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GEA Evaluation of the 2018 DEQ Storm Water Sampling Results
at the Allen Drain Southwest Corner of West Park

Gelman Sciences, Inc – Michigan Contaminated Site
600 South Wagner Road
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Summary

The GEA Evaluation demonstrates that the 4.4 ug/L dioxane detected in the Allen Drain was from a local shallow groundwater source about West Park and that the concentration of dioxane in this local shallow groundwater source is higher than 4.4 ug/L. The past Gelman Sciences, Inc. (Gelman) and Michigan Department of Environmental Quality (DEQ) work about the Old West Side: has not determined the extent or magnitude of the shallow dioxane plume; and has not obtained samples from the lower most topographic areas which present the most risk to workers and residents. There needs to be a full extent and magnitude of dioxane contamination investigation done in the shallow groundwater about the Old West Side with permanent monitoring wells to track the plume migration. The receptors include construction and utility workers and residents in buildings.

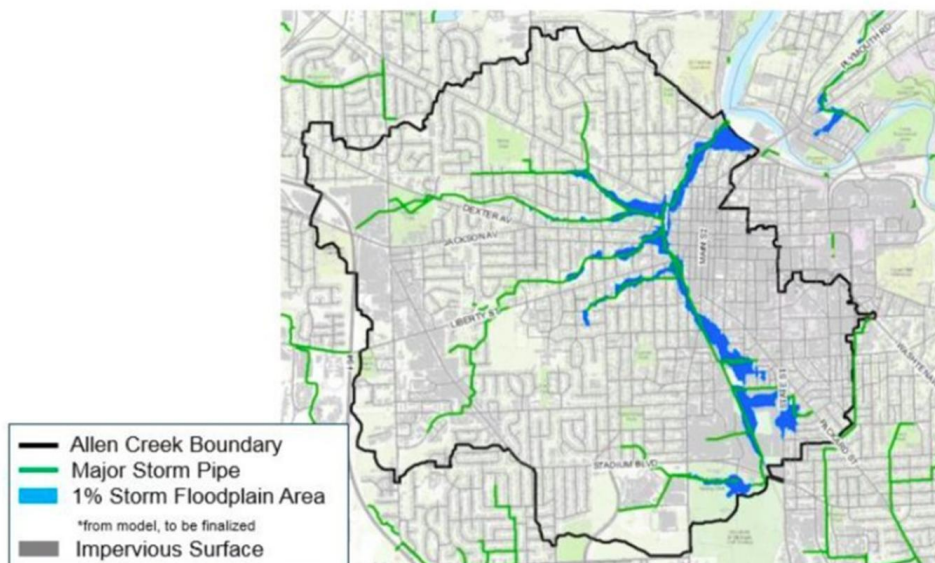
Evaluation & Findings

In 2018, the DEQ sampled the Allen Drain at the southwest corner of West Park and detected 4.4 ug/L dioxane in the storm water sample, see the following slides with the location of the Allen Drain and the approximate location of the DEQ storm drain sampling location along the Allen Drain – West Park Fairgrounds Branch.

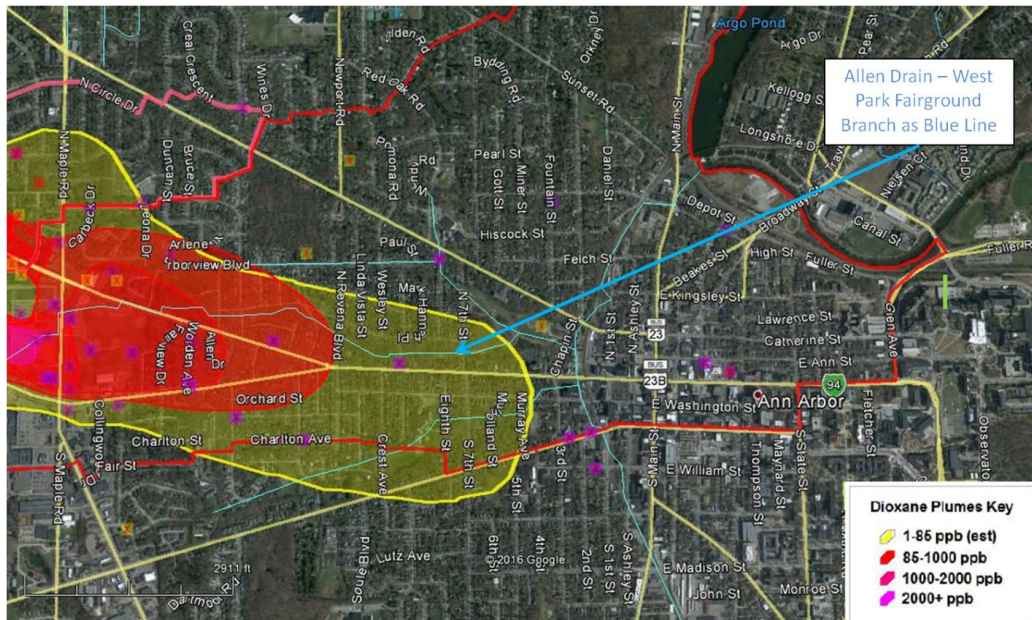
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Branches of the Allen Creek Storm Water Drain

Figure 4-1 – Allen Creek Stormwater System Overview



Approximate Location of the Gelman Dioxane Plume in the City of Ann Arbor



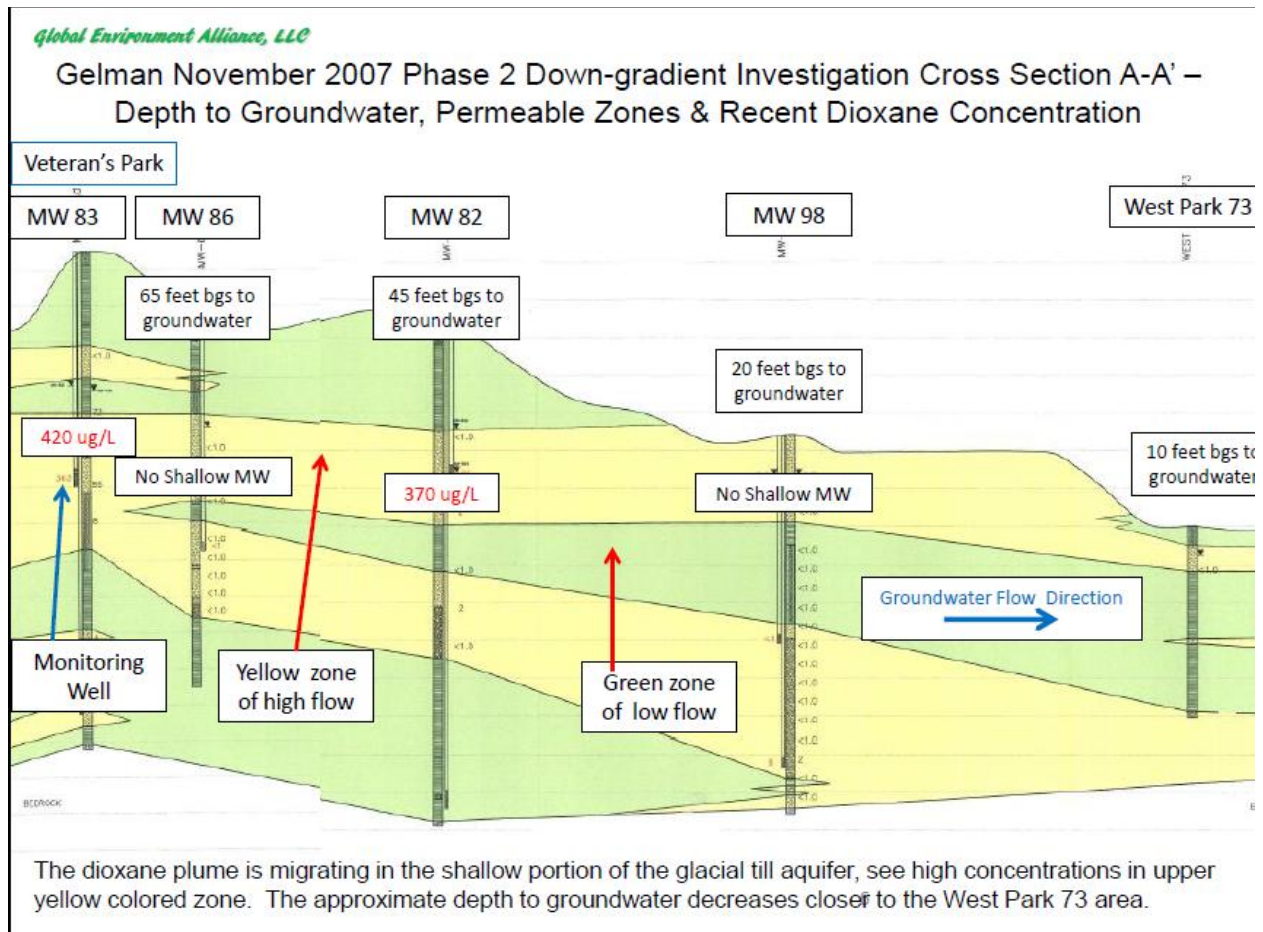
The Allen Drain is indicated by blue line.

In 2016, Gelman observed dioxane in the shallow groundwater at 1.9 ug/L and 3.3 ug/L in the Old West Side by the Slauson School. The results of the 2018 DEQ storm water sample at 4.4 ug/L from the Allen Drain – West Park Fairground Branch indicates that higher concentrations and a wider shallow plume area of dioxane may exist in the Old West Side than observed in the Gelman 2016 limited soil boring groundwater investigation.

The 4.4 ug/L dioxane in the storm water is likely from the undefined Gelman shallow dioxane groundwater contamination infiltrating into the storm drain. Any dioxane contaminated groundwater infiltrating the Allen Drain would be diluted by storm water; consequently, the surrounding dioxane contaminated groundwater about the storm drain is likely significantly higher than 4.4 ug/l dioxane.

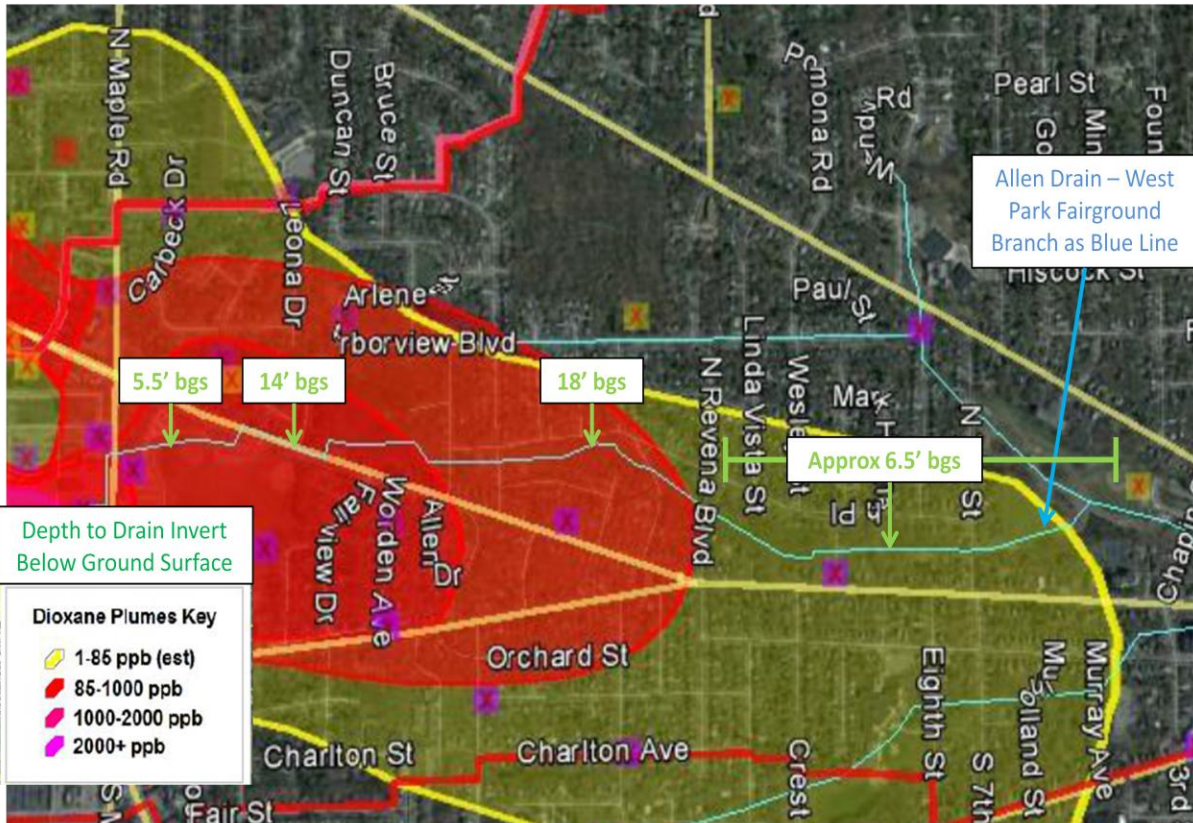
GEA gathered information from the Water Resources Commissioner Office on the Allen Drain – West Park Fairground Branch which had the 4.4 ug/L dioxane result and information from a Gelman 2007 Phase 2 Report to determine where the drain may have picked-up the dioxane plume.

Below is a cross-section from the Gelman 2007 Phase 2 Down-gradient Investigation Report depicting the topography, permeable zones and depth to groundwater in key monitoring wells. GEA has added annotations for the recent dioxane groundwater concentrations and whether the monitoring well is screened in the actual shallow groundwater horizon. The depth to groundwater decreases as the topography drops eastward from Veteran’s Park to West Park.



Below is a figure showing the approximate invert (inside the bottom of drain pipe) depth below ground surface (bgs) of the Allen Drain - West Park Fairground Branch. The drain invert about Veteran's Park is approximately 5.5 feet bgs. From Revena to West Park the drain invert is just below the surface (e.g., 6.5 feet below ground surface); except where it goes under cross streets which are above natural grade. From approximately Veteran's Park to where the drain jogs north of Dexter-Ann Arbor Road, the drain is cast in-place pipe, therefore, groundwater infiltration in this run is highly unlikely regardless of groundwater depth.

Approximate Depth of Allen Drain - West Park Fairground Branch Invert

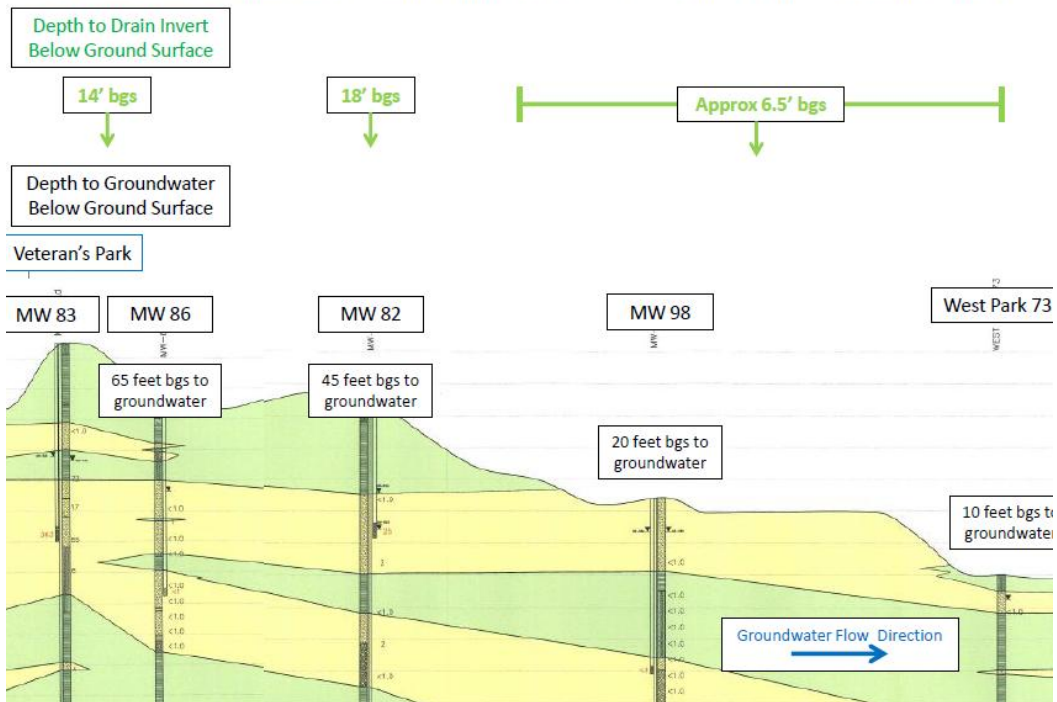


From approximately Veteran's Park to where the drain jogs north of Dexter-Ann Arbor Road, the drain is cast-in-place pipe, therefore, groundwater infiltration is highly unlikely. From Revena to West Park the drain is just below the surface; except where it goes under cross streets which are raised above natural grade..

Below are figures combining the depth to groundwater and depth to drain invert. Given that the depth to groundwater from Veteran's Park until at least MW-98s is below the invert of the drain, the dioxane detected in the Allen Drain at the southwest corner of West Park is from a local undefined shallow dioxane plume about West Park. The origin of the dioxane contaminated groundwater infiltrating the drain is not from the highly contaminated area about Veteran's Park.

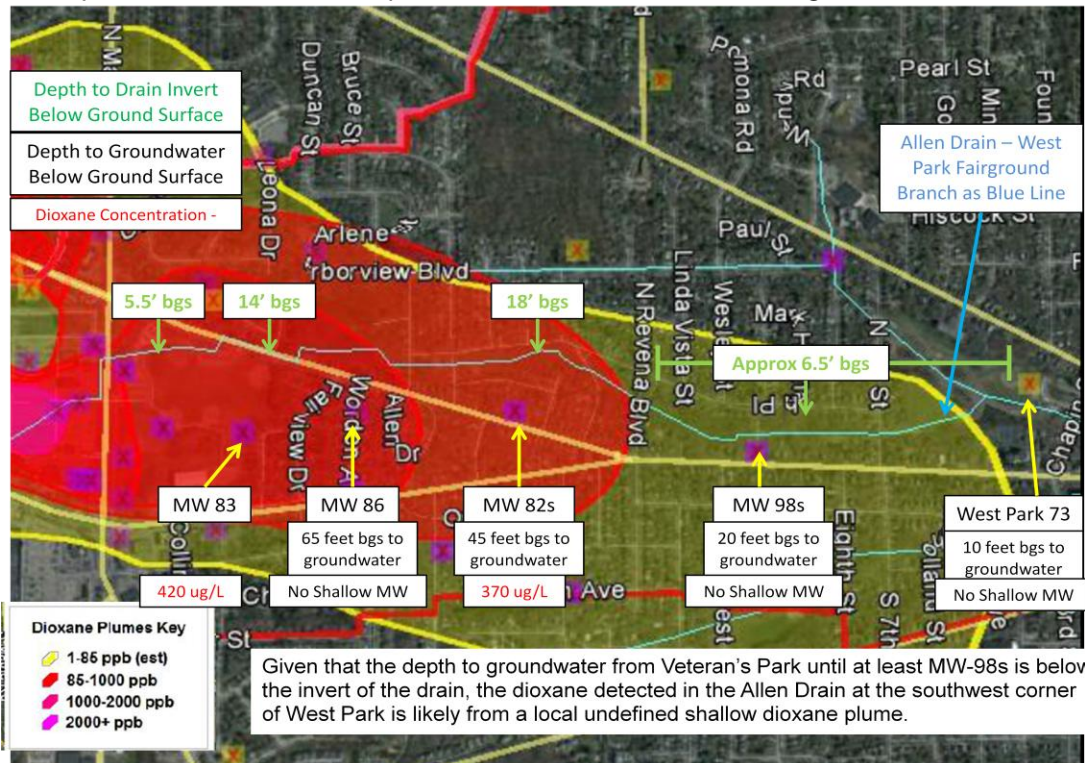
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Depth to Groundwater & Depth to Allen Drain - West Park Fairground Branch invert

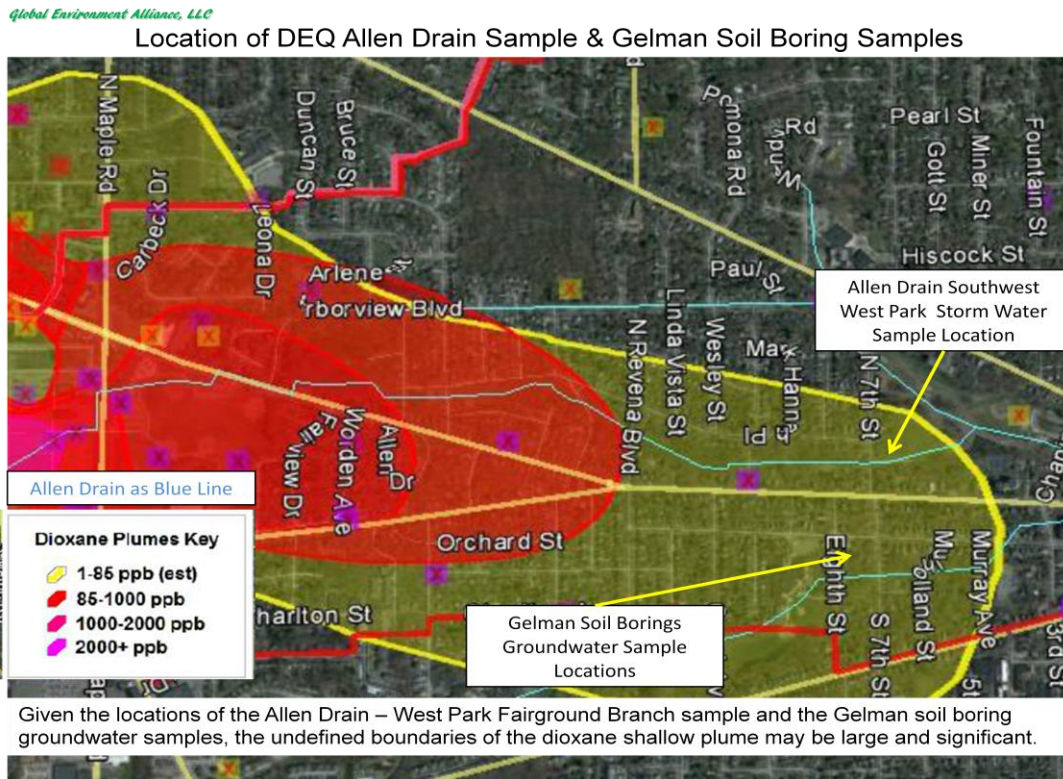


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Depth to Groundwater & Depth of Allen Drain - West Park Fairground Branch Invert

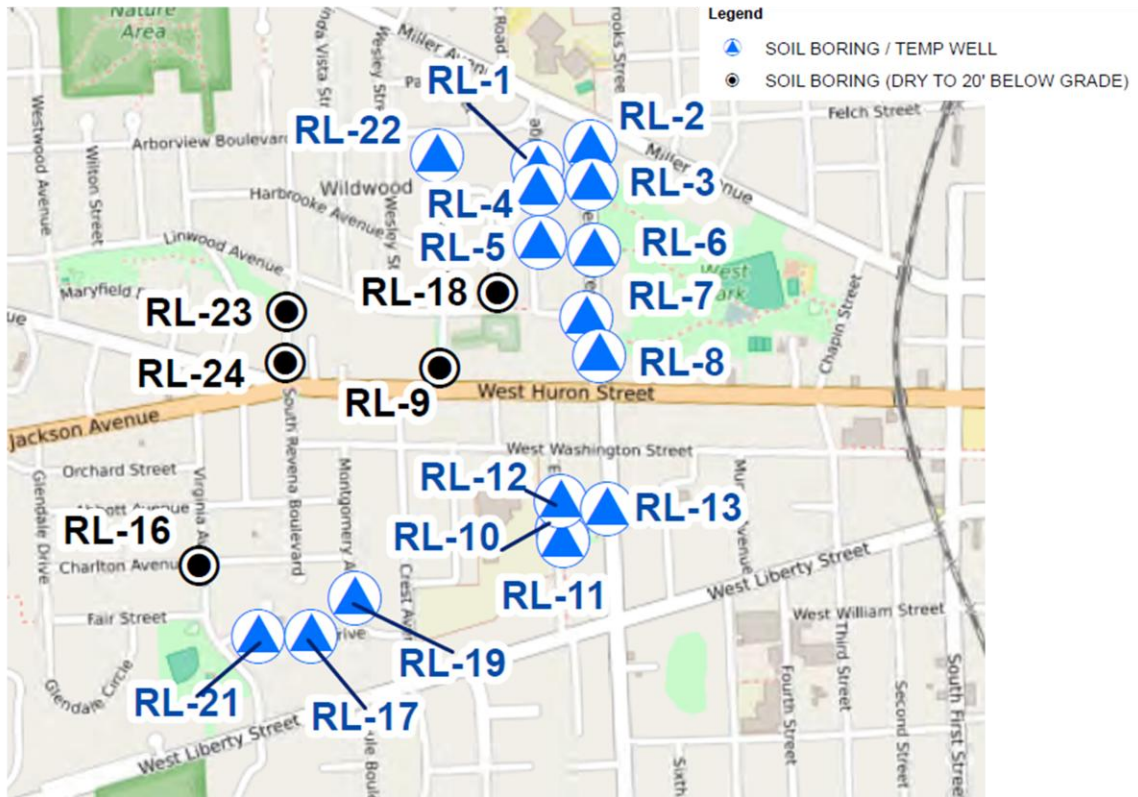


There is a large distance between the sampling locations of the 2018 Allen Drain in the southwestern portion of West Park and the Gelman 2016 Soil Boring 12 & Soil Boring 13 where dioxane was found, see the below figure. Therefore, there is a large and significant undefined shallow dioxane plume in the Old West Side.

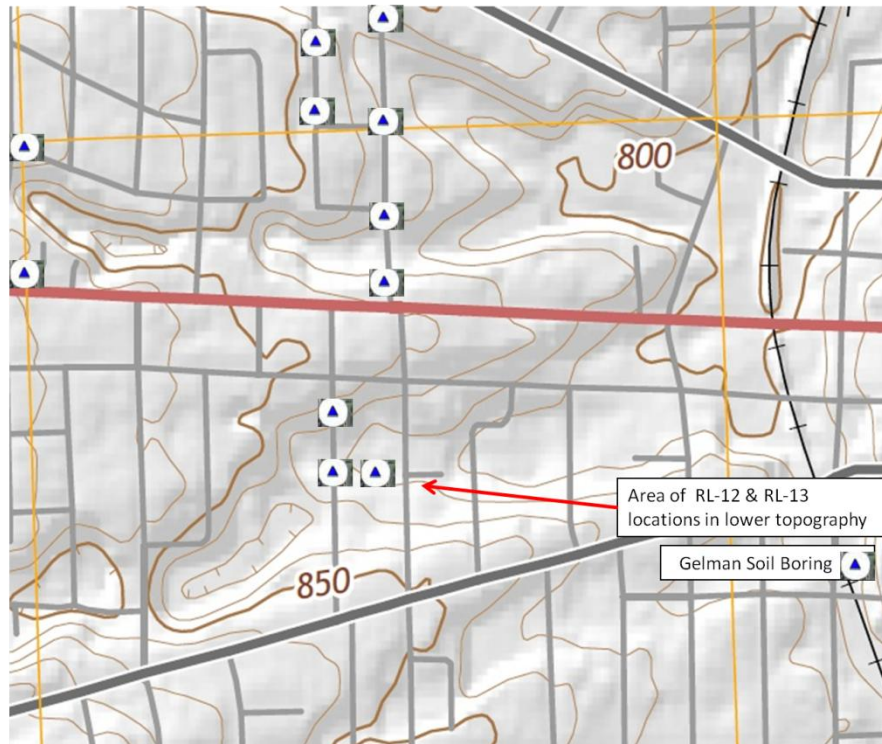


The 2016 Gelman soil boring groundwater work was very limited and stopped with the detection of 1.9 ug/L and 3.3 ug/L dioxane in two soil borings. The 2016 Gelman work did not determine whether the 1.9 ug/L to 3.3 ug/L dioxane was from the middle of a shallow dioxane plume or the edge of a shallow dioxane plume. Except for the two borings which detected the dioxane, RL-12 and RL-13, the 2016 Gelman work collected no sample from the lower topographic areas of West Park and the surrounding area, see below figures showing: the local topography based upon US Geological Survey topographic surface levels; and actual location of the 2016 Gelman soil borings. Therefore, the 2016 Gelman work did not allow for the determination of whether construction or utility workers may be exposed to shallow dioxane contamination or whether buildings are in contact with the dioxane shallow plume in these most sensitive/most at-risk low areas (e.g., along Chapin Street).

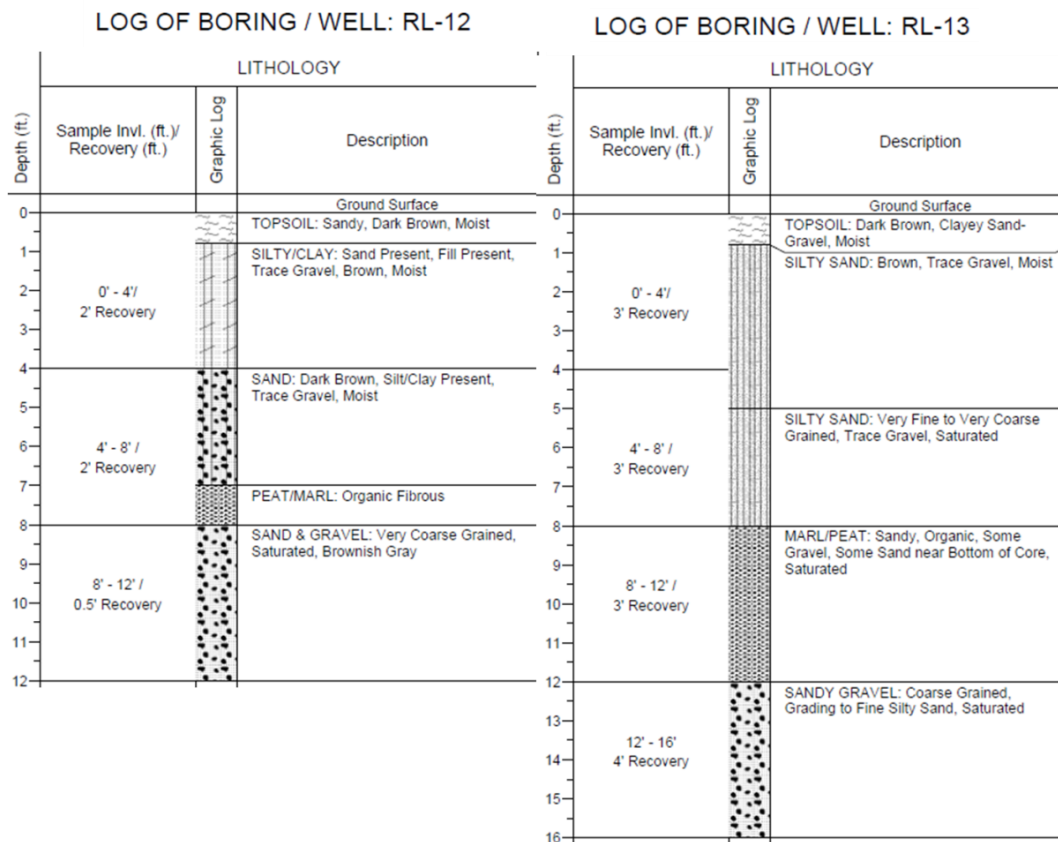
Actual Gelman Shallow Groundwater Sampling Locations



Location of Main Gelman Groundwater Sampled Locations in the West Park & Surrounding Area Overlaid on US Geological Survey Topographic Map



Most 2016 Gelman sampled locations (which in some cases differ from the DEQ Work Plan locations) where at topographic high points along 7th Avenue and hydraulically up-gradient of West Park, see the above figures. The USGS map shows shaded elevation contours. The 2016 Gelman Report states that water table elevations at the borings in higher topographic areas along 7th Avenue about RL-2, RL-3 and RL-6 ranged from 825.07 to 834 feet mean sea level and no dioxane was detected, whereas, the two borings at a lower topographic level about RL-13 had shallow groundwater located at 811 feet mean sea level with dioxane ranging from 1.9 ug/L to 3.3 ug/L. The two lower elevation borings (RL-12 and RL-13) with dioxane intersected a lower sand and gravel unit which is likely a main conduit for the dioxane (see the below extract from the boring logs in the 2016 Gelman Report). The higher topographic level borings did not reach this lower sand and gravel horizon, according to their boring logs. Based upon the land topography, water elevations and lithology, the lower topographic areas are more likely to be in contact with the shallow portion of the aquifer containing the dioxane plume. As evidenced by the 800 foot mean sea level contour line in the above USGS map, the lowest areas and most sensitive/most at-risk areas in the West Park and surrounding area were not sampled in the study.



To protect a worker exposed to the shallow dioxane plume during subsurface activities, the Michigan DEQ has compared the shallow groundwater dioxane values to a faulty Michigan DEQ Groundwater Contact Criterion (GCC) of 1,700,000 ug/l dioxane which was eliminated from use by the DEQ in 2013. This GCC was based upon an outdated dioxane toxicity constant (as was the recently replaced DEQ dioxane drinking water criterion) and an exposure equation and factors which were technically flawed, as an example see below GCC equation for non-carcinogens. The GCC only considered skin contact and not the other relevant routes of exposure for a worker in a trench in contact with contaminated groundwater. Additionally, DEQ compares the dioxane results to a USEPA Regional Screening Level of 2,300 ug/L dioxane protective of exposure to skin contact, but again this criterion does not protect against worker exposures from other routes of exposure in a trench like inhalation or inadvertent ingestion.



EQUATION FOR NON-CARCINOGENIC EFFECTS:

$$GCC = \frac{THQ \times RfD \times BW \times AT \times CF_1}{SA \times SP \times EV \times EF \times ED \times CF_2} \quad (2)$$

where,

GCC	(Groundwater contact criterion)	= chemical-specific (ug/L or ppb)
THQ	(Target hazard quotient)	= 1
RfD	(Oral reference dose)	= chemical-specific (mg/kg-day)
BW	(Body weight)	= 70 kg
AT	(Averaging time)	= 7,665 days (21 years x 365 days/year)
SA	(Skin surface area – adult)	= 3,300 cm ²
SP	(Skin penetration per event)	= chemical-specific (cm/event)
EV	(Event frequency)	= 1 event/day
EF	(Exposure frequency)	= 20 days/year
ED	(Exposure duration)	= 21 years
CF ₁	(Conversion factor 1)	= 1E+3 ug/mg
CF ₂	(Conversion factor 2)	= 1E-3 L/cm ³

The Virginia DEQ has established an approximately 353 ug/L dioxane criterion protective of a worker in a trench in contact with shallow groundwater. The Virginia DEQ criterion includes all the relevant routes of exposure, such as dermal contact, inhalation, inadvertent ingestion, etc. USEPA Headquarters Staff has referenced this Virginia DEQ value, as there is no USEPA or

Michigan DEQ criterion protective of a worker in a trench in contact with groundwater from the relevant routes of exposure.

In summary, the GEA Evaluation finds that the 4.4 ug/L dioxane detected in the Allen Drain was from a local shallow groundwater source about West Park and that the concentration of dioxane in this local shallow groundwater source is higher than 4.4 ug/L. The past Gelman and DEQ work about the Old West Side: has not determined the extent or magnitude of the shallow dioxane plume; and has not obtained samples from the lower most topographic areas which present the most risk to workers and residents. There needs to be a full extent and magnitude of dioxane contamination investigation done in the shallow groundwater about the Old West Side with permanent monitoring wells to track the plume migration. The receptors include construction and utility workers and residents in buildings.