section.

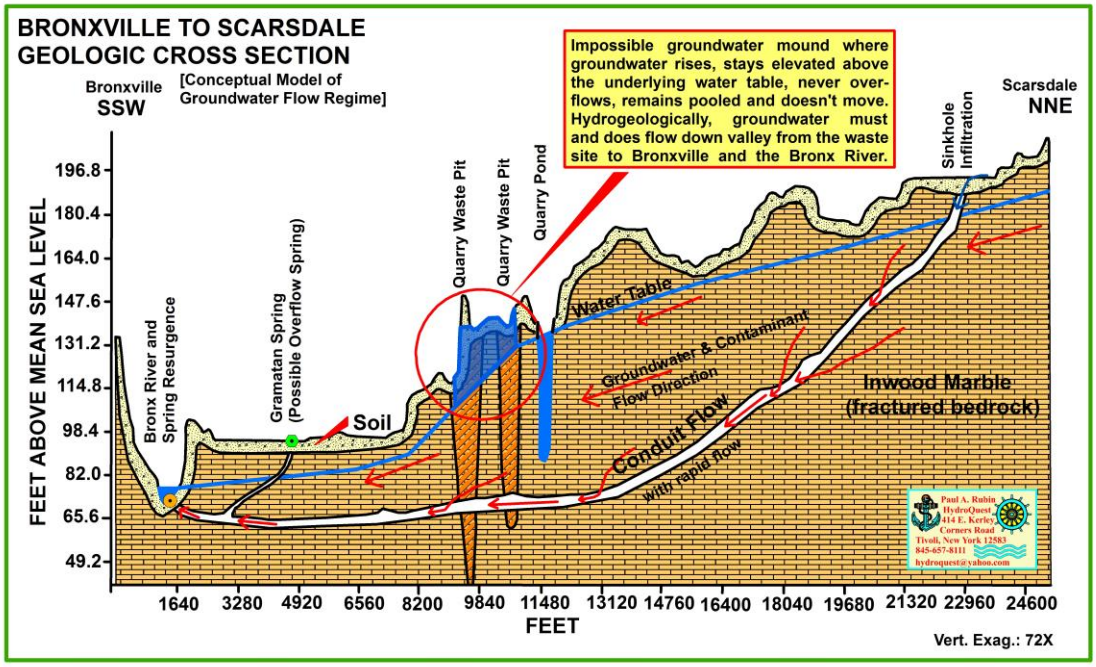


Figure 2. Bronxville to Scarsdale Geologic Cross Section with impossible hydrologic mounding required under an erroneous scenario that no offsite migration of groundwater and contaminants occurs from the Marbledale quarry chemical waste site.

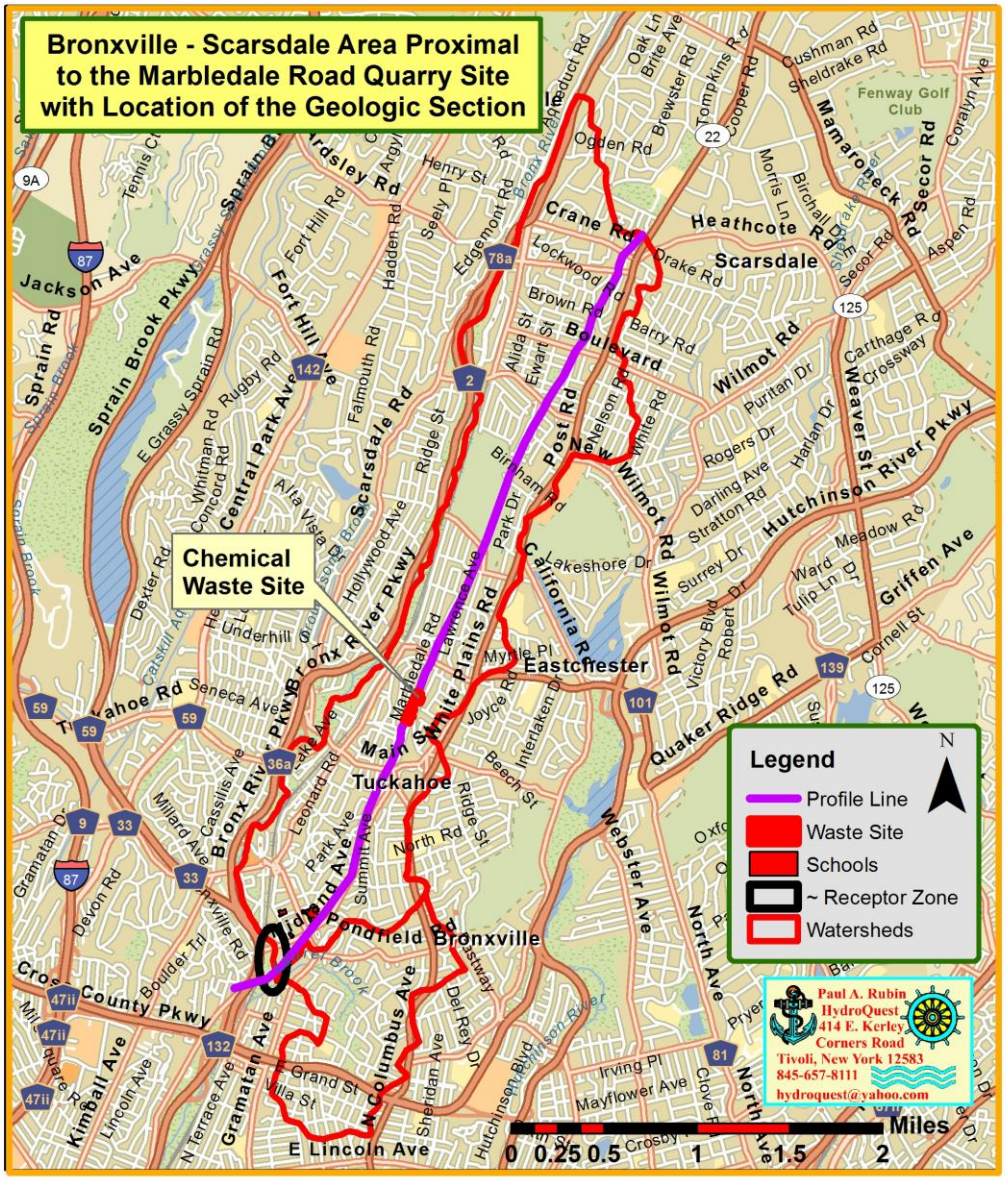
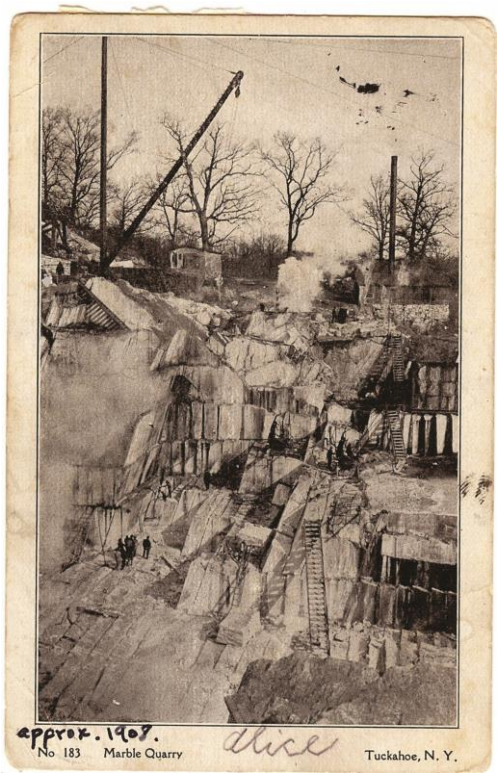


Figure 3. Location map of Figure 1 Bronxville to Scarsdale Geologic Cross Section.

Importantly, NYSDEC has used findings of the Cody Ehlers Group (1999; Summary of Environmental Conditions; Kings Electronics Co., Inc.; 40 Marbledale Road; Tuckahoe, New York) to erroneously "*document*" that karstic conduits do not exist in the area. As discussed above, the deep production well at the Kings Electronics site (approximately 574 feet south of the Brownfield site footprint in the low valley floored with the Inwood Marble; Figure 4) is largely if not entirely constructed within the schistose Manhattan Formation. This is consistent with downhole camera observations, as well as penetration of sloping (and possibly completely removed) overlying marble beds.



Figures 4 and 5. Left photo: Tuckahoe marble quarry in approximately 1907. Right photo: Lakeview Avenue 1905 (Eastchester Historic Society). Lakeview Avenue is north-northeast of the Marbledale chemical waste site along the same Inwood Marble band. Note prominent sub-vertical planes in bedrock. Joints and bedding planes provide solutional pathways for enlargement by calcium-carbonate under-saturated groundwater. The presence of sinkholes document conduit development underneath them that extend down-gradient to spring discharge locations.

NYSDECs lack of familiarity with data and reports specific to the Kings Elecronics site is documented in NYSDECs Robert W. Schick's April 8, 2016 letter to Ms. Elisabeth Harding. Schick states:

> "*In fact, data collected from the site and from the neighboring Kings Electronics site indicate that the "conduit of flow in the marble bedrock" that is postulated by some as directly connecting the quarry pit to the Bronx River, does not exist in the area. Such conduits were found much deeper, at depths of 400-500 feet below ground surface, which are well below the bottom of the quarry pits*."

While this sounds like recognition that conduits are present, it simply documents that Schick failed to read the LBG report (2000) that documents the site's deep well as being constructed in the Manhattan Schist and the discussion of fractures and fracture zones present in the well at depths of 72, 250-260, 330-334, 420, and 532-533 feet below ground surface (page 3). Significant conduits are found in carbonates, **not** in schists and gneisses. The deep Kings Electronics well is constructed in very low permeability (i.e., low hydraulic conductivity) metamorphic bedrock. Failure to identify conduits in the Manhattan schist (and then somehow by direct correlation with the quarry waste site), a bedrock unit completely different from the Inwood marble present at the quarry waste site, cannot be used to assert that there are no conduits and groundwater flow in another bedrock formation of greatly different composition and solubility. In fact, there is ample evidence that the Inwood Marble is conduit-bearing in both the Tuckahoe area and throughout the regions.

Evidence for rapid groundwater flow in conduits within the Inwood Marble includes:

> Sinking streams within the marble both in the area and within the same valley as the Marbledale Quarry Landfill (Scarsdale area);
>
> Numerous sinkholes within Inwood marble exposures in the area;
>
> The presence of numerous small and large caves in other bedrock exposures present within the former carbonate shelf comprised of the Inwood Marble and its geologic equivalent formations of Sauk Sequence carbonates;
>
> The presence of springs emanating from the Inwood Marble (e.g., Smith, 1938; Northeastern Caver, multiple years);
>
> Reference to the karstic nature of the Inwood Marble by the US Geological Survey (1992) and Merguerian and Merguerian (2014); and
>
> The presence of a large and elongate sinkhole within the same valley as the Marbledale Quarry Landfill. If sediment within this sinkhole was not being actively sapped into the subsurface and being carried away by rapid groundwater flow, the sinkhole would not be present. Instead, its existence would have been masked by glacial till deposited by the most recent glacial advance. Thus, conduit portions of the karst aquifer are both present and functioning. Conduit pathways are commonly miles long. Here, erosionally-resistant schist and gneiss formations essentially force groundwater and contaminant flow to south to a zone of low hydraulic head at the Bronx River.

As discussed above, the Kings Electronics deep production well is largely or completely constructed in Manhattan Formation schist. Geologically, this schist was most likely penetrated beneath overlying and dipping Inwood Marble beds formerly present in a quarry. Figure 6 shows the topographic setting with the erosion weak Inwood Marble present as a valley former, flanked by resistant ridge-forming schist and gneiss formations to the east and west, respectively.

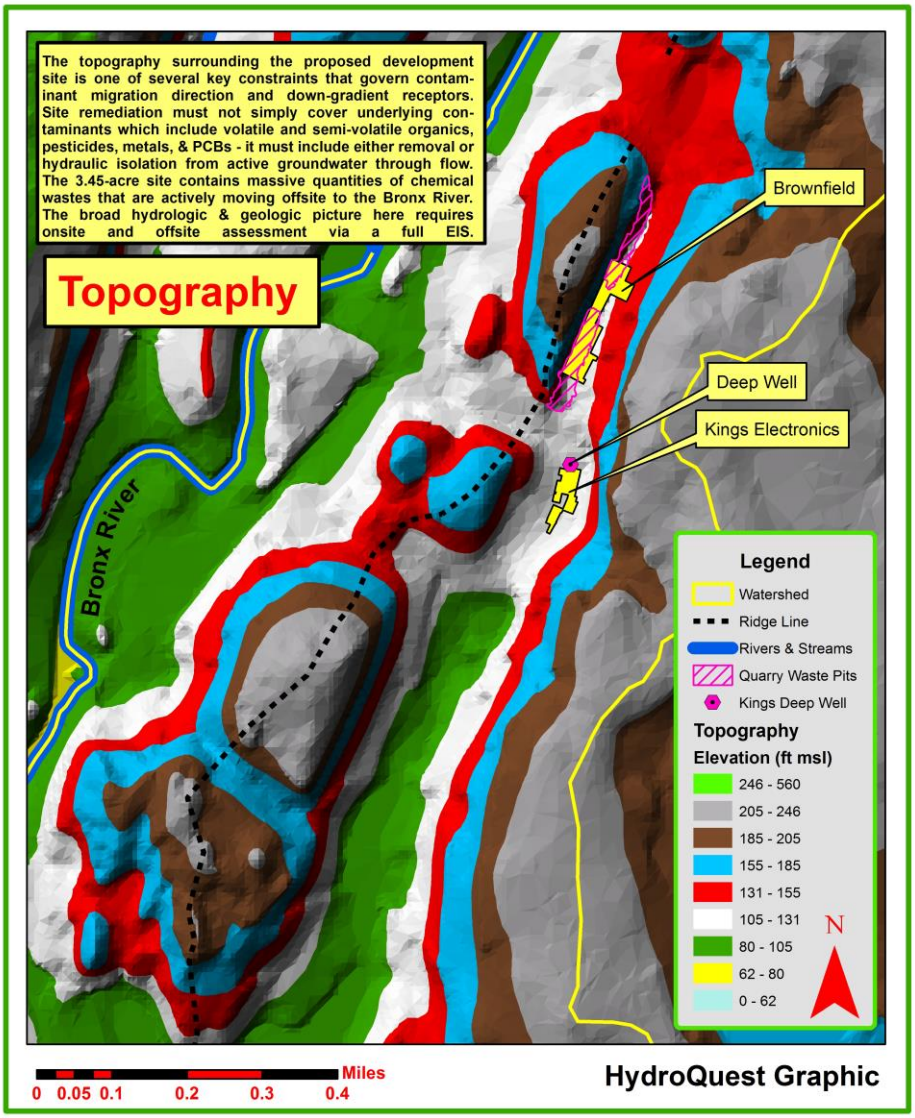


Figure 6. The structurally weak valley occupied by the Marbledale Road waste site and Kings Electronics site is flanked by erosion resistant schist and gneiss ridges. Groundwater flow is laterally constrained by impermeable schist and gneiss units.

Delineation of conduit flow paths and down-gradient receptors in karst settings requires characterization via non-traditional accepted methods (e.g., ASTM standards; tracer testing) that acknowledge that wells are most often not appropriate because they seldom encounter the rapid flow portions of karst aquifers. To date, the applicant has failed to characterize the conduit and non-conduit portions of the carbonate aquifer underlying the site, groundwater flow paths, off-site contaminant presence or absence, and down-gradient receptors. All told, the applicant has barely addressed/assessed the shallow fill aquifer present on the proposed hotel site, much less recognized and evaluated the broader hydrogeologic setting and off-site contaminant receptors. Assessment of potential remedial options, as are contemplated in the RAWP, should not be conducted until after the full vertical and horizontal extent of contamination have been characterized. Clearly, as seen in Figure 7 below, the limited waste site testing conducted to date at the proposed Brownfield development site is little but a piecemeal attempt to examine a much larger inactive hazardous waste site.

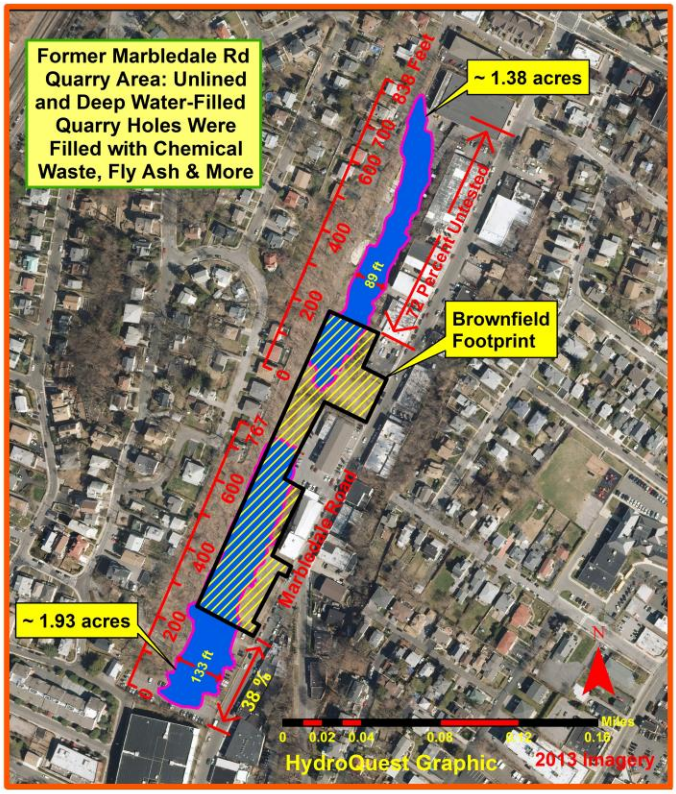


Figure 7. "*Remedial*" actions within the footprint of the Marbledale Quarry chemical waste site would fail to address most contamination.

Groundwater flow within the Inwood Marble occurs within fractures and conduits. Terrains characterized by rapid groundwater flow through soluble bedrock, including marbles, are referred to as karst terrains. Often, but not always, karst terrains exhibit one or more of the following features - sinkholes, sinking streams, lack of surface streams, solution conduits, caves, and springs. Groundwater and contaminant migration in conduit portions of karst aquifers can be rapid, far more so than in fractured bedrock portions of karst aquifers. Because conduit portions of karst aquifers are open, little or no contaminant dilution occurs before groundwater discharges from springs often miles away from where surface water flows or infiltrates into the ground. Springs generally appear near some controlling feature such as an insoluble underlying bedrock contact or regional base level (e.g., river, ocean). Locally, the Bronx River forms the regional base level. Contaminants transported from the Marbledale Quarry Landfill almost certainly discharge in one or more springs close to or in the Bronx River, somewhere within the area encompassing the Inwood Marble. Proper waste site characterization requires determination of offsite locations of karst springs via the karst ASTM standard or updated equivalent. In this regard, the RAWP is wholly incomplete.

Remedial Actions

The RAWP provides information on the objective of proposed remedial actions. Clearly, the objective is specifically tailored for a single applicant who desires to build a hotel and restaurant:

> "*The overall objective of the Site remedial actions is to mitigate the potential risks posed by the on-Site soil and soil vapor, to achieve a Site condition that allows for the proposed reuse as a commercial development including a hotel and restaurant*."

The stated objective is not to prevent offsite contaminant excursion, to prevent offsite exposure, or to insure that offsite receptors are not exposed to hazardous wastes. Risk assessments are flawed because they do NOT take into account all the potential onsite contaminants, including their concentrations, quantity, and distribution. Furthermore, failure to know the full nature and extent of contamination onsite makes it difficult or impossible to assess potential and real offsite contaminant migration and all possible receptors. Exposure pathways include:

* Vapor intrusion to homes, businesses and schools;
* Widespread contaminant dispersal from irrigation with contaminated groundwater (possibly inclusive of crops and animals and humans that ingest them);
* Contaminant influx to homes via groundwater inflow, especially to homes with sump pumps;
* Ingestion of Bronx River fish by fishermen;
* Dermal contact from recreational activities in the Bronx River (i.e., water and contaminated sediments); and
* Bioaccumulation of contaminants in aquatic wildlife.

Potential Offsite Impacts Associated with Contaminant-Laden Groundwater Constitute a Significant Threat to Public Health or the Environment [375-2.7(a)(1)]

- Vapor release into buildings located between the quarry waste site and Bronx River (~1.4 miles) via bedrock fractures, conduits and permeable soils (e.g., schools, businesses, homes);
- Areal spreading of groundwater contaminants via irrigation from wells;
- Areal spreading of waste site contaminants via irrigation from the Bronx River after groundwater discharges into the Bronx River;
- Degradation of Bronx River water quality;
- Degradation of Bronx River aquatic life and ecosystems (i.e., due to exposure to contaminants);
- Bioaccumulation of waste site contaminants in Bronx River fauna and sediments;
- Dermal contact with contaminated Bronx River water and sediments by recreational users;
- Ingestion of fish caught in the Bronx River; and
- Potential inhalation and dermal contact with contaminant-laden groundwater entering homes and businesses through near basement pathways and sumps.

The Remedial Action Work Plan addresses the importance of selecting a remedial action that will permanently and significantly reduce the toxicity and/or mobility of the detected contaminants:

"*4.2.4. Long-Term Effectiveness and Permanence*

This criterion evaluates the long-term protection of human health and the environment at the completion of the remedial action. Effectiveness is assessed with respect to the magnitude of residual risks; adequacy of controls, if any, in managing treatment residuals or untreated wastes that remain at the Site; reliability of controls against possible failure; and potential to provide continued protection."

"*4.2.5. Reduction of Toxicity, Mobility, or Volume*

This evaluation criterion addresses the preference for selecting a remedial action alternative that permanently and significantly reduces the toxicity and/or mobility of the detected contaminants. This criterion is satisfied when the remedial action is used to reduce the principal threats at a Site through capping of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media if soil is removed."

"*4.2.8. Community Acceptance*

This preferred remedial alternative (Alternate B remedy) *will cap and remove the primary environmental contamination threat and, therefore, risks from the Site to the community."*

As discussed above and in previous HydroQuest reports, none of the remedial actions proposed, including the Alternative B remedy, will do anything to stop contaminants from migrating offsite. The options put forth will do nothing to stop or permanently thwart offsite contaminant migration. Instead, accepting a remedy to allow a single developer to advance his project may ultimately make it impossible to conduct comprehensive testing and remediation of the entire chemical waste site as is depicted in Figure 7 above. In many ways, the entire RAWP is analogous to illegal spot zoning.

The underlying concept that the Marbledale quarry site should be assessed as if it were a standard landfill is a mistake. The entire site should correctly be characterized and assessed as the inactive hazardous waste site it is. A few buildings and an asphalt cap will not meet the criterion quoted above that seeks to " … *permanently and significantly reduce the toxicity and/or mobility of the detected contaminants."* Even the concept advanced in the RAWP that an asphalt cap will somehow stop downward water infiltration into the chemical waste mass and then stop groundwater movement is flawed. The work of Kutay, Aydilek, and Harman (Dynamic Hydraulic Conductivity [Permeability] of Asphalt Pavements in American Society of Civil Engineers 2006 Proceedings, p. 1-6), for example, document significant permeability through asphalt pavement exposed to repeated tire loading. The authors assessed the dynamic permeability of pavement pore structures exposed to pulsatile pressures from vehicle

loading, documenting dynamic hydraulic conductivities ranging from 1.3 mm/s to 47 mm/s. Thus, it is erroneous to forward a site remedial option (i.e., asphalt cap) that cannot effectively "… *remove the primary environmental contamination threat and, therefore, risks from the Site to the community."* The long-term risk to the public and the environment would remain unchanged under the proposed Alternative B remedy because water infiltration would continue downward through the asphalt cap into the chemical waste mass (possibly picking up hydrocarbons along the way), thus failing to "… *permanently and significantly reduce the toxicity and/or mobility of the detected contaminants. …* or *provide continued protection.*"

The Remedial Action Work Plan before NYS Department of Environmental Conservation should be placed on hold until after the entire waste site is fully characterized. This is the ONLY way that "*environmental conservation*" and protection can be achieved. All told, the Marbledale Road waste site is not a standard landfill. It is an inactive hazardous waste site - not only the southern and northern portions (Figure 7), but the entire chemical waste site. As such, the entire RAWP is not appropriate for this site. Instead, NYSDEC guidance for fully and properly characterizing inactive hazardous waste sites should be followed. The NYS Inactive Hazardous Waste Disposal Site (IHWDS) Program "*for identifying, investigating and cleaning up sites where consequential amounts of hazardous waste may exist*" should spearhead future site characterization work, for the entire chemical waste site.

Without completion of comprehensive waste site investigation it is not possible to evaluate whether all possible remedial options have not been adequately addressed. This is the case with the existing RAWP. Some remedial options that might be considered after the full nature and extent of onsite contamination are known may include:

* Source removal, full or partial;
* Groundwater pumping and treatment;
* Permeable treatment wall;
* Funnel and gate;
* In-situ chemical restoration or bioremediation;
* Hydraulic containment via pumping to maintain an inward hydraulic gradient with leachate collection and treatment;
* Hot spot removal, composite cover system and soil vapor controls - possible remedial approach depending on full characterization of horizontal and vertical extent of contamination;
* Other.

At this time, the full nature and extent of the Marbledale Road inactive hazardous waste site contamination is not known. No offsite investigation and monitoring have been conducted and exact offsite receptors of contamination have not been identified (see, for example, Figure 8 below). Similarly, most of the chemical waste site has not been adequately investigated, much of it not at all (Figure 7). Furthermore, advancement of the RAWP is being conducted for the sole benefit of an individual developer vs.

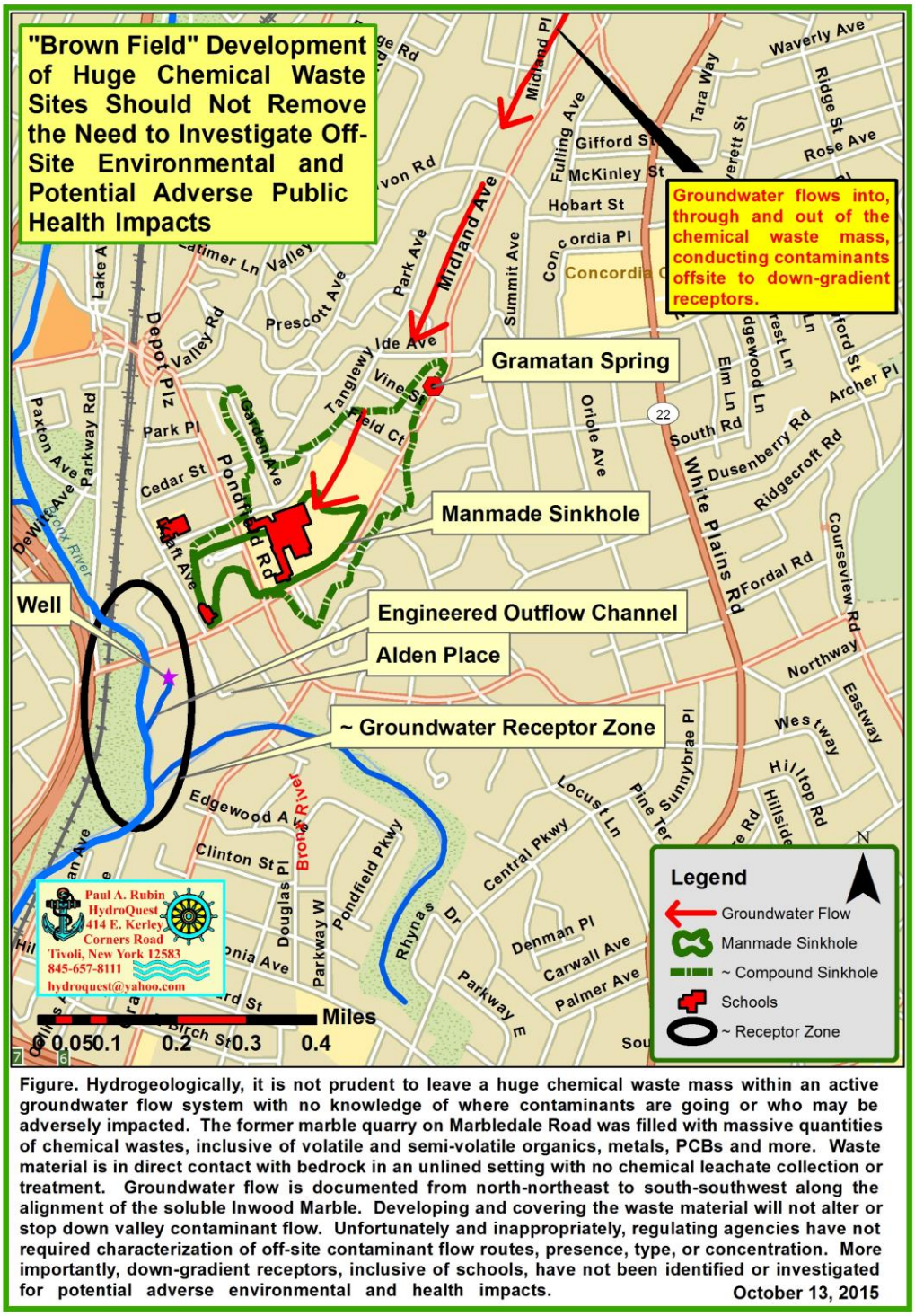


Figure 8. Offsite receptors of contamination from the Marbledale quarry chemical waste site require identification to protect public health and the environment.

comprehensive testing to assess all exposure pathways and contaminant receptors supportive of both onsite and offsite health and environmental protection.

Overall, the Remedial Action Work Plan fails to comprehensively address the entire unlined chemical waste site in a manner consistent with scientifically-based site investigations. **From a hydrogeologic standpoint, the document put forth for review as a Remedial Action Work Plan should be discarded because it completely fails to remediate an enormous chemical waste mass such that offsite contaminant migration will cease.** It is not a contaminant site remedial plan. **It does nothing to stop the inflow, through flow, and outflow of groundwater through a highly contaminated waste mass. The plan will not result in the remediation of the chemical waste site or in full protection of public health and the environment.**

The **Remedial** Action Work Plan fails to remediate almost all of the contaminants present in the chemical waste site and does nothing to stop their offsite migration. As planned, the proposed site development would potentially preclude viable remedial options that could no longer be undertaken if new development was present over part of the waste site. To proceed with site development prior to full site characterization (i.e., determination of the vertical and horizontal extent of contamination) would not be protective of the best interests of the involved communities and New York State.

Again, **the Remedial Action Work Plan before NYS Department of Environmental Conservation should be placed on hold until after the entire inactive hazardous waste site is fully characterized and appropriate remedial options have been selected and completed.**

References

Cody Ehlers Group, 1999 (Feb. 23), Summary of Environmental Conditions; Kings Electronics Co., Inc.; 40 Marbledale Road; Tuckahoe, New York.

Kutay, M.E., Aydilek, A.H. and Harman, T., 2006, Dynamic Hydraulic Conductivity (Permeability) of Asphalt Pavements in American Society of Civil Engineers Proceedings, p. 1-6.

Leggette, Brashears & Graham, Inc., 2000 (June 1), Summary of Remedial Investigation Findings; Kings Electronics Co., Inc.; 40 Marbledale Rd.; Tuckahoe, Westchester County, New York, 151 p.

Merguerian, C. and Merguerian, J.M., 2014, Field Trip Guidebook Isham and Inwood Parks, NYC; Lamont-Doherty Earth Observatory, Manhattan Prong Workshop, 06-07 September 2014; 60 p.

Smith, J. R., 1938, Springs and Wells of Manhattan and the Bronx, New York City. New-York Historical Society, New York; cited in Natural History of New York City's Parks and Great Gull Island; Transactions of the Linnaean Society of New York; Volume X, New York City, September 2007.