Investigative Water Study Report

Interstate 270 and State Route 3 Industrial Site

Franklin County, OH

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Prepared for:

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EXECUTIVE SUMMARY

Friends of Alum Creek Tributaries (FACT) hired MAD Scientist Associates, LLC (MAD) to investigate water quality in Alum Creek adjacent to the Industrial Site near Interstate 270 and State Route 3 in Westerville, Franklin County, Ohio. The Site is centered approximately on the following coordinates: 40.098505°, -82.934886° (WGS 84). The primary objectives of this study were to assess *in-situ* water quality, laboratory water and sediment chemistry, and health of Alum Creek using a bioassay to test sediment toxicity and an Invertebrate Community Index (ICI). Methodology followed protocol developed from the Ohio Environmental Protection Agency (Ohio EPA).

Fieldwork was completed by MAD staff - Environmental Scientist, Jenna Odegard and Environmental Technician, Kate Gorman - on August 1st, August 19th, September 30th and October 1st. Five locations along Alum Creek were sampled for *in-situ* water quality and laboratory water and sediment chemistry. Two of these locations (one upstream and one downstream of the Industrial Site) were also sampled for sediment and macroinvertebrates to complete the bioassay and ICI assessment.

Parameters tested for included water temperature, dissolved oxygen (DO), pH, specific conductivity (SpCond), turbidity, Nitrate (NO_3^-), gasoline range organics (GRO), diesel range organics (DRO), oil range organics (ORO), Cadmium (Cd), dissolved orthophosphorus (OP), and total suspended solids (TSS). Instream sampling found the following concerning results: the average conductivity exceeded the ideal range for many species. ORO and DRO levels were higher near the outfall, though the Ohio EPA has not established thresholds to discern normal vs. elevated levels of oil range organics.

Bioassay testing with sediment collected from upstream and downstream of the Industrial Site revealed a 12.5% lower survival rate for the midge (*Chironomus dilutus*) in the downstream sample than in the upstream sample. The downstream sample was significantly different from the laboratory control, based on a p-value of 0.05, while the upstream sample was not. Finally, using the ICI assessment, structural community differences were noted between the upstream and downstream sampling locations however, the ICI scores were similar. Upstream and downstream received scores of 34 and 36, respectively and were evaluated as “marginally good” to “good.”

Based on the sediment chemistry analysis and bioassay findings, there were no clear violations of established water quality standards; however, there were some indications of environmental quality degradation found downstream of the Industrial Site. Therefore, it is recommended that the Ohio EPA review these findings and determine if more monitoring is needed, or if corrective actions, possibly through permit revisions, need to be established for the Site.

INVESTIGATIVE WATER STUDY REPORT

INTERSTATE 270 AND STATE ROUTE 3 INDUSTRIAL SITE
FRANKLIN COUNTY, OH

1 INTRODUCTION

Friends of Alum Creek Tributaries (FACT) hired MAD Scientist Associates, LLC (MAD) to investigate water quality in Alum Creek adjacent to the Industrial Site (henceforth referred to at the Site) near Interstate 270 and State Route 3 in Westerville, Franklin County, Ohio. The sampling reach was centered approximately on the following coordinates: 40.098505°, -82.934886° (WGS 84). The primary objectives of this study were to evaluate Alum Creek *in-situ* water quality, water and sediment chemistry via laboratory testing, and health of Alum Creek using a bioassay and an Invertebrate Community Index (ICI). ICI methodology followed protocol developed from the Ohio Environmental Protection Agency (Ohio EPA, 2015).

Field work was completed by MAD staff Environmental Scientists (Team) on behalf of FACT. The Team was led by Qualified Data Collector (QDC #01167) Jenna Odegard, with assistance from Environmental Technician Kate Gorman. The Team made Site visits and conducted sampling on August 1st, August 19th, September 30th and October 1st. Weather conditions during field work were sunny and moderately hot (high of about 90 degrees Fahrenheit), with no precipitation during sampling events. Photographs of the Site are presented in Appendix A.

1.1 Site Background

The Site is located within the Bliss Run-Alum Creek watershed (12-digit Hydrologic Unit Code OH050600011602) in Northern Woods neighborhood in Westerville, Franklin County. It is within the Eastern Corn Belt Plains (ECBP) ecoregion. The drainage area in this location is about 153 square miles (Appendix B).

The area of interest includes Alum Creek and the land adjacent to the east. The land was acquired and owned by Westerville Industrial dating back to 1974 (Franklin County Auditor's Office, 2020). It was developed by the late 1970s and continued expanding into the late 1980s, shown by a historical aerial from December 1979 (ODOT, 2020; Appendix C). Several other companies have owned/currently own the property including, Corna Kokosing Construction, Third Generation Plumbing Inc., Clearwater Pools Inc., Kurtz Bros., and New River Electrical Corporation (Franklin County Auditor's Office, 2020). Before human development, the area was likely a forested riparian corridor of Alum Creek. The Alum Creek multi-use trail runs alongside the river, crossing the river in the upstream portion of the Site. Rip-rap, artificial substrate, and numerous culverts are now present within the river. In the upstream reach, south of interstate 270, Alum Creek is bordered by a well-established, forested riparian buffer. Further south within the assessment area, there is a narrow, forested buffer where numerous industrial facilities (*e.g.*, asphalt plants, concrete plants, and yard waste facilities) border the eastern bank of the stream. A bike trail exists on the west side.

1.2 Citizen Complaints

Since 2013, residents within a two-mile radius of the Site have filed numerous complaints (approximately 134 as of July 2019) to the City of Westerville and the Ohio EPA (Appendix D). Westerville citizens report experiences of strong asphalt/chemical odors that cause headache, cough, nausea, dizziness, and a burning sensation in the sinuses. Several residents have voiced concerns of particulate matter (originating from the Site) coating the insides and outsides of nearby houses. Other reports include noise pollution late at night disrupting residents' sleep. Citizens have also reported the inability to go outside, let children outdoors, or use the trail during peak asphalt production because of the intense effect of the odors.

1.3 Ohio Water Quality Standards

Ohio has water quality standards (WQS) to determine if a surface waterbody is meeting its designated use. These are standards written into Ohio Administrative Code (OAC). OAC 3745-1-04 states criteria applicable to all waters. The general water quality criteria most applicable to this water study include the following, which state that all surface waters shall be:

(A) Free from suspended solids or other substances that enter the waters as a result of human activity and that will settle to form putrescent or otherwise objectionable sludge deposits, or that will adversely affect aquatic life.

(B) Free from floating debris, oil, scum and other floating materials entering the waters as a result of human activity in amounts sufficient to be unsightly or cause degradation.

(C) Free from materials entering the waters as a result of human activity producing color, odor or other conditions in such a degree as to create a nuisance.

(D) Free from substances entering the waters as a result of human activity in concentrations that are toxic or harmful to human, animal or aquatic life or are rapidly lethal in the mixing zone.

2 OBJECTIVES

The primary objectives of this study were to investigate the water quality of Alum Creek, to record any evidence of degradation downstream of the Site, and determine if this section of Alum Creek meets the OAC Water Quality Standards. To do this, sampling of biotic and abiotic components of the creek was performed. Five sampling locations, transitioning from upstream to downstream of the Site were evaluated for *in-situ* water quality (water and sediment chemistry), and two of these sampling locations were additionally evaluated using a bioassay test and ICI sampling and analysis (Figure 1).

3 METHODS

MAD conducted a literature review and background research to become familiar with the Site's history and current condition. The Team conducted reconnaissance on August 1st to gather background information for the development of a sampling plan (Appendix A, Photographs 1-7). Fieldwork and sampling took place on August 19th, September 30th and October 1st to gather data on general characteristics, water quality, water and sediment chemistry, sediment toxicity, and macroinvertebrate community along the Site in Alum Creek (Appendix A, Photographs 8-20). Alum Creek was assessed for approximately 0.8 miles between river miles 18.2 to 19.3 starting from downstream of Interstate 270 toward State Route 3 and terminating near Cooper Park.

Sampling locations (see Figure 1) included the following:

1. Upstream of the Site, just south of I-270;
2. Upstream of the Site, near a tributary where the smell of asphalt fumes were first noticed;
3. Mid-reach near the Site, where riprap was deposited on the east stream bank;
4. Directly next to Site, where an outfall with backflow prevention was discharging (low flow); and
5. Downstream of the Site where the strong odor dissipated and was less noticeable.

For each sampling location, general parameters such as substrate type, water depth and velocity were recorded. Notable features and stream characteristics were documented throughout the reach, as well as observations of pollution and chemical odors, industrial activity, etc.

Sampling locations and noteworthy features were recorded with a hand-held Trimble GeoExplorer 6000XH GPS unit. This unit is capable of sub-foot accuracy following differential correction (post-processing) for improved accuracy. The precision of GPS data is subject to variation in canopy cover, atmospheric interference, and satellite configuration.

3.1 Literature Review

The following data sources were reviewed and used as supplemental information on hydrology, NPDES permits, and land use cover types of the Site:

- Google Earth Library. 2020. USGS Topographic Maps. Northeast Columbus, OH quadrangle.
- Google Earth Pro aerial photographs. Accessed in 2020.
- Ohio Geographically Referenced Information Program (OGRIP). 2013. High Resolution Ortho imagery.
- OGRIP. 2012. LiDAR.
- Ohio Department of Transportation. 2020. Aerial Imagery Archive. Columbus, Ohio.
- Ohio EPA. 2017. Kokosing Construction NPDES Permit.
- Ohio EPA. 2008 and 2010. Waterbody Report for Alum Creek.

3.2 Site Visits and Investigation for Alum Creek

Reconnaissance of the Site took place on August 1st, 2019. Sampling was conducted during two main sampling events. During the first sampling event on August 19th, water quality, water chemistry and sediment chemistry were conducted at five locations. In addition, macroinvertebrate *in-situ* artificial substrate sampling devices called Hester-Dendy (HD) samplers were set at two locations: one upstream of the Site at Sampling Location 1 (Appendix A, Photographs 9-11) and downstream of the Site at Sampling Location 4 (Appendix A, Photographs 16-18).

During the second sampling event on September 30th, water quality monitoring took place again at the five sampling locations. Sediment samples for bioassay testing were collected at upstream and downstream locations and delivered to a contracted lab for analysis (Appendix A, Photographs 12 and 19). The HD samplers were retrieved from both locations and a qualitative macroinvertebrate collection occurred for Sampling Location 1 using dip nets and handpicking from the area in all instream macrohabitat types present (*e.g.*, pool, riffle, run, and margin). Jenna returned to the Site on October 1st to complete macroinvertebrate qualitative sampling at the downstream Sampling Location 4.

3.2.1 Water Quality

At five sampling locations, in-situ field parameters for water quality were measured with a YSI Professional Plus meter (Appendix A, Photograph 13). These parameters include water temperature, dissolved oxygen (DO), pH, specific conductivity (SpCond), turbidity, and Nitrate (NO_3^-). Water samples were collected to analyze for turbidity in the MAD laboratory with a Hach 2100Q portable turbidimeter later. The equipment was calibrated prior to sampling events to ensure proper function. Water velocity was recorded using a rented Hach Portable Velocity Meter. General information such as water depth and site conditions were also recorded each Site visit. General water quality parameters are routinely collected during water studies and can indicate issues or pollution, inform other findings, and therefore were important for us to include to have a basic understanding of the water quality in this reach.

3.2.2 Water and Sediment Chemistry

Water or sediment samples were collected in five locations for chemical analysis during the first sampling event to determine concentrations of the following parameters: gasoline range organics (GRO), diesel range organics (DRO), oil range organics (ORO), Cadmium (Cd), dissolved orthophosphorus (OP), and total suspended solids (TSS). Water samples were collected to test for levels of dissolved OP and TSS, while sediment was collected for the remainder of parameters. Sediment was chosen when allowed as a testing method due to it's ability to show accumulation of contaminants compared to water which typically shows concentrations only at that one moment in time. MAD collected samples and delivered them to Advanced Analytics Laboratory (AAL) within 24 hours of sample collection to be analyzed. Chemical parameters such as suspended solids, oils, metals, nutrients, etc. are often the result of human activity and can be harmful or toxic to human, animal, or aquatic life. For example, OP is a type of phosphorus available for uptake by algae and aquatic plant use. Levels of phosphorus are naturally low within waterbodies and when they are found to be high, it is typically due to human influences (*e.g.*, agriculture, industry, lawn fertilizers etc.), which cause influxes of nutrients into aquatic systems (Pallardy and Jarcho, 2010).

3.2.3 Bioassay

Bioassays can be used to determine if there are pollutant concentrations present that are toxic or harmful to human, animal or aquatic life. Typically, whole sediment toxicity tests are conducted with two species (*Hyalella azteca*; amphipod, and *Chironomus dilutus*; midge) simultaneously, so that a range of organism sensitivity can be assessed in ecosystem risk assessments. *Hyalella* is an epi-benthic organism, whereas *Chironomus* is a burrowing organism. Due to budget restrictions in this preliminary investigative study, only *C. dilutus* was used in the bioassay in order to focus testing efforts on the effects of toxins and pollutants accumulating in the sediment overtime on benthic macroinvertebrates.

One-gallon sediment samples were collected from the upstream and downstream sections of the Site (Sampling Locations 1 and 4) to determine if there was a difference in survival of midges living in these conditions in laboratory settings. Sediment was collected using a metal bowl and spoon and deposited into a screw-top plastic bucket for delivery to the lab. Samples were delivered to Great Lakes Environmental Center (GLEC) laboratories for toxicological analysis on October

1st, within 24 hours of sample collection. The 10-day whole sediment toxicity test using *C. dilutus* was conducted at GLEC from November 1 - 11, 2019.

3.2.4 Macroinvertebrate Community Analysis

Macroinvertebrates were sampled within Alum Creek following methodology and protocols outlined by the Ohio EPA Biological Criteria for the Protection of Aquatic Life (Ohio EPA, 2015). This method uses a combination of HDs and qualitative sampling to calculate an ICI score.

Macroinvertebrate sampling was conducted by MAD technician Kate Gorman and Environmental Scientist, Jenna Odegard, who has her Level 3 qualified data collector (QDC) for invertebrate sample collection and data analysis. During the first sampling event, HDs were set at Sampling Location 1 (upstream) and Sampling Location 4 (downstream). At each location, water depth to HDs, total water depth, water velocity, and distance from bank to HDs were recorded. Flagging tape was tied to overhanging branches above the HDs' locations and the GPS coordinates were recorded to mark their location during retrieval. After six weeks of colonization, both sets of HDs were retrieved. Additional qualitative sampling of all habitats present was performed using dip nets, accompanied by handpicking for macroinvertebrates dwelling on rocks. The sampling team also searched the stream for mussels.

Jenna identified macroinvertebrates and delivered vouchers to Midwest Biodiversity Institute (MBI) for identification confirmation by Level 3 QDC taxonomists. MBI also identified midges (Family: Chironomidae), which are taxonomically diverse and require specific expertise for species-level identification.

Analysis of the macroinvertebrate community using the ICI involves ten structural community metrics, each with four scoring categories of 6, 4, 2, and 0 points, based on the drainage area. Metrics 1-9 are all generated from the artificial substrate sample data, while Metric 10 is based solely on the qualitative sample data. The summation of the individual metric scores (determined by the relevant attributes of an invertebrate sample with consideration given to sampling site drainage area) results in the ICI score, which ranges from 0 (very poor community condition) to 60 (exceptional community condition). The macroinvertebrate community is known to be an indicator

of stream health, and it is regularly assessed in Ohio to evaluate if the water body is attaining its status (*i.e.*, it is performing as it is expected to, based on its designated use).

4 RESULTS

The literature findings and field observations indicate potentially harmful impacts from the Site on Alum Creek. The instream sampling showed higher levels of oil near the industrial plant and decreased survivability of midges from the sediment downstream. Macroinvertebrate communities did not greatly differ between the upstream and downstream samples. Complete findings are discussed in the following sections.

4.1 Literature Findings

In 2008 and 2010, Bliss Run-Alum Creek was impaired due to "unknown" causes (Ohio EPA, 2008; Ohio EPA, 2010). The Ohio EPA watershed reports indicate that stream impairment may be due to excessive oil/grease, heavy metals such as Cd, and excessive sediment (Ohio EPA, 2008; Ohio EPA, 2010). River miles 17.3 to 19.8 were sampled between 1996 and 2001 for macroinvertebrates. ICI scores over this time period have been variable, but the most recent scores were 28 to 30, which would classify macroinvertebrate communities as "fair," indicating some level of biological impairment.

Kokosing Construction Co. has a general NPDES permit with a TSS annual benchmark limit of 100 mg/L. This is very high and unlikely to be surpassed. There is no other pollution benchmark monitoring they are required to do. Benchmark monitoring uses a pollution concentration level that is expected to adversely affect aquatic life and compares it to stormwater outfall results in order to evaluate the performance of stormwater control measures. Although they are a standard asphalt plant, Ohio EPA does not consider them an asphalt emulsion facility, and therefore, they do not have an annual effluent limit for oil and grease. They are required to do quarterly oil and sheen visual inspections, but no limits have been established. If oils or odors are detected, they are to self-report and make corrective actions of any issues. Sometimes they will put in place an odor absorbing material, although this is not required.

4.2 Site Findings

The water study to investigate the impacts of the Site on the health of Alum Creek was completed between August 1st and October 1st. The field efforts included documentation of general conditions, *in-situ* water quality, laboratory-tested water and sediment chemistry, a bioassay and macroinvertebrate community analysis.

4.2.1 General Observations

Reconnaissance of the area via kayak took place on August 1st, 2019 (Appendix A; Photograph 1). The primary substrates present were silt, sand, gravel and cobble throughout the stream (Appendix A, Photograph 2). Artificial substrate/armoring (concrete) was also present on the stream banks bordering a portion of the Site (Appendix A, Photographs 3-4). Water willow (*Justicia* sp.) was common, and during both sampling events, water depths averaged about 12 inches. The stream contained a variety of habitat for aquatic life, including root mats, woody debris, riffles, gravel bars and "islands" of American sycamore (*Platanus occidentalis*) and willow species (*Salix* spp.) Invasive species included honeysuckle (*Lonicera maackii*) along the eroding stream banks. The stream bank vegetation is mowed near the Kokosing plant (Appendix A, Photograph 5). Pawpaw trees (*Asimina triloba*) were also noted.

An inlet tributary entering Alum Creek from the Site was noticed and photographed (Appendix A, Photograph 3). The tributary width was about four feet at the confluence with Alum Creek and narrowed to two feet towards the industrial plant. Substrates ranged from silt to cobble, with highly eroded banks. Sandy soils were noted on the left stream bank (facing downstream). The tributary water depth measured nine inches. The inlet flowed from the Site into Alum Creek (later named Sampling Location 2). A strong odor was noticed downstream near this location. The odor persisted downstream near the Site. There were no observations of stressed vegetation or discolored soils. This strong, noxious odor near the Site was noted again on August 19th and September 30th. At Sampling Location 4, there was an outfall that had a cover with hinge to serve as backflow prevention. It was discharging at low flow during all site visits (Appendix A, Photographs 6-7).

A variety of wildlife were seen and/or heard during site visits including gray tree frogs (*Hyla versicolor*), kingfisher (*Megaceryle alcyon*), great blue heron (*Ardea herodias*), mottled sculpin

(*Cottus bairdii*), bass (*Micropterus* sp.) and another large fish (most likely a common carp [*Cyprinus carpio*] or white sucker [*Catostomus commersonii*]). A non-living and somewhat weathered mucket (*Actinonaias ligamentina)* shell was found downstream of Sampling Location 1 (Appendix A, Photograph 21). One Eastern spiny softshell turtle (*Apalone spinifera spinifera*) was observed sunning on a bank at Sampling Location 5 adjacent to Cooper Park.

4.2.2 Water Quality

Complete water quality data from each location is listed within Appendix E. The averages (and standard deviation) of water quality sampling results for the Site at Alum Creek are displayed on Table 1. The average conductivity of this portion of Alum Creek exceeds the ideal range (150-500 µs/cm) for fisheries and indicates that the creek may not be suitable for certain species of fish and macroinvertebrates (USEPA, 2012). Conductivity levels were not noticeably higher near the Site, however, they were high at Sampling Location 2 (near the tributary), which had the highest levels of conductivity compared to the other sampling points within Alum Creek. In September, this amount was almost double the upper range value of ideal conductivity, meaning there are excess ions in the water. In our samples, conductivity was generally high and road salt runoff or sewage overflow pipes entering Alum Creek could be an influence. The tributary running through the Site is likely the source of high conductivity, but also had the lowest Nitrate value. Nitrate values were collected only in September, but were low with a median of 0.95 mg/L. All values were below the 10 mg/l Maximum Daily Limit (MDL) enforced by the USEPA for drinking water (USEPA, 2017) and well below 100 mg/L, which is the average for agricultural fields.

Table 1. Averaged Water Quality Results of Five Sampling Locations within Alum Creek adjacent to the Industrial Site near Interstate 270 and State Route 3 in Westerville, Franklin County, Ohio. Samples were collected in August and September 2019.

Analysis	Date	Depth (inches)	Flow (ft/sec)	Temp (ºC)	DO (mg/L)	DO Sat (%)	pH	SpCond (umho/cm)	Turb (NTU)	NO_3^- (mg/L)
Average	8/19/2019	12	0.38	24.2	6.47	77.3	7.71	506.4	9.82	*
St. Dev	8/19/2019	12.5	0.28	0.44	0.34	3.8	0.22	77.1	2.05	*
Average	9/30/2019	11.55	0.378	22.88	6.56	76.58	7.81	804.6	4.942	0.892
St. Dev	9/30/2019	9.69	0.65	1.04	0.61	8.0	0.25	128	1.54	0.43

Temp= Temperature; DO=Dissolved Oxygen; DO Sat=Dissolved Oxygen Saturation; SpCond=Specific Conductivity; Turb=Turbidity; NO_3^-=Nitrate; *no data; error in reading/probe

Average DO levels within this section of Alum Creek meet the 6 mg/l required for sanitary wastewater (Ohio EPA, 2018). Additionally, average DO concentrations at all sampling points meet the minimum value required for most invertebrates (4 mg/L; Fondriest, 2013). DO is also within the ideal range for salmonids (USEPA, 2012). Although salmonids are not present in Alum Creek, this threshold provides a potentially useful benchmark of sensitive species for comparison. pH values became closer to alkaline (basic) from Sampling Location 1 to Sampling Location 5. The recommended pH range for most fish is between 6.0 and 9.0 (Fondriest, 2013). All *in-situ* water samples tested at Alum Creek were within this range.

4.2.3 Water and Sediment Chemistry

Appendix F summarizes the water and sediment chemistry analysis results from AAL. OP levels within Alum Creek ranged from 0.08-0.19 mg/L. The highest level of OP was found was at Sampling Location 4, near the outfall of the Site. This level was just above 0.18mg/L, which permit levels for monitoring nearby sites such as the Alum Creek Water Reclamation Facility (WRF) estimate to be the 50th percentile (Ohio EPA, 2017). TSS levels are not of concern, ranging from 5 to 10 mg/L. The highest level sampled in Alum Creek was 10 mg/L, which does not exceed the annual effluent limit of 100 mg/L. Similar permit levels indicate 46.9 mg/l is the 50th percentile and (Ohio EPA, 2017).

GRO and Cd were measured to be at levels below detection limits of the analysis, meaning they were below 1 mg/kg and 0.5 mg/kg, respectively. ORO levels were low upstream, starting at 21 mg/kg at Sampling Location 1, increased near the Site and spiked to their highest level of 296 mg/kg at Sampling Location 4, at the Site's outfall location. This is 14 times higher than the level of ORO found upstream of the Site. The Ohio EPA does not have specific guidance or thresholds to discern normal versus elevated levels of oil range organics. Formal guidelines exist for sites with underground storage tanks, which require ORO levels in soil to be under 5,000 mg/kg, otherwise action must take place (BUSTR, 2017). The highest ORO level (296 mg/kg) sampled at Alum Creek was well below this threshold; however, corrective action to reduce the amount of oil is recommended to protect Alum Creek from further degradation. Similarly, DRO levels were highest again at Sampling Location 4. There, near the outfall, they reached 50 mg/kg, while upstream of the Site they were non-detected (*i.e.*, less than 10 mg/kg). Sampling Location 4 was 3.7 times higher in DRO than was found at Sampling Location 2. This indicates there is likely a

point source because of the spiked level of oils, but may also be some oil runoff from the Site's property overall.

Maximum oil and grease levels outside of the mixing zone should be less than 1,000 mg/kg (converted from 10 mg/L in Table 37-1; Ohio EPA, 2018). This data does not reach that threshold, however OAC 3745-1-37 for statewide water quality criteria for recreation use designations and aesthetic conditions states that, "Surface waters shall be free from floating oils and shall at no time produce a visible sheen or color film. Levels of oils or petrochemicals in the sediment or on the banks of a watercourse which cause deleterious effects on the biota will not be permitted" (Ohio EPA, 2018). There may be hidden effects of this oil input, such as biological impacts as seen in the following section.

4.2.4 Bioassay

Sediment collections for the bioassay conducted at GLEC laboratory found that there was a statistically significant reduction (p-value < 0.05) in *C. dilutus* survival in the downstream sediment samples after 10 days of exposure when compared to the control. Meanwhile, the upstream and control samples were not significantly different from each other, based on an accepted p-value of 0.05 (Tables 2 and 5 in Appendix G). This indicates that there may be impact from pollutant accumulation in the sediment downstream of the Site that does not exist in the upstream or laboratory control sediments. The midges in the downstream sediment sample had a 12.5 percent lower survival rate than in the upstream sediment sample (Table 2). Although this is a large decrease in survival, upstream and downstream samples were not significantly different from each other.

Table 2. Bioassay Results from Alum Creek Upstream, Downstream, and Laboratory Control Samples. Table duplicated from Table 5 in Bioassay Report by GLEC (Appendix G).

	Chironomus dilutus 10-day Test					
	10-Day Percent Survival		Average Ash Free Dry[1] Weight (mg)		Average Biomass[2] Weight (mg)	
Laboratory Control 1°	88.8	Steel's Many	0.949	Bonferroni T-Test	0.839	Wilcoxon's Rank Sum
GLC# SS416 Alum Creek Downstream	72.5 *		0.685 *		0.492 *	
GLC# SS417 Alum Creek Upstream	85.0		0.699 *		0.570 *	

* Significantly different from laboratory control sediment ($p \leq 0.05$)

[1] Average Ash-Free dry weight is the total dry weight divided by the number of surviving organisms

[2] Biomass weight is the total dry weight of surviving organisms divided by the initial number of organisms

Growth and biomass at the upstream and downstream location were not significantly different from each other but were both significantly different from the laboratory control. The complete Sediment Toxicity Report can be found in Appendix G.

4.2.5 Macroinvertebrate Communities

The field sampling sheets and macroinvertebrate taxa lists for upstream and downstream sampling locations can be found in Appendices H and I. A total of 3,241 and 3,200 organisms were identified from the upstream and downstream macroinvertebrate samples, respectively.

Upstream and downstream samples received ICI scores of 34 and 36**,** respectively, categorizing them as "marginally good" and "good," based on their location within the ECBP region with a drainage area of 153 square miles (Tables 3 and 4). Overall, these scores are at the top and bottom of the scoring category breaks and therefore are considered to be very similar communities. There were differences noticed in the macroinvertebrate communities, such as the upstream sample having a greater percentage of caddisflies and lower percentage of mayflies than downstream (both generally high quality macroinvertebrates), but these differences in scores balanced out across sampling locations. The overall ICI score 2-point difference in score is attributed to the fewer

number of dipteran taxa in the upstream sample compared to the downstream sample. However, within the upstream sample, we found twice as many individuals of a sensitive taxa (*Tanytarsini* tribe midges; 8.6%) compared to downstream (3.7%), which may indicate slightly better conditions upstream than downstream. However, this difference was not sufficient to influence the metric score.

Table 3. ICI Results of Alum Creek Sampling conducted in 2019 upstream of the Industrial Site near interstate 270 and State Route 3 in Westerville, Franklin County, Ohio.

Upstream Sample Data Evaluation			
Metrics	**Metric Name**	**Number**	**Score**
1	Total number of taxa	51	6
2	Number of mayfly taxa	4	2
3	Number of caddisfly taxa	4	4
4	Number of dipteran taxa	14	4
5	% mayfly composition	8.73	2
6	% caddisfly composition	32.86	6
7	% tribe *tanytarsini* midge composition	8.64	2
8	% other dipteran and non-insect composition	48.35	2
9	% tolerant organisms	8.08	4
10	Number qual EPT taxa	10	2
Total Score		**34**	
Narrative Rating		**Marginally good**	

Table 4. ICI Results of Alum Creek Sampling conducted in 2019 downstream of the Industrial Site near interstate 270 and State Route 3 in Westerville, Franklin County, Ohio.

Downstream Sample Data Evaluation			
Metrics	**Metric Name**	**Number**	**Score**
1	Total number of taxa	60	6
2	Number of mayfly taxa	5	2
3	Number of caddisfly taxa	3	4
4	Number of dipteran taxa	22	6
5	% mayfly composition	45.41	6
6	% caddisfly composition	5.15	2
7	% tribe *tanytarsini* midge composition	3.71	2
8	% other dipteran and non-insect composition	44.35	2
9	% tolerant organisms	6.87	4
10	Number qual EPT taxa	9	2
Total Score		**36**	
Narrative Rating		**Good**	

5 SUMMARY & CONCLUSIONS

Approximately 0.8 miles of Alum Creek upstream and downstream of the Site was assessed, starting from downstream of Interstate 270 toward State Route 3 and ending near Cooper Park. MAD evaluated *in-situ* water quality (water and sediment chemistry) at five locations, and evaluated the health of Alum Creek using a bioassay test and ICI sampling and analysis at two locations. Water quality results generally fell within normal ranges for stream health for all sampled parameters except for SpCond, which was above the known ideal level at all but one sampling point during one event and was found to be highest during both sampling events at Sampling Location 2.

From all laboratory-tested water and sediment chemistry samples analyzed, DRO and ORO levels were highest near the Site outfall, and thought to be of concern, though Ohio EPA does not provide standards to determine normal vs. elevated levels of oil. It is recommended that the Ohio EPA investigate these oil concentrations further. Bioassay testing revealed a 12.5 percent lower survival rate for the midge (*C. dilutus*) in the downstream sediment sample than in the upstream sediment sample. The downstream sediment sample was significantly different in midge survival from the upstream and laboratory control samples, based on an accepted p-value of less than 0.05. Finally, Based on upstream and downstream ICI scores of 34 and 36**,** respectively, macroinvertebrate communities upstream were categorized by the narrative rating as “marginally good” while downstream communities were categorized as “good.”

OAC WQSs require that all waters of Ohio shall be “free from floating debris, oil, scum and other floating materials entering the waters as a result of human activity in amounts sufficient to be unsightly or cause degradation”. There is evidence that this is not the case, because levels of ORO were 14 times higher near downstream of the Site compared to upstream.

The OAC also states that all waters of Ohio shall be “free from substances entering the waters as a result of human activity in concentrations that are toxic or harmful to human, animal or aquatic life or are rapidly lethal in the mixing zone.” The toxicology bioassay indicated significantly lower survivability of the midges living in sediment collected from downstream of the Site compared to upstream location and the laboratory control. This may indicate harmful impacts from the Site, and we recommend that more testing be carried out to better understand the causes of this toxicity.

Furthermore, based on the number of citizen complaints and the amount of ORO and DRO detected, it seems that qualitative odor and sheen quarterly visual inspections along with self-report may be insufficient for this Site. We recommend that, at a minimum, the Ohio EPA require that the industrial operation review and revise their processes and stormwater management practices (BMPs). It would also be prudent to establish an oil limit in their NPDES general permit through benchmark monitoring, or even consider requiring an individual permit to address neighborhood complaints and protect Alum Creek water quality.

MAD recommends that the Ohio EPA further investigate water quality and BMPs at the Site and continue water and macroinvertebrate monitoring to evaluate impacts to Alum Creek and the watershed. Additionally, conducting fish sampling may further elucidate adverse impacts to community structure and the health of individual organisms. This will ensure that the Site is meeting the OAC WQSs requirements are being met.

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FIGURES

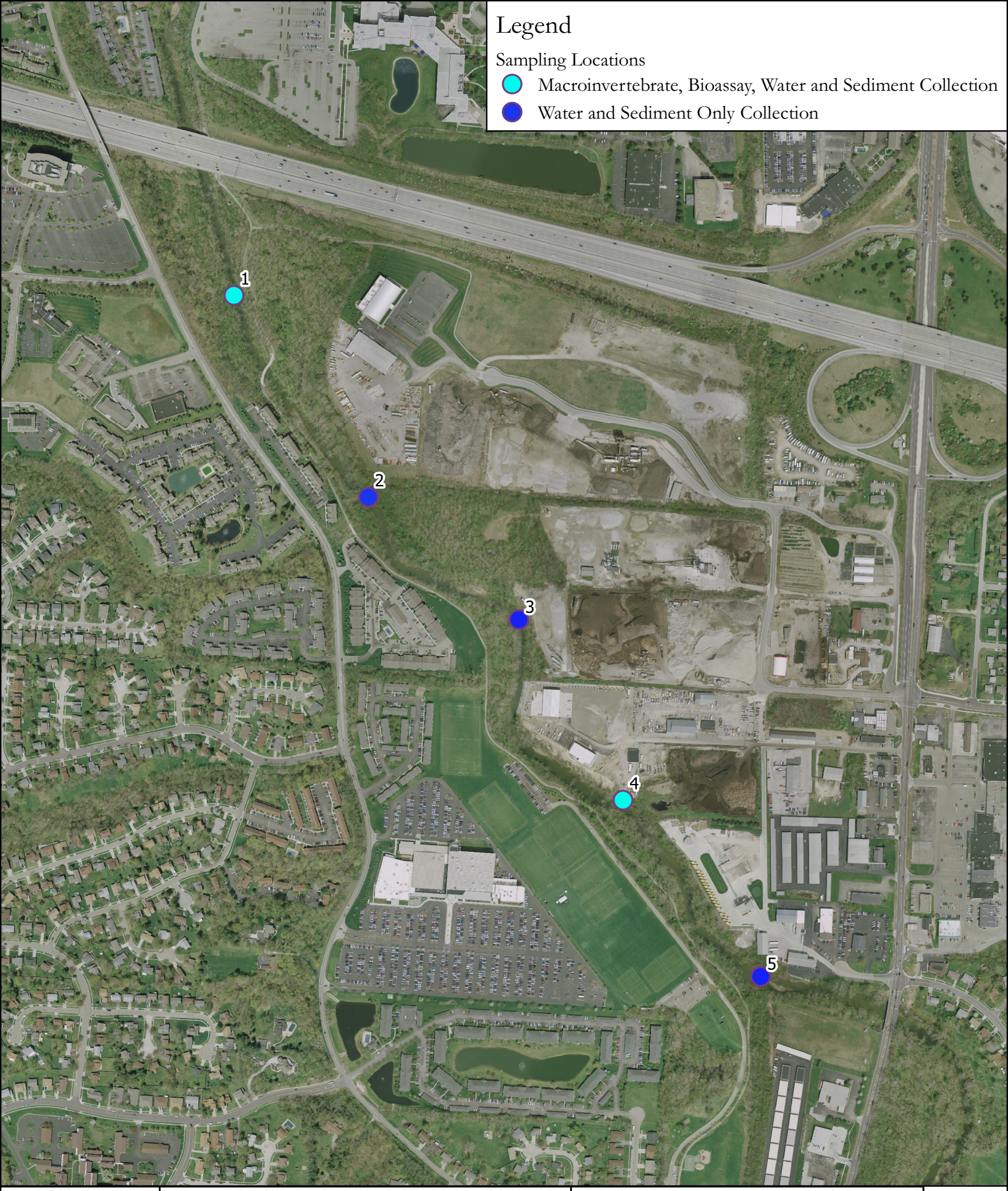


Figure 1. Sampling Locations
FACT Water Study- Industrial Site
Westerville, Ohio

Sources:,Ohio Statewide Imagery Program II (2013).

MAD SCIENTIST ASSOCIATES LLC

Date: November 21, 2019

0 250 500 750 1000 1250 1500 ft

Created By: Jackie Kopechek;
Modified By: Jenna Odegard

APPENDIX A

Photographs

Photograph 1 (Taken 8/1/2019). General view from a kayak of Alum Creek downstream of the I-270 bridge with about 16 inches of water flowing between water willow. Photograph taken facing southeast.

Photograph 2 (Taken 8/1/2019). Representative view of substrate comprised of sand, cobble, and gravel. Photograph taken upstream of the Industrial Site.

Photograph 3 (Taken 8/1/2019). Representative view of tributary coming from the Industrial Site entering Alum Creek from the eastern side. Silty soils and concrete were present on the banks.

Photograph 4 (Taken 8/1/2019). Concrete slab armored bank with an outflow pipe that was not flowing during the sampling events. Photograph taken of stream bank left facing east.

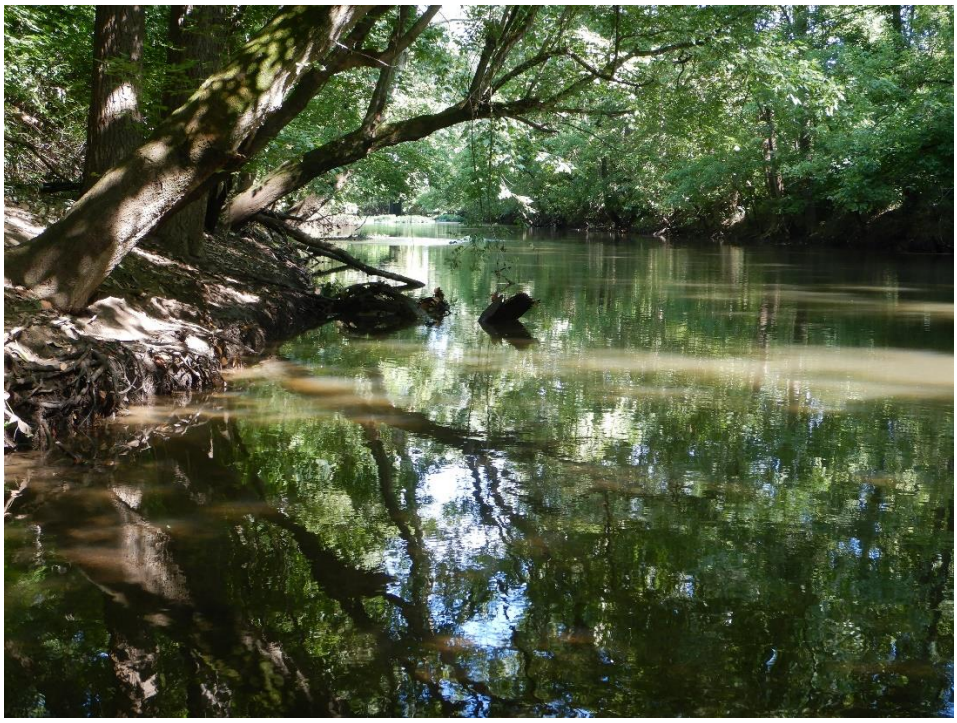
Photograph 5 (Taken 8/1/2019). Root wads and signs of erosion in Alum Creek adjacent to the industrial site. Trucks can be seen beyond the mowed vegetated buffer. Photograph taken of stream bank left facing east.

Photograph 6 (Taken 8/1/2019). A capped outflow culvert set back approximately 15 feet from Alum Creek was seen leaking liquid through the sampling events. Photograph taken facing northwest.

Photograph 7 (Taken 8/1/2019). Liquid seen flowing out of capped outfall pipe near the Industrial Site.

Photograph 8 (Taken 8/19/2019). Sampling Location 1, where water quality, water and sediment chemistry, toxicity and macroinvertebrate samplers were collected upstream of the Industrial Site.

Photograph 9 (Taken 8/19/2019). Macroinvertebrate Hester Dendy (HD) sampler set at Sampling Location 1.



Photograph 10 (Taken 8/19/2019). Photograph taken from HD sampler location facing upstream at Sampling Location 1.

Photograph 11 (Taken 8/19/2019). Photograph taken from HD sampler facing downstream at Sampling Location 1.

Photograph 12 (Taken 9/30/2019). Photograph of sediment collected for sediment toxicity and bioassay testing from Sampling Location 1.

Photograph 13 (Taken 8/19/2019). Water quality data collection at Sampling Location 2.

Photograph 14 (Taken 8/19/2019). Water quality Sampling Location 3. Artificial concrete slabs present on the stream bank.

Photograph 15 (Taken 8/19/2019). Sampling Location 4, where water quality, water and sediment chemistry, and toxicity samples were collected downstream of the Industrial Site. Photograph taken facing upstream and north.

Photograph 16 (Taken 8/19/2019). Macroinvertebrate Hester Dendy (HD) sampler set at Sampling Location 4.

Photograph 17 (Taken 8/19/2019). Photograph taken from HD sampler location facing upstream at Sampling Location 4.

Photograph 18 (Taken 8/19/2019). Photograph taken from HD sampler location facing downstream at Sampling Location 4.

Photograph 19 (Taken 9/30/2019). Photograph of sediment collected for sediment toxicity and bioassay testing from Sampling Location 4.

Photograph 20 (Taken 8/19/2019). Water quality tested at Sampling Location 5. Photograph taken facing northwest.

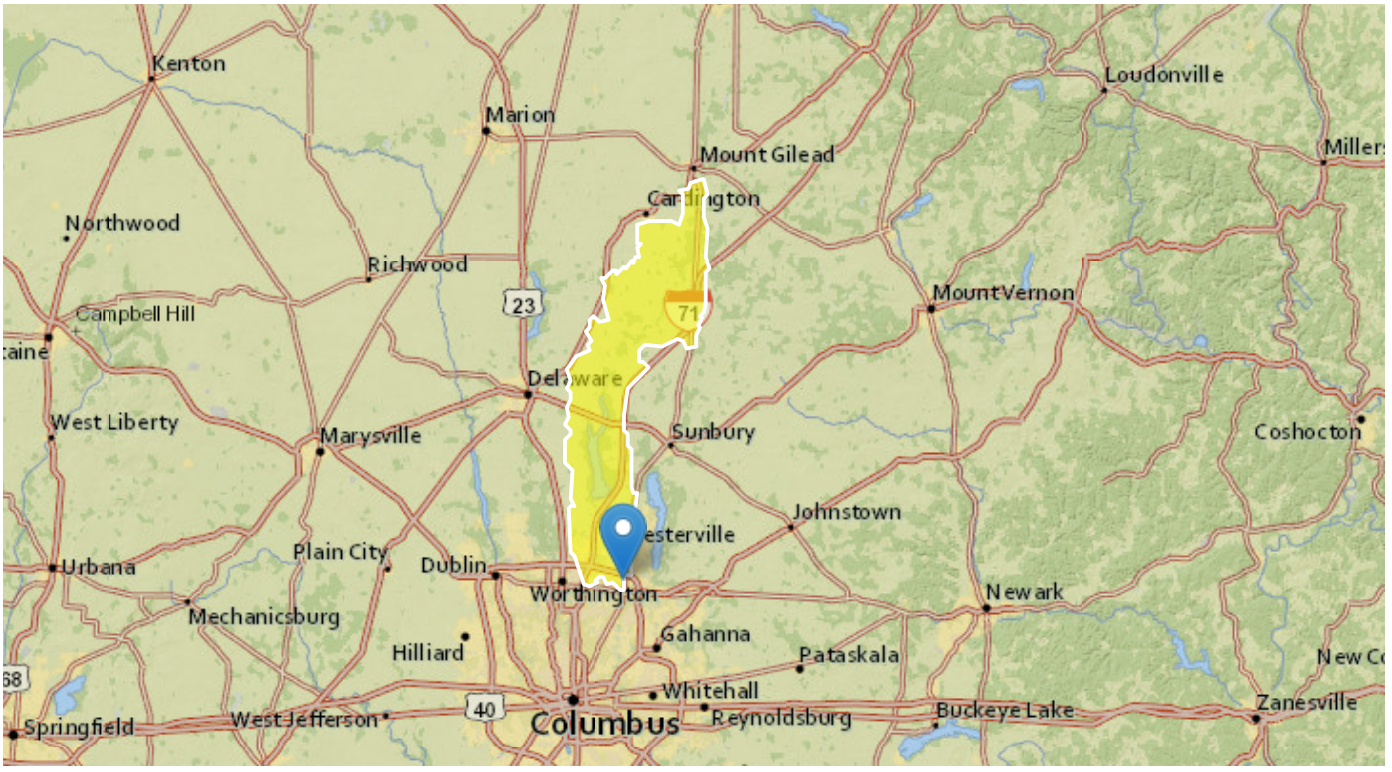
Photograph 21 (Taken 9/30/2019). The only mussel found within sampling reach was a non-living mucket (*Actinonaias ligamentina*) shell observed downstream of Sampling Location 1.

APPENDIX B

StreamStats Watershed Map

StreamStats Report

Region ID: OH
Workspace ID: OH20190531173740164000
Clicked Point (Latitude, Longitude): 40.09459, -82.93062
Time: 2019-05-31 13:38:01 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	153	square miles
LC92STOR	Percentage of water bodies and wetlands determined from the NLCD	3.74	percent
STREAM_VARG	Streamflow variability index as defined in WRIR 02-4068, computed from regional grid	0.76	dimensionless
LAT_CENT	Latitude of Basin Centroid	4464379.0278	decimal degrees

General Flow Statistics Parameters[Low Flow LatGT 41.2 wri02 4068]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	153	square miles	0.12	7422
LC92STOR	Percent Storage from NLCD1992	3.74	percent	0	19
STREAM_VARG	Streamflow Variability Index from Grid	0.76	dimensionless	0.25	1.13
LAT_CENT	Latitude of Basin Centroid	4464379.0278	decimal degrees	41.2	41.59

General Flow Statistics Disclaimers[Low Flow LatGT 41.2 wri02 4068]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

General Flow Statistics Flow Report[Low Flow LatGT 41.2 wri02 4068]

Statistic	Value	Unit
Harmonic Mean Streamflow	0.0000217	ft^3/s

General Flow Statistics Citations

Koltun, G. F., and Whitehead, M. T.,2002, Techniques for Estimating Selected Streamflow Characteristics of Rural, Unregulated Streams in Ohio: U. S. Geological Survey Water-Resources Investigations Report 02-4068, 50 p (http://oh.water.usgs.gov/reports/wrir/wrir02-4068.pdf)

Application Version: 4.3.1

APPENDIX C

Historical Aerial Photograph

Aerial of the Industrial Site taken in December 1979 (ODOT, 2020).

APPENDIX D

Citizen Complaints

IV. CITIZEN TESTIMONIALS & EXPRESSIONS OF CONCERN:

Collected via facebook, in person, via OEPA public record requests, etc.
** Westerville residents or experienced in Westerville

1. **D:** 2 miles sw of industrial site—8/1/14…OEPA--"Mr. R. called today to report that the asphalt plant odor was very strong today at approx.. 8 a.m. in the area of his house."

2. **M: 1.9 miles NE of the industrial site—5/15/13—OEPA-- "Mrs. C called to report that the asphalt plant odor was extremely strong this morning at 8:30 a.m. and that she experienced a significant headache after experiencing the odors…"

3. **Anonymous: ~1/4 mile from site—7/7/12. An OEPA Rep says: "I had a voicemail this morning from someone saying they were driving by the giant piles of asphalt plant on 270 and rt 3 around 9:00 last night and had to close the windows of their car because of a strong chemical burning smell that caused his eyes to burn and cough…"

4. **D: NW of site, ~1.5 miles. I work at 270 and Cleveland. Close enough to get some of the odor. Always makes me physically ill. To the point of needing to sit down because I'm so nauseous and dizzy. Happens every time I get anywhere around that smell.

5. **J: I smell it every time I use that exit, it's terrible. I actually try to avoid the exit if I can.

6. **T:** Sometimes the smell is faint. Sometimes I can't open my windows because it smells so bad. A couple times I was embarrassed to have friends over it smelled so bad. I started getting headaches 6 or 7 years ago. I can't say if it is or isn't caused or affected by the odors. We moved to Huber R. in 1996. 26 years ago come March. I can say for sure back then there was no putrid smell. I remember being able to be outside with my kids for hours at a time with no terrible odors. The worst odors have just started in the last several years. I grew up near A.B. brewery so I am used to some odors being present but the ones here in the last few years are truly awful

7. **J: ~2 miles NE of site: Nov. 11, 2014: OEPA Rep states: "J. R. called city of Westerville to complain about odors from Scioto Materials. He said the citizen said he could smell the facility inside his home with doors and windows closed and the odors made him nauseous."

****8. P:** I know the kids hate playing out on recess because it smells so bad. I know I would love to be able to sit out on my patio and enjoy a cup of coffee and read a good book but I can't with that smell.

9. L: E/SE of site. Spring, 2015, Huber Ridge: I am working in the yard again. I have brought out my glass top outdoor furniture that I can clean to shiny. In just a few hours on some days, a residue, a gray, gritty residue, will develop—it's not dust. I am almost 52 years and although I am by far not Martha Steward worthy, I know what dust is…I leave my windows open in spring/summer/early fall and the stuff is on the screens(which I am getting ready to replace all of them) and gets in the house—this isn't regular "dust." My parents resided in a rural area of low traffic and had outdoor glass top furniture. They did not have "industrial" operations and they never had this mess. I am not as concerned about the "compost" odor (perhaps I should be) although it does overtake the front porch on humid days when it isn't breezy. I can say for sure,

it's very discouraging to go around, out and in, "dust," and by the time you are finished, you can write your name where your efforts began, and it looks like a few days of build up within a couple of hours and I don't just go around with swiffy, or "rag" I use polishes and cleaners. My neighbors have shared the same issues over the years, and one of them, she IS a Martha, and she has talked about this in her house.

10. G: Directly west of the site—1/4 of a mile away: My wife and I live in a lovely little condo located on Cooper Rd. In 2001 we were one of the first owners in what was then a new development. We intentionally bought a second floor back side unit overlooking Alum Creek mainly for the view. On many days it is pleasant to sit on our balcony and enjoy the creek and greenery on the banks. However, on other days the smell of asphalt from Scioto Materials Co., located just across Alum Creek from us, is totally overwhelming; on these days it is impossible for us to sit on our balcony. On other days the terrible odors from Kurtz Bros mulching plant, also across the creek from us, are unpleasant to the point that we must stay inside and keep our windows closed. Noise from heavy machinery at Kurtz is also a problem at night, sometimes interfering with restful sleep, because the machinery often operates until early hours of the morning. Personally I can put up with the mulch odor because it is worst, on only a few days, and it's probably not super detrimental to our health. I'm am more concerned about the toxic air from Scioto Materials Co. Asphalt and its associated chemicals—it's not only annoying; It's a legitimate public health hazard. I hate to think of how children in our neighborhood are impacted. It's an environmental injustice. I also frequently jog and walk on the bike path that goes behind our unit. I have to pick my days and my times if I want to avoid the toxic air quality. In my opinion, residential development in this area has grown around what was and is an industrial site. Those in charge of urban planning in this location should have taken action to promote more responsible development here, but that's water over the bridge at this point. Scioto Materials Co. and Kurtz Bros should relocate in the interest of public health and safety. The concrete plants in the area probably should also relocate. Their toxic emissions are not as immediately conspicuous as the asphalt and mulch odors, but in terms of health and safety, their particulates could be even worse for us than the bad odors.

11. T: E/SE of site: Huber Ridge. I'm glad that someone is going to do this. I have a friend who used to live near there and we would walk our newborns in that park. Until one day we caught a whiff of that stuff and decided we should go elsewhere!

****12. B:** E/SE of site. Spring, 2015: I live in Westerville, near Kohls. My family is continually bothered by the terrible smell from the Kokosing Asphalt Plant. Not only the asphalt plant smell but also the concrete and mulch plants. So many companies have found a home in the area south of I-270 because it is so convenient to our freeway system. Good for them, bad for all of us. What you might not realize is how dangerous these odors are to our health. I have been contacting the EPA for the past 10 years. The problem is that it takes a village to solve this problem. I know people don't want to get involved, don't have the time, etc. But in order to have these companies held accountable, you must become involved. The health effects might unfortunately effect you or your children at some point. We need to stop the pollution before we are statistics. I know everyone is busy, but getting involved is as easy as making a phone call EVERY time you smell the odor, or notice extreme dust in the area, something dark coming

from the stacks, etc. It takes 5 minutes. The EPA will not do anything or even come to the site without our complaints. Many improvements were made and one company moved from the location. If you have noticed increased headaches, sinus problems, difficulty breathing, irritated eyes, you too might be reacting to the odors. Pick up the phone and let the EPA know about it.

13. P: (East of site—across the creek): I have made notes of the following issues throughout the summer, for example:

NOISE POLLUTION: constant level of noise starts approx. 6,7,8 a.m. and can continue until 6 p.m. and beyond: noise from trucks, conveyor belts, trucks backing up "beep, beep, beep," able to hear inside of condo with windows closed; constant loud, rumbling, low tone noise able to hear inside of condo with windows closed; extremely loud banging, booming noises, can start around 6 a.m. and can continue until 8 or 9 a.m..."boom, boom, boom," I mean very, very loud booms, sounds like a large metal weight being dropped to break up large hard objects, actually can feel the ground shaking, maybe large pieces of concrete or large rocks are being smashed?

SMELLS/ODORS: a) very strong metallic smells, have noticed in morning, continues throughout the day;affects breathing, have stopped walking or spending time outdoors on metallic smell days; b) very strong asphalt smell, continues throughout day, affects breathing, have stopped walking or spending time outdoors on asphalt smell days c) very strong mulch smell, continues throughout day, have stopped walking or spending time outdoors on very strong mulch days.

I discussed the following issues related to pollution at the industrial site with the following below:

9/10/15: phone call to Kris Weiss, Ohio EPA public interest center

11/5/15: phone call to Chris Corder, Aide to Rep. Gonzales

11/10/15: phone call to Bryan Rhoads, Code Enforcement, Blendon Township

Also see the email below dated 11/22/15 (log from 11/11/15 through 11/19/15) that was sent to Bryan Rhoads, that references noise related complaints involving the industrial site:

Note: The noise ratings (0-10) are based on outside noise from the industrial site that I could hear from inside my condo:

Email to Bryan Rhoads: Dear Bryan, Hope things are going well for you. This is M. my home address is.....Condo on Alum Creek. I spoke to you on the phone on 11/10/15 and registered some complaints about the "noise" coming from the industrial site at 270 & Rt. 3. I am sending you my log of additional noise-related complaints re: the site from 11/11/15 through 11/19/15. If you need any additional info., please contact me at....

Complaints involve the following Cos:

Metro Materials and Sarasota Transport

Log 11/15 through 11/19

11/11/15: 7 a.m. to 5:30 p.m.; mfg constant loud rumbling industrial & truck noise; can hear mfg noise inside condo (with windows closed), scale 7/10

11/12: 7a.m. to 5 p.m., mfg constant loud rumbling industrial and truck noise; can hear mfg noise inside condo, scale 8.5/10

11/16: 7:30 a.m. to 7 p.m, mfg constant loud rumbling industrial & truck noise, can hear mfg noise inside condo, scale 8.5/10

11/17: 7 a.m. to 6 p.m., mfg constant loud rumbling industrial & truck noise, can hear mfg noise inside condo, scale, 8/10. Used cancelling headphones

11/18/15: 7 a.m. to 4;30 p.m (SAME), scale 7/10. Used headphones.

11/19/15: 7:30 to 4:30 AND 11 p.m. overnight thru 7 a.m (11/20/15); mfg constant loud rumbling industrial & truck noise, can hear mfg noise inside condo, scale 8.5-10. To be able to concentrate used noise cancelling headphones throughout day. Mfg noise started again. Used noise cancelling phone to get to sleep.

SOME EFFECTS OF MANUFACTURING NOISE DURING REFERENCED TIME PERIOD: More nervous, anxious, stressed out, unable to concentrate, sleeplessness, did not walk on Alum Creek path or around condo complex during mfg noise, did not sit out on my back porch during mfg noise.

SOME ENVIRONMENTAL EFFECTS: No longer hear birds singing in the morning or see as many birds around throughout the day and night. Do not see as many ducks in Alum Creek behind condo complex.

Please keep a record of my noise complaints on file. If you need any additional info., please contact me. M.

14. B: I live on _____, immediately across Alum Creek from Scioto Materials. One large machine in particular is quite loud. In August, they started running this machine all night long. It emits a steady 60 dB or higher as measured from my balcony. Even now, this noise is intermittent at all hours of the night, making it impossible for residents on my side of the building to sleep. Opening windows is out of the question. It would be very helpful if they could refrain from running machinery during evening hours.

15. G: Hello, the past week has been very stinky. I officially left a complaint with the EPA and Blendon Township. It's appalling that I can't enjoy my porch on a long holiday weekend because the air is thick and noxious.

16. G: I'm bothered by the mulch smell all the time. If I knew about it before I moved here, I wouldn't have moved here. I used to live by the brewery, it smelled so much better than the mulch plant, which to me smells like a pig farm. I'm also very curious if they put any chemicals on top of the rotting mulch.

**17. J: I live approx.. 1.5 miles north of the site. This site impacts my life greatly—my physical health and my mental health. When the wind is blowing the noxious asphalt odors my way, I cannot go outside to enjoy my beautiful wooded property; I cannot go outside to exercise; I cannot open my windows. When I have been exposed to these odors for any period of time (getting accidentally exposed to them BECAUSE I always check the wind before I walk outside), I have experienced burning in my nose, throat, chest; I have experienced weakness in my body, slight headaches, etc. There have also been times when these noxious odors are so bad I can smell them inside my house. Last week (Oct. 19, 2015) I could smell the odors INSIDE my house on 2 mornings, even with all of my windows closed, and I had to leave my house. I am also concerned about the large amount of particulates that are being emitted from this property. I could go on and on about this but that's all for now.

18. P: Dear Honorable Gonzales,

I look forward to attending the Dec. 7 (2015) meeting regarding the Westerville Road industrial sites to convey by my presence that this site is a source of concern that needs to be addressed. I am hopeful that you will be able to provide quick and reasonable solutions and/or directives to address the many issues associated with this site.

Learning about the effects of contaminants from the asphalt plants on my health was enlightening and disturbing. Add to that, learning that some companies are polluting Alum Creek and possibly our water supply in Huber Ridge is also a serious matter of concern, not only for residents, but also for the animals; terrestrial and aquatic.

My primary and personal complaint stems from Kurtz Brothers and how the stench from the mulching process negatively impacts my quality of life, breathing, and eventually property values. When Kurtz Bros. process their mulch, I have to stay inside and certainly close windows. It is quite unpleasant and inconvenient. I have filed complaints with the EPA and did not receive responses from them.

Thank you, for agreeing to meet about these very important issues.

19. S: I live 1.5 miles north of the plant. There are days when there is a strong asphalty smell in the air that is very unpleasant. I called to file a complaint with the Ohio EPA.

**20. L: I've lived in Westerville since I was born 30+ years ago, my father since he was 5 years old in the very same house about a mile or so from the plants….so I'd say I have the right to be frustrated with the stink being raised by these companies. Most of the sites have been added in the last decade baring Anderson's concrete, from what I remember as a child. But the smell only started within the last decade-ish timeframe (in fact I remember the first day my husband and I smelled this horrible odor was while living in our first apartment literally just around the corner from the house I grew up in), so that is probably some indication as to what sites are giving off the unnatural foul smells. And personally, I love cow manure because it's a naturally occurring smell, so that wouldn't bother me at all!

21. J: Agree with several of the above comments. We have lived here for what will be 15 years in March. It was only in the last several years that the smells were noticeable. So bad sometimes that my kids don't want to go outside and play. And when we have visitors, I have to try and explain the smell… it's embarrassing. As far as any illness or similar problems, it would be hard to say for sure.

****22. J:** I hate driving anywhere down that way, including 270, it stinks so bad!!!

23. S: I am still in the process of finding out why I cough but this past summer, I had to go in the house because the smell was so strong it made me cough so bad. Dr. seems to think it is allergies, makes sense then to what triggers the cough.

24. K: It was horrible tonight. I went to Glengary to pick up some Chinese food. The odor made me nauseous.

****25. E.** I drive to Westerville 4 days a week. We used to live there and I remember the smell. Now that we have moved I feel like the smell is 100 times worse. I always switch to the recycled air option in my van when I am getting off at route 3 because it smells so bad right off the highway. It's awful. I will sign any petition or help in any way possible because I can't imagine living around that smell daily

26. A. It's so bad! I love living here except this horrid toxic odor nearly every day!!

27: I live on _____. I know it only appears to be a foul smell but god only knows what chemicals from that plant behind speedway are being pumped into the air we all breathe. Every morning I wake up it's there. If I leave my windows open over night in the morning the house is filled with the smell. What can we do? I'm concerned for my children as well as yours.

G: Are we talking about chemical or manure smell?

J: I keep thinking that's a manure/wood chip smell. Am I wrong?

P: It is mulch being processed and some smell manure, some think pig farm, etc. It smells.

R : the mulch smell is from Kurtz brother when they turn the hard waste they collect. It smells but is not harmful.

28. Anonymous: I don't think people realize mulch is often pallets and rats, mice, small animals all get churned up in it. I was told this by someone who makes mulch. Yuck.

B.: Some days it smells like chemicals and other days processed wood. Does the county provide any kind of air quality tests or if tests have been completed where can we find results?

J: it's probably also the asphalt plant at the Corna Kokosing Materials plant. Their always mixing up a fresh batch for all the road construction going on.

29. C: We tried for years to get the sulfur dioxide monitored from the asphalt plant. When we finally did get some action they just added two more asphalt stacks to comply with volume emissions, money talks.

30. T: Yeah, that "sweet cherry" smell (as we call it) has been really bad the past couple of days. I pretty much always chalk it up to wind direction, esp since we got it (maybe even more frequently) when we lived by Westerville South. I agree, it sucks. I feel pretty bad for people who are around the Vineyard by the creek/at that park, sometimes I will drive by there, close up all of my windows and turn off the vents and I still get hit pretty badly.

B: Definitly nothing sweet about it.

T: I agree, it honestly mostly goes without description. Potent. Repugnant. Those work, but still don't accurately describe it some days....

31. S: I worry about this daily

32. D: I hate it too! The smell is so strong!

33. A: Honestly burning my sinuses today. Wind...

B: My children and myself have all experienced the same burning sensation. They tell us it's no cause for concern. I must have idiot stamped on my forehead.

34. D: I live right on _____the smell gets really bad at times.

35. E: I live on _____. I grew up in a farm community and manure smells better than that.

36. Hello Kristopher (Ohio EPA)
I am a resident of the Huber Ridge neighborhood in Westerville, Ohio. In previous years we have dealt with the smells coming from the industrial site at route 3 and 270 on a fairly limited basis. As you know, wind direction plays a large part in who you hear from that is affected by the smells coming from this site. Fortunately for us, we moved from Westerville proper (northwest of the site) 3 years ago, so we do not experience the foray of smells quite as often in our now south/east proximity to the site. I am a very level headed, non-extreme, non-alarmist, person. However, as this whole situation continues with no resolve to our community, I will gladly make myself a thorn in your side ... because the fact that I can't open my windows on a 72* day at the end of June and enjoy some fresh air due to smells coming from a site that you claim is "operating by Ohio EPA standards" is COMPLETELY AND UTTERLY UNACCEPTABLE. I have a 15 month old daughter that cannot play outside at our home on this beautiful day. Thankfully she will be heading to her grandparents house in Westerville proper, which won't be experiencing the smells and pollutants today as Huber Ridge is bombarded with it. The smell today is most definitely a 4+ with burning, itching, watery eyes and difficulty breathing due to the noxious odor. Please send someone's once to smell this repugnant odor. I AM REQUESTING THIS COMPLAINT BE ADDED TO THE OFFICIAL FILE ON THIS SITE....

6/27/17

Kristopher,
This has to be the worst day of smells we've yet experienced at our current house. The asphalt production smell is apparently ramping up, as I came home to take my daughter to the slide at the school playground directly behind our house and the air is absolutely permeated with the

asphalt smell. It's so strong it makes my throat burn and I feel nauseated and weak kneed when the wind blows *this* particular odor our way. We are at Huber Ridge Elementary School. There is no possible way that at this direct time the plant could be operating under normal regulations, and if "they are," those regulations need to be reviewed for the well being of all of those in our community. Please note this in the official file on the route 3/270 industrial site. Is there any way for you to expedite a meeting with the Citizens for Clean Air group to get some answers and information about why this is happening with such frequency?
Regards,
L.

6/27/17

Kristopher,
With all do respect to your and your crews professional knowledge ... I grew up on a horse and cow farm. The smell we are experiencing is not the smell of manure mulch. It is a smell of additives. I have zero concern with natural manure smells, but rather additions to the mulch that make it smell so sickeningly and falsely sweet. Are these additives allowed? Are they in fact caused by not turning the mulch pile frequently enough? Is this a site-able violation of their operation?
Regards,
L.

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37 and 38. D and L. JUST SAW THIS AND YOUR SITE! First, Thank You. We live in Huber Ridge, and most certainly, the airborne particulates ARE AN ISSUE. I have glass top outdoor furniture, look Martha Stewart I am not, but at the same time, within a very short period of time having cleaned the glass and the furniture, you can see and feel a gritty type residue. The same goes for if you leave car windows down, the "dust", we have black vehicles now, so it's even more pronounced. Husband used to be fussy, not seeming like I was tidying or perhaps the dogs causing additional "dust" in the house. I have lived in other places and had pets. What we have here is NOT "dust". This is a gritty, grey,residue and you can SEE THAT even on the rags when you dust and clean

D and L. on the one way across from Huber school, the other morning the stench of decay was SO PUNGENT I searched my flower bed to make sure some sort of animal had not died on my front lawn.

**39. For the record the pungent smell of processed mulch greeted me as I exited my vehicle today to shop at Marc's in Westerville. I used my shirt to cover my nose. Around 11:20.
Regards,
P.

---

40. 9/7/17 via email
I live at _____ in the Condos at River Ridge on Cooper Road. I'm pretty much at ground zero, directly across Alum Creek. Various odors are bad, but the one that has been most horrendous smells, quite frankly, like manure. Only not just manure in mulch smell, but more like you've fallen into a pile of it. It has been an all-day smell, and sometimes for a few hours. If you'd like to come over to my complex and check it out, you are very welcome to do so.
Thanks!
A

FACEBOOK PAGE
P.
November 8, 2017 at 7:39pm

Dear Neighbors, If you are unable to attend tomorrow night's meeting but would like to be counted as a concerned citizen, then please reply to this post with "yes" and there will be a record of your concern. Thank you.

41 T:—yes
42 T:—yes
43 C:—yes
44 C:—yes
45 E:—yes
46 K:—yes
47 R:—yes
48 E:—yes
49 D:—yes
50 J:—yes
51 C:—yes
52 M:—yes
53 H:—yes
54 K:—yes
55 C:—yes
S:—I plan on being there
56 S:—yes
57 B:—yes
58 B:—yes
59 S:—yes
60 E: – yes
61 E:—yes
62 J:--yes
63 G:—yes, yes

64 My son lives in neighborhood and he says yes

65 A.—yes

66 L—yes

67 T—yes

68 P—yes

69 L—yes

70 J—yes

71 R—yes

72 T—yes

73 J—yes

74 C—yes

75 L.—yes

76 S—To me the smell is awful, but the BIG scare is the amount of chemicals in the air and water, our well is very very close to the plants

77 L—I think it's so important for us not to just talk about this theoretical "next generation" with our officials, but for them to actually see and know the faces of the next generation this impacts. The faces of children who aren't always able to go out and play in their own yards or even local playground on the days when the smells are so terrible.

**78 K: (Email to me Nov. 21, 2017) I've lived in Westerville for about 18 years and grew up in Genoa Township a few years before that. For the last 15 years, my husband and I have lived in Old Westerville, just off of State Street on the North end of town. I started noticing a really strong asphalt smell about four years ago. I'm not sure why I never noticed it before that. Initially, I chalked the smell up to the roadwork they were doing one street over. When that was done, I thought it must be a paving project the City was was doing on the trails in the park near our house. When that project was over and I still smelled it, I thought it must be some of the other road projects happening around town. But eventually, I noticed that there weren't any road projects happening that close to me anymore and I could still smell the smell on a very regular basis. I started to worry about what it was and thought perhaps it was Worthington Industries' facility over on Maxtown, but that didn't seem to be right either. So when I saw some women complaining about it on a local moms Facebook group and your name and efforts came up, that is when I realized the actual source of the smell was likely from that site. I have not experienced the other issues that others complained about and am thankful I don't live closer to the site for that reason. We did move to a different part of Westerville (still on the north end) early this past summer and I still smell the strong odor in our new house.

**K. (11/21/17)

We live near the intersection of Otterbein and College now. It was terrible both there and also when we stopped into Big Lots this afternoon. I don't recall smelling it as much in the winter before. I really hope they run less rather than more.

**11/21/17 (B texted me)

79 Uptown had a horrible smell this morning. I can taste the asphalt right now at 3:18 p.m. So much for a walk…horrible smelling!! B. just drove by on the way home from work and said the smell is coming from drying, he believes. Not the big stack. Pisses me off.

**80 Yes! Something has changed!! I grew up here in the '90s not far from there and never remember anything close to what I've smelled these past few years. I moved away in 2001 and back here in 2010.
A. (12/6 or 7, 2017)(via my email)

**81 Email from K. to me on 2/2/18

I haven't kept track and didn't do a good job reporting the smells when they bothered me unfortunately. However, I remember the asphalt smell being really bad around Thanksgiving and maybe right after. I have smelled a really strong mulch smell on a few days more recently since then.

I am worried about the smells once the weather warms up.

I am thankful for your efforts and will try to be better about supporting you and helping with this cause in the future. I am really sorry to hear your work often falls on deaf ears.

Thanks for checking in.
K.

82. 2/13/18 via email
Update:
The heavy equipment noise at Kurtz Brothers continued until about 2 this morning. It started back up around 5:30. I have had to call off work this morning with a tremendous headache and exhaustion from lack of sleep. Since the noise is going quite loudly again now just before 8 a.m, I will have to get out of here and go to work without sleep and with a pounding headache to try to escape the noise. I wish someone would come here and listen to this so you can see what we are having to endure. Please help us. B

FACEBOOK CONVERSATION (HUBER RIDGE RESIDENTS, 2/27/18)

**83. As if your life (read: my families life) is not already "a living hell" when we too often can't even take our nightly walk outside without our nose and lungs burning? Or let our kid play on the back patio. Or run the A/C during the summer because it brings strong outside smells in. Or open our windows during cold fronts on the sometimes rare nice summer nights because we're East/SE of the site. Or know that on the days we're not getting bombarded, someone else probably is .....

And you know, I let fear of retaliation (from companies and neighbors alike) keep me from letting N. do an interview with our little family about the severe impact the industrial site has had on our family at MULTIPLE locations we have lived in Westerville. It's just all so strange to me how people aren't even a little curious. Just a little. But hey, curiosity after all, kills the cat, and it would appear many are too busy being sheep (L.)

**84. L. Again, I'm floored at how inconsistent the smells are. Which street are you on J.? The asphalt smell alone is enough to knock me off my feet sometimes (more infrequent), but the pungent sour mulch smell is what really gets to me and makes me feel like I might wretch ... my husband used to call it "burning feet" when we lived by Westerville South years ago before we knew where it was coming from (it's not funny, but you just have to laugh!!)

85. A. Some days, there is nothing. Other days, it seems like it's burning your nose hairs off. I've lived here for a year and smelled it multiple times. Paris and Vienna.

86. S. 30 years here, it's real and awful.

APPENDIX E

Water Quality Summarized Data

Water Sampling Conducted in Alum Creek on 8/19/2019 and 9/30/2019.

Sampling Location	Date	Time	Depth (inches)	Flow (ft/sec)	Temp (°C)	DO (mg/L)	DO Sat (%)	pH	SpCond (umho/cm)	Turb (NTU)	NO_3^- (mg/L)
1	8/19/2019	11:52	7.5	0.79	23.8	6.95	82.4	7.39	529	9.3	*
2	8/19/2019	12:30	4	0.49	23.7	6.33	74.5	7.59	560	9.57	*
3	8/19/2019	13:07	34	0.04	24.4	6.55	78.4	7.77	370.1	13.3	*
4	8/19/2019	13:40	10	0.35	24.5	6.51	78.3	7.85	536	8.99	*
5	8/19/2019	14:33	4.5	0.25	24.7	6.03	72.7	7.94	537	7.92	*
1	9/30/2019	11:50	5.5	1.52	21.8	6.81	77.9	7.5	758	6.83	1.22
2	9/30/2019	15:30	8.25	0	21.7	5.55	63.2	7.59	1034	6.16	0.14
3	9/30/2019	15:54	28	0.24	23.4	6.9	81.2	7.9	736	4.66	0.98
4	9/30/2019	16:12	4	0	23.8	7.08	84	7.98	746	3.98	1.02
5	9/30/2019	17:00	12	0.13	23.7	6.46	76.6	8.08	749	3.08	1.1

Temp= Temperature; DO=Dissolved Oxygen; DO Sat=Dissolved Oxygen Saturation; SpCond=Specific Conductivity; Turb=Turbidity; NO_3^-=Nitrate

APPENDIX F

Water and Sediment Chemistry Summarized Data

Water and Sediment Samples collected within Alum Creek on 9/30/2019.

Sampling Location	Dissolved OP (mg/L)	TSS (mg/L)	DRO (mg/kg)	ORO (mg/kg)	GRO (mg/kg)	Cd (mg/kg)
1	0.08	5	ND	21.2	ND	ND
2	0.09	5	13.5	66	ND	ND
3	0.05	10	ND	55.4	ND	ND
4	0.19	4	50.4	296	ND	ND
5	0.13	4	19.5	148	ND	ND

OP= Orthophosphorous, TSS= Total suspended sediment, DRO= Diesel range organics, ORO= Oil range organics, GRO= Gasoline range organics, Cd= Cadmium, ND=Not detected

APPENDIX G

Toxicology Bioassay Report: *Chironomus dilutus* 10-Day Whole Sediment Toxicity Testing Results

Great Lakes Environmental Center

December 12, 2019

Jenna Odegard
MAD Scientist Associates, LLC
253 N. State St. #101
Westerville, OH 43081

RE: Final Report: *Chironomus dilutus* 10-Day Whole Sediment Toxicity Testing Results: Alum Creek
GLEC Project Number: 2487-00

Dear Ms. Odegard:

Great Lakes Environmental Center, Inc. (GLEC) has completed our analysis of the *Chironomus dilutus* 10-day survival and growth whole sediment toxicity tests. These tests were performed with two sediment samples collected by MAD Scientist Associates personnel from Alum Creek. The sample identification numbers, survival, and growth test results for the two sediment samples and a laboratory control are summarized and provided in the following tables:

- Table 1 Sample Identification Numbers, Sampling Date, and Shipping Dates of Sediment Samples.
- Table 2: 10-Day *Chironomus dilutus* (*C. dilutus*) Average Percent Survival
- Table 3: 10-Day *C. dilutus* Average Growth and Biomass Estimates (expressed as average ash-free-dry-weight (AFDW))
- Table 4: Summary of Mean Water Quality Parameters of Overlying Water Samples Collected Prior to Renewal
- Table 5: Summary of Data Used for Statistical Analysis, Data that was Significantly Different from the Laboratory control, and the Statistical Analyses Conducted on the Whole Sediment Toxicity Test Data.

Water quality data for the overlying water for each sediment sample tested are summarized in Table 4. Summaries of the statistical analyses conducted on the whole sediment toxicity test data are provided in Table 5. The daily laboratory bench data sheets can be found in Appendix E. Chain of Custody forms and reference toxicant data are provided in Appendices A and D, respectively.

METHODS

Two sediment samples were analyzed at our Columbus, Ohio laboratory following GLEC's written protocols which are based on the procedures outlined by: EPA/600/R-99/064 *Methods for Measuring the Toxicity and Bioaccumulation of Sediment-Associated Contaminants with Freshwater Invertebrates*, Second Edition; ASTM 1706-95B, *Standard Test Methods for Measuring the Toxicity of Sediment Associated Contaminants with Freshwater Invertebrates* (ASTM 2000); and GLEC Standard Operating Procedures (SOPs).

The two sediment samples were collected and shipped by MAD Scientist Associates personnel and were received at GLEC, where they were assigned a unique GLEC laboratory identification number and stored at 0-6°C until test initiation (see Table 1 below).

Table 1. Sample Identification Numbers, Sampling Date, and Shipping Dates of Sediment Samples.

Sample I.D.	Sample Description	GLEC Lab. ID Number	Date Sampled	Date Received
Alum Creek Downstream	Site Sample	SS416	September 30, 2019	October 1, 2019
Alum Creek Upstream	Site Sample	SS417	September 30, 2019	October 1, 2019

The 10-day *C. dilutus* toxicity tests were initiated on November 1, 2019 with each of the two investigative sediment samples, laboratory control sediment, and a laboratory water control.

Summary of Test Procedures: 10-Day *Chironomus dilutus* Whole Sediment Toxicity Tests

Newly hatched *C. dilutus* (2^{nd}-3^{rd} instar at test initiation, cultured by Aquatic Biosystems) were used to initiate the 10-day whole sediment toxicity tests. *C. dilutus* were continuously exposed for 10 days to each of the sediment samples, a laboratory control sediment, and a laboratory water control. There were eight replicate beakers for each sediment sample, laboratory control sediment, and a laboratory water control. The water only control contained a small amount of sand but no sediment. Each replicate contained 10 animals. The primary laboratory control sediment was formulated by mixing 80% Boardman River (Traverse City, MI) sediment and 20% artificial sediment.

The *C. dilutus* were exposed in 500 mL glass test chambers, each containing 100 mL of whole sediment and 175 mL of overlying water. Prior to adding the whole sediment to each test chamber, the controls and investigative sediments were

thoroughly homogenized using a pre-cleaned stainless steel spoon and bowl until a uniform color and texture was achieved.

Overlying water was intermittently supplied to each test chamber at least twice daily (once every 12-hours) via a static-renewal water delivery system. The overlying water consisted modified smith water ($CaSO_4$• $2H_20$ 0.05 g/L, $CaCl_2$ 0.5 g/L, $MgSO_4$ 0.03 g/L, $NaHCO_3$ 0.096 g/L, KCL 0.004 g/L with an addition of NaBr at a concentration of 0.002 g/L) for the *C. dilutus*.

The *C. dilutus* test chambers were fed 1.5 mL of Tetrafin® goldfish food slurry (4 mg/mL dry solids) once daily.

Temperature and dissolved oxygen (DO) concentration of the overlying water in the test chambers were measured daily in two alternating replicates for each test sediment, and the results were recorded on the laboratory bench data sheets. If the DO dropped below 2.5 mg/L, the number of daily overlying water renewals was increased (up to 4 times per day) until the DO recovered to greater than 3.0 mg/L. Aeration was added where DO did not recover to these levels. Alkalinity, hardness, pH, and total ammonia (as N) were measured in the overlying water on test days 0 and 10 (Table 4). These results were also recorded on the laboratory bench data sheets.

Observations of organism behavior and any anomalies observed within the sediment were made daily for each test chamber and recorded on the laboratory bench data sheets.

The number of *C. dilutus* surviving in each replicate test chamber was recorded at test termination (10 days), and a summary of the percent survival is provided in Tables 2 and 5. The average ash free dry weight [AFDW in milligrams (mg)] of the surviving organisms for each *C. dilutus* replicate, and the biomass [AFDW (mg) of the surviving organisms divided by the initial number of organisms] was also determined at test termination, and the results are summarized in Table 3 and 5.

A statistical analysis, using the program TOXSTAT (version 3.5, 1996) and following statistical guidelines provided in EPA Method 600/R-99/064 and ASTM Method 1706-95B (2000), was used to compare the 10-day survival and growth endpoints. Survival data were check for normality using the Shapiro-Wilk's test prior to transformation. If the data failed normality it was transformed using an arc sine-square root transformation. The transformed data were then tested for normality and homogeneity of variances. Next, an analysis of variance (ANOVA) was conducted using the most appropriate parametric (e.g., Dunnet's or Bartlett's t-tests) or nonparametric (e.g., Steel's Many-One Rank or Wilcoxon with Bonferroni's) t-test. If the data failed to meet the assumptions of normality or homogeneity, then the nonparametric test was used to analyze the data.

Growth data were initially evaluated for normal distribution and homogeneity of variances. Next, an analysis of variance (ANOVA) was conducted using the most appropriate parametric (e.g., Dunnet's or Bartlett's t-tests) or nonparametric (e.g., Steel's Many-One Rank or Wilcoxon with Bonferroni's) t-test. If the data failed to meet the assumptions of normality or homogeneity, then the nonparametric test was used to analyze the data. In addition to growth being evaluated as average ash-free dry weight of the surviving organisms, growth was also analyzed as biomass (average ash-free dry weight of surviving organisms divided by the number of initial organisms). The survival and growth for each investigative sample was considered statistically different when significantly lower ($p < 0.05$) than that observed in the primary sediment control.

GLEC laboratory controls for each toxicity test met the minimum survival and growth requirements as specified in EPA method 600/R-99/064 and those requirements are acknowledged in the following results section for each set of toxicity tests.

RESULTS

10-Day *Chironomus dilutus*

The organisms in the laboratory control sediment met the required minimum survival (70 percent) and growth (0.48 mg AFDW at test termination) criteria for a *C. dilutus* acceptable test control (Tables 2 and 3). The acceptable requirements for survival and growth for the *C. dilutus* test can be found in EPA method 600/R-99/064, Table 12.1.

The overlying water quality measurements (Table 4) were also within the acceptable limits (with noted exceptions below) following the EPA testing protocol (i.e., daily mean temperatures were 23°C ± 1 °C; dissolved oxygen (DO) was maintained above 2.5 mg/L in the overlying water; and there were no variations greater than 50% in overlying water hardness, alkalinity, or total ammonia measurements within each test type). Consequently, the *C. dilutus* whole sediment toxicity tests were conducted following the standard protocols and are valid assessments of sediment toxicity.

Statistical Analysis for 10-Day *Chironomus dilutus* Tests

Survival and growth results from the laboratory Control 1 sediment sample 10-day whole sediment toxicity test were compared statistically to the two investigative sediment samples: SS416 (Alum Creek Downstream) and SS417 (Alum Creek Upstream). There was a statistically significant reduction ($p < 0.05$) in *C. dilutus*

survival in one (SS416 (Alum Creek Downstream)) of the sediment samples after 10 days of exposure when compared to the control (Tables 2 and 5)

Growth [measured as AFDW of surviving organisms (mg)] was significantly reduced ($p<0.05$) in both investigative sediment samples. Sediments with a statistically significant difference when comparing survival are assumed to be statistically different in growth and not used when comparing growth. When comparing growth between SS417 (Alum Creek Upstream) and the control using a 2-sample t-test there was a statistical significant difference (Table 3 and 5).

The growth data were also evaluated using the biomass [AFDW of surviving organisms divided by the initial number of organisms at the test start (Day 0) (mg)]. Again, sediments with a statistically significant difference when comparing survival are assumed to be statistically different in growth and not used when comparing biomass. When comparing biomass between SS417 (Alum Creek Upstream) and the control using a 2-sample t-test it to showed a statistically significant difference (Table 3 and 5).

Outputs for the survival and growth statistical analyses for the *C. dilutus* whole sediment toxicity tests are provided in Appendix C.

Alum Creek Sediment sample comparison and analysis

The two investigative samples (SS416 (Alum Creek Downstream) and SS417 (Alum Creek Upstream)) were statistically compared to one another using a 2-sample t-test. When comparing survival, ash-free dry weight and biomass data between the two samples, there was no significant difference found. Outputs for this analysis can be found in Appendix B.

If you have any questions, or if you would like additional information, please contact either myself or Dennis McIntyre at (614) 487-1040. Thank you for the opportunity to provide our toxicity testing services to MAD Scientist Associates.

Sincerely,

Craig Davis
Senior Research Technician

TABLE 2. **Comparison of Percent Survival Between the Laboratory Control and Investigative Sediment Samples (Alum Creek Upstream and Alum Creek Downstream) for the MAD Scientist *Chironomus dilutus* 10-Day Whole Sediment Toxicity Tests Conducted November 1, 2019 to Novemeber 11, 2019.**

	Number Test Organisms Surviving per Replicate[r]		
REPLICATE NUMBER	**Laboratory Control 1°**	**GLC# SS416 Alum Creek Downstream**	**GLC# SS417 Alum Creek Upstream**
1	2	4	7
2	10	8	9
3	9	8	9
4	10	9	9
5	10	8	7
6	10	8	8
7	10	5	9
8	10	8	10
10-Day Percent Survival	**88.8**	**72.5** [a]	**85.0**

[r] Replicates initiated with 12 organisms each

[a] Significantly different from laboratory control sediment ($p \leq 0.05$)

TABLE 3. Comparison of Ash Free[1] Dry Weight, Biomass[2] Dry Weight (mg) and Percent Survival Between the Laboratory Control and Investigative Sediment Samples (Alum Creek Upstream and Alum Creek Downstream) for the MAD Scientist *Chironomus dilutus 10*-Day Whole Sediment Toxicity Tests Conducted November 1, 2019 to

	Laboratory Control 1°		GLC# SS416 Alum Creek Downstream		GLC# SS417 Alum Creek Upstream	
REPLICATE NUMBER	**Average[1] Weight (mg)**	**Biomass[2] Weight (mg)**	**Average[1] Weight (mg)**	**Biomass[2] Weight (mg)**	**Average[1] Weight (mg)**	**Biomass[2] Weight (mg)**
1	1.095	0.219	0.862	0.345	0.871	0.610
2	0.956	0.956	0.695	0.556	0.582	0.524
3	0.970	0.970	0.650	0.520	0.681	0.613
4	0.927	0.927	0.822	0.740	0.481	0.433
5	0.905	0.905	0.604	0.483	0.826	0.578
6	0.992	0.992	0.649	0.519	0.771	0.617
7	0.830	0.830	0.612	0.306	0.683	0.615
8	0.914	0.914	0.588	0.470	*	*
Average Ash Free Dry Weight[1] (mg)	**0.949**		**0.685 [a]**		**0.699 [a]**	
Average Biomass[2] Weight (mg)		**0.839**	[a]	**0.492 [a]**		**0.570 [a]**
28-Day Percent Survival	**88.8**		**72.5 [a]**		**85.0**	

[1] Average Ash Free Dry Weight is the total ash free dry weight divided by the number of surviving organisms

[2] Biomass weight is the total ash free dry weight of surviving organisms divided by the initial number of organisms

[a] Significantly different from laboratory control sediment ($p \leq 0.05$)

*Ash from organism was not on pan when removed from the r

TABLE 4. Summary of Mean Water Quality Parameters of Overlying Water Samples Collected Prior to Renewal for the MAD Scientist *Chironomus dilutus* 10-Day Whole Sediment Toxicity Tests Conducted November 1, 2019 to Novemeber 11, 2019.

Sample ID GLC #	Temperature EC *n=55*	pH (s.u.) *n=26*	Dissolved Oxygen (mg/L) *n=40*	Specific Conductivity (Φmhos) *n=10*	Hardness (mg/L $CaC0_3$) *n=2*	Alkalinity (mg/L $CaC0_3$) *n=2*	Total Ammonia (mg/L) *n=2*
Laboratory Control 1°	22.7 (22.4-22.9)	7.65	4.8 (3.8-7.7)	360	114	100	1.35
GLC# SS416 Alum Creek Downstream	22.7 (22.4-22.9)	7.79	6.2 (5.2-8.4)	358	112	86	0.26
GLC# SS417 Alum Creek Upstream	22.7 (22.5-22.9)	7.86	6.1 (5.2-7.8)	374	114	80	0.11

Table 5. A summary of data used for statistical analysis, data that was significantly different from the laboratory control, and the statistical analyses conducted on the whole sediment toxicity test data.

	Chironomus dilutus 10-day Test					
	10-Day Percent Survival		**Average Ash Free Dry[1] Weight (mg)**		**Average Biomass[2] Weight (mg)**	
Laboratory Control 1°	88.8	Steel's Many	0.949	Bonferroni T-Test	0.839	Wilcoxon's Rank Sum
GLC# SS416 Alum Creek Downstream	72.5 *		0.685 *		0.492 *	
GLC# SS417 Alum Creek Upstream	85.0		0.699 *		0.570 *	

* Significantly different from laboratory control sediment ($p \leq 0.05$)

[1] Average Ash-Free dry weight is the total dry weight divided by the number of surviving organisms

[2] Biomass weight is the total dry weight of surviving organisms divided by the initial number of organisms

Appendix A
Chain of Custody Forms

Great Lakes Environmental Center
1295 KING AVE.
COLUMBUS, OH 43212
PHONE: (614) 487-1040
FAX: (614) 487-1920

Two Important Notes for Whole Effluent Toxicity Testing:

- **There is a maximum hold time of 36 hours for all samples**
  (Hold time begins when a composite sample is completed)
- **Samples must be received at 6 °C (4°C +2°C)**

CHAIN OF CUSTODY FORM (TO BE COMPLETED ONSITE AND SUBMITTED WITH SAMPLES)

FACILITY: MAD Scientist Associates
LOCATION: 253 N. State St. Suite 101; Westerville
CONTACT PERSON: Jenna Odegard
PHONE: 614-818-9156

COLLECTOR: Jenna Odegard
DATE: 9/30/2019
WITNESS: Kate Gorman
DATE: 9/30/2019

EEC# (lab only)	SAMPLE * ID	SAMPLE SOURCE (Eff/Upstr.)	TYPE (grab or composite)	SAMPLE START DATE	SAMPLE START TIME (24-hr notation)	SAMPLE END DATE	SAMPLE END TIME (24-hr notation)	VOLUME COLLECTED	SAMPLE CONTAINER	SAMPLE COLLECTOR INITIAL	OTHER COMMENTS AND TEMPS
55917	~~Alum Creek Upstream~~	Alum Creek Downstream	grab	9/30/19	14:00	~~14:05~~ 9/30/19	14:05	1 gal.	cubitainer	JLO	
55917	~~Alum Creek Downstream~~	Alum Creek Upstream	grab	9/30/19	16:30	9/30/19	16:35	1 gal.	cubitainer	JLO	

ANALYSIS REQUIRED: Please fill in completely

NAME OF STREAM SAMPLED: Alum Creek

Species: ☐ *Ceriodaphnia dubia* ☐ *Pimephales promelas* (fathead minnows) ☑ Other - please specify: Chironomus

Test Type: ☐ Acute: ☐ 24-hour ☐ 48-hour ☐ Chronic (7-day)
☐ Acute: ☐ 24-hour ☐ 48-hour ☐ Chronic (7-day)
☐ 96-hour: ☐ with 48-hour renewal ☐ without 48-hour renewal
☑ Other - please specify: 10-day acute

Dilutions: ☐ Screen (100% only) ☐ Definitive (5 sample concentrations): List test concentrations: _____

Dilution Water: ☐ Receiving Water ☐ Lab water ☐ Other – please specify: _____

TRANSFER OF SAMPLES:
(FIRST SIGNATURE IS SAMPLER, LAST SIGNATURE IS AUTHORIZED LABORATORY REPRESENTATIVE)

	SHIPPER	RECEIVER	DATE	TIME
1.	Jenna J Odegard	Dennis Eckhe	10/1/2019	12:00 pm
2.			10/1/2019	12:00

For Lab Use Only:
☐ ice remaining in cooler upon receipt

Temperature of samples when received: _____

FOR **SATURDAY DELIVERY**??? **MARK PACKAGE** AS SUCH AND **CALL GLEC** ON FRIDAY WITH TRACKING NUMBER

entry error 4/4 10/21/19

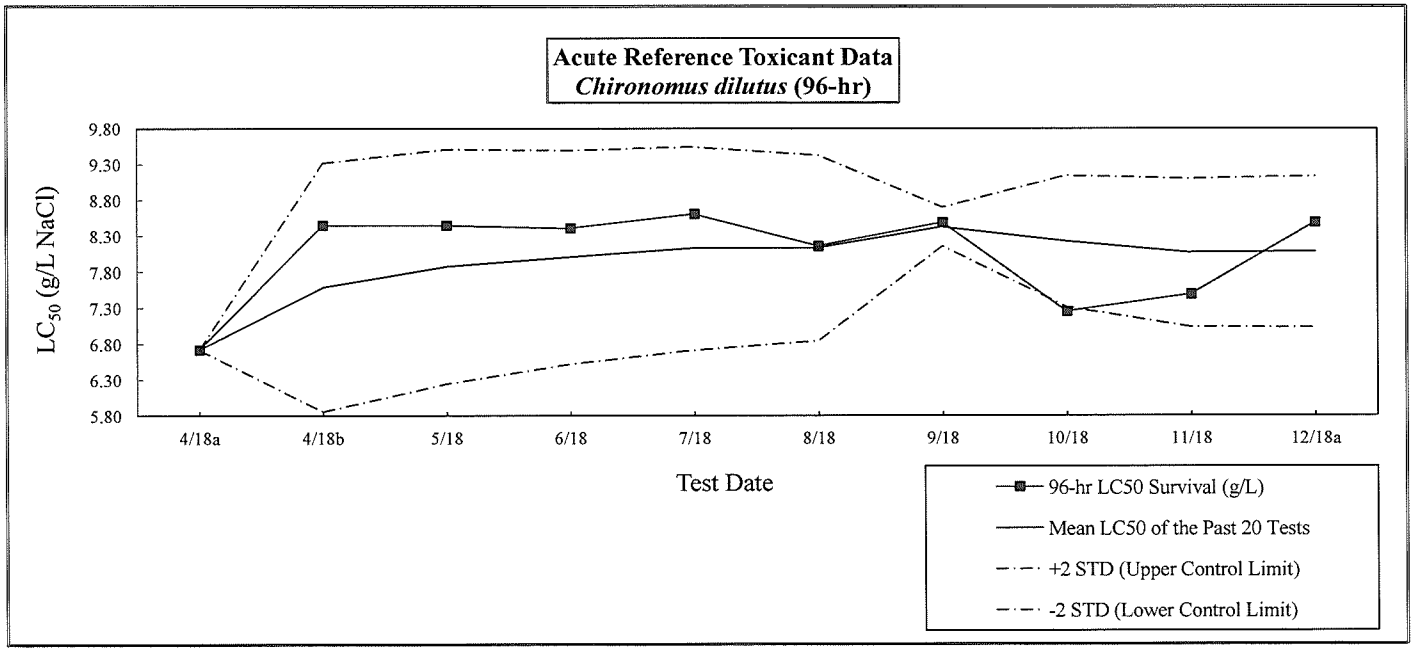
*Containers mislabled-correction was made upon clients Request CRD 10/25/19 stored in Refrig #3

Appendix B
Reference Toxicity Data

Great Lakes Environmental Center
Columbus, Ohio

20 Most Recent Acute Reference Toxicant Tests
Toxicant: NaCl (Dechlorinated Tap Water)
Test Species: *Chironomus dilutus*
Endpoint: 96-hr Survival

Test Date (Month/Year)	96-hr Control Survival (%)	96-hr LC_{50} Survival (g/L)	Mean LC_{50} of the Past 20 Tests	+2 STD (Upper Control Limit)	-2 STD (Lower Control Limit)	Coefficent of Variation of the Past 20 Tests[1]
3/1/18	97.5	6.72	6.72	6.72	6.72	0.00
3/7/18	100.0	8.45	7.59	9.32	5.85	0.11
3/9/18	92.5	8.45	7.87	9.50	6.24	0.10
3/14/18	97.5	8.41	8.01	9.49	6.52	0.09
3/16/18	97.5	8.61	8.13	9.54	6.71	0.09
3/23/18	95.0	8.16	8.13	9.42	6.84	0.08
4/18/18	80.0	8.49	8.43	8.70	8.16	0.02
10/24/19	82.5	7.25	8.23	9.14	7.31	0.06
11/01/19	95.0	7.49	8.07	9.10	7.04	0.06
11/15/19	80.0	8.49	8.08	9.13	7.03	0.07



Appendix C
Statistical Printouts

Title: MADcdsur
File: MADSURCD. Transform: ARC SINE(SQUARE ROOT(Y))

Shapiro - Wilk's Test for Normality

D = 1.1775
W = 0.7402

Critical W = 0.8840 (alpha = 0.01 , N = 24)
W = 0.9160 (alpha = 0.05 , N = 24)

Data FAIL normality test (alpha = 0.01). Try another transformation.

Warning - The first three homogeneity tests are sensitive to non-normality and should not be performed with this data as is.

Title: MADcdsur
File: MADSURCD. Transform: ARC SINE(SQUARE ROOT(Y))
Number of Groups: 3

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	Con 1	1	0.2000	0.4636
1	Con 1	2	1.0000	1.4120
1	Con 1	3	0.9000	1.2490
1	Con 1	4	1.0000	1.4120
1	Con 1	5	1.0000	1.4120
1	Con 1	6	1.0000	1.4120
1	Con 1	7	1.0000	1.4120
1	Con 1	8	1.0000	1.4120
2	SS417	1	0.7000	0.9912
2	SS417	2	0.9000	1.2490
2	SS417	3	0.9000	1.2490
2	SS417	4	0.9000	1.2490
2	SS417	5	0.7000	0.9912
2	SS417	6	0.8000	1.1071
2	SS417	7	0.9000	1.2490
2	SS417	8	1.0000	1.4120
3	SS416	1	0.4000	0.6847
3	SS416	2	0.8000	1.1071
3	SS416	3	0.8000	1.1071
3	SS416	4	0.9000	1.2490
3	SS416	5	0.8000	1.1071
3	SS416	6	0.8000	1.1071
3	SS416	7	0.5000	0.7854
3	SS416	8	0.8000	1.1071

Title: MADcdsur
File: MADSURCD. Transform: ARC SINE(SQUARE ROOT(Y))

Summary Statistics on Transformed Data TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	Con 1	8	0.4636	1.4120	1.2731
2	SS417	8	0.9912	1.4120	1.1872
3	SS416	8	0.6847	1.2490	1.0319

Title: MADcdsur
File: MADSURCD. Transform: ARC SINE(SQUARE ROOT(Y))

Summary Statistics on Transformed Data TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM	C.V. %
1	Con 1	0.1102	0.3320	0.1174	26.0783
2	SS417	0.0213	0.1460	0.0516	12.2939
3	SS416	0.0367	0.1915	0.0677	18.5607

Title: MADcdsur
File: MADSURCD. Transform: ARC SINE(SQUARE ROOT(Y))

Steel's Many-One Rank Test - Ho: Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	RANK SUM	CRIT. VALUE	DF	SIG 0.05
1	Con 1	1.2731				
2	SS417	1.1872	50.00	49.00	8.00	
3	SS416	1.0319	44.50	49.00	8.00	*

Critical values are 1 tailed (k = 2)

Title: MAD CD AFDW
File: MADAFDW . Transform: NO TRANSFORMATION

Shapiro - Wilk's Test for Normality

D = 0.1541
W = 0.9688

Critical W = 0.8350 (alpha = 0.01 , N = 15)
W = 0.8810 (alpha = 0.05 , N = 15)

Data PASS normality test (alpha = 0.01). Continue analysis.

Title: MAD CD AFDW
File: MADAFDW . Transform: NO TRANSFORMATION

F-Test for Equality of Two Variances

GROUP	IDENTIFICATION	VARIANCE	F
1	con 1	0.0059	
2	SS417	0.0188	3.1710

(p-value = 0.1567)

Critical F = 9.1553 (P=0.01, 6, 7)
5.1186 (P=0.05, 6, 7)

Since F <= Critical F, FAIL TO REJECT Ho: Equal Variances (alpha = 0.01).

Title: MAD CD AFDW
File: MADAFDW . Transform: NO TRANSFORMATION
Number of Groups: 2

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	con 1	1	1.0950	1.0950
1	con 1	2	0.9560	0.9560
1	con 1	3	0.9700	0.9700
1	con 1	4	0.9270	0.9270
1	con 1	5	0.9050	0.9050
1	con 1	6	0.9920	0.9920
1	con 1	7	0.8300	0.8300
1	con 1	8	0.9140	0.9140
2	SS417	1	0.8710	0.8710
2	SS417	2	0.5820	0.5820
2	SS417	3	0.6810	0.6810
2	SS417	4	0.4810	0.4810
2	SS417	5	0.8260	0.8260
2	SS417	6	0.7710	0.7710
2	SS417	7	0.6830	0.6830

Title: MAD CD AFDW
File: MADAFDW . Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	con 1	8	0.8300	1.0950	0.9486
2	SS417	7	0.4810	0.8710	0.6993

Title: MAD CD AFDW
File: MADAFDW . Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM	C.V. %
1	con 1	0.0059	0.0770	0.0272	8.1128
2	SS417	0.0188	0.1370	0.0518	19.5980

Title: MAD CD AFDW
File: MADAFDW . Transform: NO TRANSFORMATION

ANOVA Table

SOURCE	DF	SS	MS	F
Between	1	0.2321	0.2321	19.5740
Within (Error)	13	0.1541	0.0119	
Total	14	0.3863		

(p-value = 0.0007)

Critical F = 9.0738 (alpha = 0.01, df = 1,13)
= 4.6672 (alpha = 0.05, df = 1,13)

Since F > Critical F REJECT Ho: All equal (alpha = 0.05)

Title: MAD CD AFDW
File: MADAFDW . Transform: NO TRANSFORMATION

2 Sample t-Test - TABLE 1 OF 2 Ho: Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	t STAT	SIG 0.05
1	con 1	0.9486	0.9486		
2	SS417	0.6993	0.6993	4.4243	*

Equal Var: t critical value = 1.7709 (1 Tailed, alpha = 0.05, df = 13)
(p-value = 0.0003)

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG 0.05
1	con 1	0.9486	0.9486		
2	SS417	0.6993	0.6993	4.2615	*

Unequal Var: t critical value = 1.8331 (1 Tailed, alpha = 0.05, df = 9)
(p-value = 0.0011)

Title: MAD CD AFDW
File: MADAFDW . Transform: NO TRANSFORMATION

2 Sample t-Test - TABLE 2 OF 2 Ho: Control<Treatment

Equal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	con 1	8			
2	SS417	7	0.0998	10.5	0.2493

Unequal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	con 1	8			
2	SS417	7	0.1073	11.3	0.2493

Title: MAD CD BIOMASS
File: MADBIO . Transform: NO TRANSFORMATION

Shapiro - Wilk's Test for Normality

D = 0.4851
W = 0.6396

Critical W = 0.8350 (alpha = 0.01 , N = 15)
W = 0.8810 (alpha = 0.05 , N = 15)

Data FAIL normality test (alpha = 0.01). Try another transformation.

Warning - The F-test of homogeneity is sensitive to non-normality and should not be performed with this data as is.

Title: MAD CD BIOMASS
File: MADBIO . Transform: NO TRANSFORMATION
Number of Groups: 2

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	con 1	1	0.2190	0.2190
1	con 1	2	0.9560	0.9560
1	con 1	3	0.9700	0.9700
1	con 1	4	0.9270	0.9270
1	con 1	5	0.9050	0.9050
1	con 1	6	0.9920	0.9920
1	con 1	7	0.8300	0.8300
1	con 1	8	0.9140	0.9140
2	SS417	1	0.6100	0.6100
2	SS417	2	0.5240	0.5240
2	SS417	3	0.6130	0.6130
2	SS417	4	0.4330	0.4330
2	SS417	5	0.5780	0.5780
2	SS417	6	0.6170	0.6170
2	SS417	7	0.6150	0.6150

Title: MAD CD BIOMASS
File: MADBIO . Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	con 1	8	0.2190	0.9920	0.8391
2	SS417	7	0.4330	0.6170	0.5700

Title: MAD CD BIOMASS
File: MADBIO . Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM	C.V. %
1	con 1	0.0652	0.2554	0.0903	30.4318
2	SS417	0.0048	0.0691	0.0261	12.1192

Title: MAD CD BIOMASS
File: MADBIO . Transform: NO TRANSFORMATION

ANOVA Table

SOURCE	DF	SS	MS	F
Between	1	0.2704	0.2704	7.2464
Within (Error)	13	0.4851	0.0373	
Total	14	0.7555		

(p-value = 0.0185)

Critical F = 9.0738 (alpha = 0.01, df = 1,13)
= 4.6672 (alpha = 0.05, df = 1,13)

Since F > Critical F REJECT Ho: All equal (alpha = 0.05)

Title: MAD CD BIOMASS
File: MADBIO . Transform: NO TRANSFORMATION

2 Sample t-Test - TABLE 1 OF 2 Ho: Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	t STAT	SIG 0.05
1	con 1	0.8391	0.8391		
2	SS417	0.5700	0.5700	2.6919	*

Equal Var: t critical value = 1.7709 (1 Tailed, alpha = 0.05, df = 13)
(p-value = 0.0092)

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG 0.05
1	con 1	0.8391	0.8391		
2	SS417	0.5700	0.5700	2.8635	*

Unequal Var: t critical value = 1.8595 (1 Tailed, alpha = 0.05, df = 8)
(p-value = 0.0105)

Title: MAD CD BIOMASS
File: MADBIO . Transform: NO TRANSFORMATION

2 Sample t-Test - TABLE 2 OF 2 Ho: Control<Treatment

Equal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	con 1	8			
2	SS417	7	0.1771	21.1	0.2691

Unequal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	con 1	8			
2	SS417	7	0.1748	20.8	0.2691

Title: MADcdsur
File: MADSURCD. Transform: ARC SINE(SQUARE ROOT(Y))

Shapiro - Wilk's Test for Normality

D = 0.4059
W = 0.8500

Critical W = 0.8440 (alpha = 0.01 , N = 16)
W = 0.8870 (alpha = 0.05 , N = 16)

Data PASS normality test (alpha = 0.01). Continue analysis.

Title: MADcdsur
File: MADSURCD. Transform: ARC SINE(SQUARE ROOT(Y))

F-Test for Equality of Two Variances

GROUP	IDENTIFICATION	VARIANCE	F
1	SS416	0.0367	
2	SS417	0.0213	1.7219

(p-value = 0.4904)

Critical F = 8.8854 (P=0.01, 7, 7)
4.9949 (P=0.05, 7, 7)

Since F <= Critical F, FAIL TO REJECT Ho: Equal Variances (alpha = 0.01).

Title: MADcdsur
File: MADSURCD. Transform: ARC SINE(SQUARE ROOT(Y))
Number of Groups: 2

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	SS416	1	0.4000	0.6847
1	SS416	2	0.8000	1.1071
1	SS416	3	0.8000	1.1071
1	SS416	4	0.9000	1.2490
1	SS416	5	0.8000	1.1071
1	SS416	6	0.8000	1.1071
1	SS416	7	0.5000	0.7854
1	SS416	8	0.8000	1.1071
2	SS417	1	0.7000	0.9912
2	SS417	2	0.9000	1.2490
2	SS417	3	0.9000	1.2490
2	SS417	4	0.9000	1.2490
2	SS417	5	0.7000	0.9912
2	SS417	6	0.8000	1.1071
2	SS417	7	0.9000	1.2490
2	SS417	8	1.0000	1.4120

Title: MADcdsur
File: MADSURCD. Transform: ARC SINE(SQUARE ROOT(Y))

Summary Statistics on Transformed Data TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	SS416	8	0.6847	1.2490	1.0319
2	SS417	8	0.9912	1.4120	1.1872

Title: MADcdsur
File: MADSURCD. Transform: ARC SINE(SQUARE ROOT(Y))

Summary Statistics on Transformed Data TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM	C.V. %
1	SS416	0.0367	0.1915	0.0677	18.5607
2	SS417	0.0213	0.1460	0.0516	12.2939

Title: MADcdsur
File: MADSURCD. Transform: ARC SINE(SQUARE ROOT(Y))

ANOVA Table

SOURCE	DF	SS	MS	F
Between	1	0.0965	0.0965	3.3295
Within (Error)	14	0.4059	0.0290	
Total	15	0.5024		

(p-value = 0.0895)

Critical F = 8.8616 (alpha = 0.01, df = 1,14)
= 4.6001 (alpha = 0.05, df = 1,14)

Since F < Critical F FAIL TO REJECT Ho: All equal (alpha = 0.05)

Title: MADcdsur
File: MADSURCD. Transform: ARC SINE(SQUARE ROOT(Y))

2 Sample t-Test - TABLE 1 OF 2 Ho: Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	TRANS t STAT	SIG 0.05
1	SS416	1.0319	0.7250		
2	SS417	1.1872	0.8500	-1.8247	

Equal Var: t critical value = 1.7613 (1 Tailed, alpha = 0.05, df = 14)
(p-value = 0.9553)

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	TRANS T STAT	SIG 0.05
1	SS416	1.0319	0.7250		
2	SS417	1.1872	0.8500	-1.8247	

Unequal Var: t critical value = 1.7709 (1 Tailed, alpha = 0.05, df = 13)
(p-value = 0.9544)

Title: MADcdsur
File: MADSURCD. Transform: ARC SINE(SQUARE ROOT(Y))

2 Sample t-Test - TABLE 2 OF 2 Ho: Control<Treatment

Equal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	SS416	8			
2	SS417	8	0.1407	19.1	-0.1250

Unequal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	SS416	8			
2	SS417	8	0.1415	19.2	-0.1250

Title: MAD CD AFDW
File: MADAFDW . Transform: NO TRANSFORMATION

Shapiro - Wilk's Test for Normality

D = 0.3238
W = 0.9363

Critical W = 0.8350 (alpha = 0.01 , N = 15)
W = 0.8810 (alpha = 0.05 , N = 15)

Data PASS normality test (alpha = 0.01). Continue analysis.

Title: MAD CD AFDW
File: MADAFDW . Transform: NO TRANSFORMATION

F-Test for Equality of Two Variances

GROUP	IDENTIFICATION	VARIANCE	F
1	SS416	0.0302	
2	SS417	0.0188	1.6058

(p-value = 0.5804)

Critical F = 10.7859 (P=0.01, 7, 6)
5.6955 (P=0.05, 7, 6)

Since F <= Critical F, FAIL TO REJECT Ho: Equal Variances (alpha = 0.01).

Title: MAD CD AFDW
File: MADAFDW . Transform: NO TRANSFORMATION
Number of Groups: 2

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	SS416	1	0.8620	0.8620
1	SS416	2	0.6950	0.6950
1	SS416	3	0.6500	0.6500
1	SS416	4	0.8220	0.8220
1	SS416	5	0.6040	0.6040
1	SS416	6	0.6490	0.6490
1	SS416	7	0.6120	0.6120
1	SS416	8	0.2880	0.2880
2	SS417	1	0.8710	0.8710
2	SS417	2	0.5820	0.5820
2	SS417	3	0.6810	0.6810
2	SS417	4	0.4810	0.4810
2	SS417	5	0.8260	0.8260
2	SS417	6	0.7710	0.7710
2	SS417	7	0.6830	0.6830

Title: MAD CD AFDW
File: MADAFDW . Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	SS416	8	0.2880	0.8620	0.6478
2	SS417	7	0.4810	0.8710	0.6993

Title: MAD CD AFDW
File: MADAFDW . Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM	C.V. %
1	SS416	0.0302	0.1737	0.0614	26.8105
2	SS417	0.0188	0.1370	0.0518	19.5980

Title: MAD CD AFDW
File: MADAFDW . Transform: NO TRANSFORMATION

ANOVA Table

SOURCE	DF	SS	MS	F
Between	1	0.0099	0.0099	0.3981
Within (Error)	13	0.3238	0.0249	
Total	14	0.3337		

(p-value = 0.5390)

Critical F = 9.0738 (alpha = 0.01, df = 1,13)
= 4.6672 (alpha = 0.05, df = 1,13)

Since F < Critical F FAIL TO REJECT Ho: All equal (alpha = 0.05)

Title: MAD CD AFDW
File: MADAFDW . Transform: NO TRANSFORMATION

2 Sample t-Test - TABLE 1 OF 2 Ho: Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	t STAT	SIG 0.05
1	SS416	0.6478	0.6478		
2	SS417	0.6993	0.6993	-0.6309	

Equal Var: t critical value = 1.7709 (1 Tailed, alpha = 0.05, df = 13)
(p-value = 0.7305)

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG 0.05
1	SS416	0.6478	0.6478		
2	SS417	0.6993	0.6993	-0.6415	

Unequal Var: t critical value = 1.7709 (1 Tailed, alpha = 0.05, df = 13)
(p-value = 0.7338)

Title: MAD CD AFDW
File: MADAFDW . Transform: NO TRANSFORMATION

2 Sample t-Test - TABLE 2 OF 2 Ho: Control<Treatment

Equal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	SS416	8			
2	SS417	7	0.1447	22.3	-0.0515

Unequal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	SS416	8			
2	SS417	7	0.1423	22.0	-0.0515

Title: MAD CD BIOMASS
File: MADBIO . Transform: NO TRANSFORMATION

Shapiro - Wilk's Test for Normality

D = 0.1525
W = 0.8991

Critical W = 0.8350 (alpha = 0.01 , N = 15)
W = 0.8810 (alpha = 0.05 , N = 15)

Data PASS normality test (alpha = 0.01). Continue analysis.

Title: MAD CD BIOMASS
File: MADBIO . Transform: NO TRANSFORMATION

F-Test for Equality of Two Variances

GROUP	IDENTIFICATION	VARIANCE	F
1	SS416	0.0177	
2	SS417	0.0048	3.7086

(p-value = 0.1312)

Critical F = 10.7859 (P=0.01, 7, 6)
5.6955 (P=0.05, 7, 6)

Since F <= Critical F, FAIL TO REJECT Ho: Equal Variances (alpha = 0.01).

Title: MAD CD BIOMASS
File: MADBIO . Transform: NO TRANSFORMATION
Number of Groups: 2

GRP	IDENTIFICATION	REP	VALUE	TRANS VALUE
1	SS416	1	0.3450	0.3450
1	SS416	2	0.5560	0.5560
1	SS416	3	0.5200	0.5200
1	SS416	4	0.7400	0.7400
1	SS416	5	0.4830	0.4830
1	SS416	6	0.5190	0.5190
1	SS416	7	0.3060	0.3060
1	SS416	8	0.4700	0.4700
2	SS417	1	0.6100	0.6100
2	SS417	2	0.5240	0.5240
2	SS417	3	0.6130	0.6130
2	SS417	4	0.4330	0.4330
2	SS417	5	0.5780	0.5780
2	SS417	6	0.6170	0.6170
2	SS417	7	0.6150	0.6150

Title: MAD CD BIOMASS
File: MADBIO . Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 1 of 2

GRP	IDENTIFICATION	N	MIN	MAX	MEAN
1	SS416	8	0.3060	0.7400	0.4924
2	SS417	7	0.4330	0.6170	0.5700

Title: MAD CD BIOMASS
File: MADBIO . Transform: NO TRANSFORMATION

Summary Statistics on Data TABLE 2 of 2

GRP	IDENTIFICATION	VARIANCE	SD	SEM	C.V. %
1	SS416	0.0177	0.1330	0.0470	27.0184
2	SS417	0.0048	0.0691	0.0261	12.1192

Title: MAD CD BIOMASS
File: MADBIO . Transform: NO TRANSFORMATION

ANOVA Table

SOURCE	DF	SS	MS	F
Between	1	0.0225	0.0225	1.9175
Within (Error)	13	0.1525	0.0117	
Total	14	0.1750		

(p-value = 0.1894)

Critical F = 9.0738 (alpha = 0.01, df = 1,13)
= 4.6672 (alpha = 0.05, df = 1,13)

Since F < Critical F FAIL TO REJECT Ho: All equal (alpha = 0.05)

Title: MAD CD BIOMASS
File: MADBIO . Transform: NO TRANSFORMATION

2 Sample t-Test - TABLE 1 OF 2 Ho: Control<Treatment

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	t STAT	SIG 0.05
1	SS416	0.4924	0.4924		
2	SS417	0.5700	0.5700	-1.3847	

Equal Var: t critical value = 1.7709 (1 Tailed, alpha = 0.05, df = 13)
(p-value = 0.9053)

GROUP	IDENTIFICATION	TRANSFORMED MEAN	MEAN CALCULATED IN ORIGINAL UNITS	T STAT	SIG 0.05
1	SS416	0.4924	0.4924		
2	SS417	0.5700	0.5700	-1.4430	

Unequal Var: t critical value = 1.7959 (1 Tailed, alpha = 0.05, df = 11)
(p-value = 0.9116)

Title: MAD CD BIOMASS
File: MADBIO . Transform: NO TRANSFORMATION

2 Sample t-Test - TABLE 2 OF 2 Ho: Control<Treatment

Equal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	SS416	8			
2	SS417	7	0.0993	20.2	-0.0776

Unequal Variances:

GROUP	IDENTIFICATION	NUM OF REPS	MIN SIG DIFF (IN ORIG. UNITS)	% OF CONTROL	DIFFERENCE FROM CONTROL
1	SS416	8			
2	SS417	7	0.0966	19.6	-0.0776

Appendix D
Water Bath Temp Log

F C

10/28/19, 1000, cm = 23.1 23.1

10/29/19, 0730, cm = 22.7 22.7

Water Bath # 2

Water Bath Temprature Record for 28d [redacted]

Date	Time	Temp Probe #	C/O Water Temp	Air Temp	W.B Temp.	Initials	Comments
10/30/2019	0730	#49	22.7	21.9	23.1	AF	
10/30/2019	15:00	#48			23.1	YBC	
10/31/2019	0755	#48	22.9	22.1	22.8	AF	
10/31/2019	1825	#49 (-0.3)	22.9	21.6	23.1	DAW	
11/1/2019	08:30	#48 (+0.1	22.5	23.0	22.8	YBC	
11/1/2019	1835	#48 (+0.1)	22.7	20.5	22.8	~~AF~~ DAW	
11/2/2019	0705	#48 (+0.1)	22.9	19.7	22.9	CM	
11/2/2019	2100	#48 (+0.1)	23.2	18.9	22.8	CM	
11/3/2019	0700	#49 (-0.3)	22.6	19.3	22.9	CM	
11/3/2019	2000	#49 (-0.3)	23.0	20.0	23.5	CM	
11/4/2019	0755	#49 (-0.3)	22.9	19.6	22.8	AF	
11/4/2019	1555	#48 (+0.1)	22.7	20.9	22.9	CM	
11/5/2019	0755	#49 (-0.3)	23.0	18.8	22.7	AF	
11/5/2019	1850	#48 (+0.1)	23.0	21.1	22.8	DAW	
11/6/2019	0910	#48 (+0.1)	22.6	20.5	22.6	CM	
11/6/2019	1520	#49 (-0.3)	22.6	21.9	22.8	CM	
11/7/2019	0825	#48 (+0.1)	22.8	21.3	23.0	CM	
11/7/2019	1830	#49 (-0.3)	23.0	20.5	23.1	DAW	
11/8/2019	0800	~~#48 (+0.1)~~	22.7	18.2	22.7	AF	
11/8/2019	1815	#47 (+0.1)	23.7	18.6	23.0	DAW	
11/9/2019	08:10	#49 (-0.3)	22.4	17.8	23.1	YBC	
11/9/2019	1904	#47 (+0.1)	22.5	16.3	23.3	CM	
11/10/2019	0644	#47 (+0.1)	22.1	18.3	23.2	CM	
11/10/2019	1445	#47 (+0.1)	22.6	20.8	23.2	CM	
11/11/2019	0805	#49 (-0.3)	22.8	19.5	23.2	AF	
11/11/2019	1850	#47 (+0.1)	23.2	20.5	23.0	DAW	
11/12/2019	0720	#47 (+0.1)	22.7	20.8	23.2	CM	
11/12/2019	1900	#48 (+0.1)	22.8	19.9	22.9	DAW	
11/13/2019	0755	#48 (+0.1)	22.6	20.0	23.1	CM	
11/13/2019	1535	#48 (+0.1)	23.0	20.6	23.1	AF	

* entry error CM 11/1/19 11-8-19 AF

11-13-19 AF

Plot Title: Water Bath 2

#	Date Time, GMT-04:00	Temp, °C (LGR S/N: 20235641, SEN S/N: 202356	Stopped (L
172	10/31/19 11:30:00PM	23.16	
173	11/01/19 12:00:00AM	23.256	
174	11/01/19 12:30:00AM	23.016	
175	11/01/19 01:00:00AM	23.016	
176	11/01/19 01:30:00AM	23.28	
177	11/01/19 02:00:00AM	23.112	
178	11/01/19 02:30:00AM	22.92	
179	11/01/19 03:00:00AM	23.04	
180	11/01/19 03:30:00AM	23.28	
181	11/01/19 04:00:00AM	23.088	
182	11/01/19 04:30:00AM	22.872	
183	11/01/19 05:00:00AM	22.872	
184	11/01/19 05:30:00AM	23.088	
185	11/01/19 06:00:00AM	23.256	
186	11/01/19 06:30:00AM	23.16	
187	11/01/19 07:00:00AM	23.04	
188	11/01/19 07:30:00AM	22.944	
189	11/01/19 08:00:00AM	22.944	
190	11/01/19 08:30:00AM	23.064	
191	11/01/19 09:00:00AM	23.256	
192	11/01/19 09:30:00AM	23.184	
193	11/01/19 10:00:00AM	23.28	
194	11/01/19 10:30:00AM	23.328	
195	11/01/19 11:00:00AM	22.992	
196	11/01/19 11:30:00AM	22.896	
197	11/01/19 12:00:00PM	22.968	
198	11/01/19 12:30:00PM	23.112	
199	11/01/19 01:00:00PM	23.184	
200	11/01/19 01:30:00PM	23.04	
201	11/01/19 02:00:00PM	22.8	
202	11/01/19 02:30:00PM	22.776	
203	11/01/19 03:00:00PM	23.016	
204	11/01/19 03:30:00PM	23.16	
205	11/01/19 04:00:00PM	23.256	
206	11/01/19 04:30:00PM	22.92	
207	11/01/19 05:00:00PM	22.992	
208	11/01/19 05:30:00PM	23.16	
209	11/01/19 06:00:00PM	23.328	
210	11/01/19 06:30:00PM	22.92	
211	11/01/19 07:00:00PM	23.064	
212	11/01/19 07:30:00PM	23.256	
213	11/01/19 08:00:00PM	23.088	
214	11/01/19 08:30:00PM	22.92	
215	11/01/19 09:00:00PM	23.136	
216	11/01/19 09:30:00PM	23.088	

217	11/01/19 10:00:00PM	22.92
218	11/01/19 10:30:00PM	22.968
219	11/01/19 11:00:00PM	23.136
220	11/01/19 11:30:00PM	23.256
221	11/02/19 12:00:00AM	22.848
222	11/02/19 12:30:00AM	23.04
223	11/02/19 01:00:00AM	23.16
224	11/02/19 01:30:00AM	23.208
225	11/02/19 02:00:00AM	22.872
226	11/02/19 02:30:00AM	22.92
227	11/02/19 03:00:00AM	22.896
228	11/02/19 03:30:00AM	23.016
229	11/02/19 04:00:00AM	23.088
230	11/02/19 04:30:00AM	23.304
231	11/02/19 05:00:00AM	22.848
232	11/02/19 05:30:00AM	22.896
233	11/02/19 06:00:00AM	23.016
234	11/02/19 06:30:00AM	22.968
235	11/02/19 07:00:00AM	23.016
236	11/02/19 07:30:00AM	23.16
237	11/02/19 08:00:00AM	23.16
238	11/02/19 08:30:00AM	23.112
239	11/02/19 09:00:00AM	23.016
240	11/02/19 09:30:00AM	23.064
241	11/02/19 10:00:00AM	22.872
242	11/02/19 10:30:00AM	22.896
243	11/02/19 11:00:00AM	22.92
244	11/02/19 11:30:00AM	22.8
245	11/02/19 12:00:00PM	22.896
246	11/02/19 12:30:00PM	23.016
247	11/02/19 01:00:00PM	23.208
248	11/02/19 01:30:00PM	23.112
249	11/02/19 02:00:00PM	22.896
250	11/02/19 02:30:00PM	23.016
251	11/02/19 03:00:00PM	23.16
252	11/02/19 03:30:00PM	23.04
253	11/02/19 04:00:00PM	23.016
254	11/02/19 04:30:00PM	23.16
255	11/02/19 05:00:00PM	23.352
256	11/02/19 05:30:00PM	22.848
257	11/02/19 06:00:00PM	22.968
258	11/02/19 06:30:00PM	23.016
259	11/02/19 07:00:00PM	23.088
260	11/02/19 07:30:00PM	23.16
261	11/02/19 08:00:00PM	23.232
262	11/02/19 08:30:00PM	23.136
263	11/02/19 09:00:00PM	22.848

264	11/02/19 09:30:00PM	23.04
265	11/02/19 10:00:00PM	23.256
266	11/02/19 10:30:00PM	23.16
267	11/02/19 11:00:00PM	22.992
268	11/02/19 11:30:00PM	23.064
269	11/03/19 12:00:00AM	23.136
270	11/03/19 12:30:00AM	23.16
271	11/03/19 01:00:00AM	23.016
272	11/03/19 01:30:00AM	22.92
273	11/03/19 01:00:00AM	22.8
274	11/03/19 01:30:00AM	22.824
275	11/03/19 02:00:00AM	22.896
276	11/03/19 02:30:00AM	23.064
277	11/03/19 03:00:00AM	23.208
278	11/03/19 03:30:00AM	23.136
279	11/03/19 04:00:00AM	23.208
280	11/03/19 04:30:00AM	23.04
281	11/03/19 05:00:00AM	23.16
282	11/03/19 05:30:00AM	22.92
283	11/03/19 06:00:00AM	22.824
284	11/03/19 06:30:00AM	22.872
285	11/03/19 07:00:00AM	22.92
286	11/03/19 07:30:00AM	22.968
287	11/03/19 08:00:00AM	22.824
288	11/03/19 08:30:00AM	22.944
289	11/03/19 09:00:00AM	22.753
290	11/03/19 09:30:00AM	23.208
291	11/03/19 10:00:00AM	23.184
292	11/03/19 10:30:00AM	23.112
293	11/03/19 11:00:00AM	22.968
294	11/03/19 11:30:00AM	22.896
295	11/03/19 12:00:00PM	22.872
296	11/03/19 12:30:00PM	22.968
297	11/03/19 01:00:00PM	23.016
298	11/03/19 01:30:00PM	23.136
299	11/03/19 02:00:00PM	23.136
300	11/03/19 02:30:00PM	22.848
301	11/03/19 03:00:00PM	22.968
302	11/03/19 03:30:00PM	23.064
303	11/03/19 04:00:00PM	23.088
304	11/03/19 04:30:00PM	23.136
305	11/03/19 05:00:00PM	23.064
306	11/03/19 05:30:00PM	23.064
307	11/03/19 06:00:00PM	23.16
308	11/03/19 06:30:00PM	23.184
309	11/03/19 07:00:00PM	22.968
310	11/03/19 07:30:00PM	22.872

311	11/03/19 08:00:00PM	22.944
312	11/03/19 08:30:00PM	23.112
313	11/03/19 09:00:00PM	23.232
314	11/03/19 09:30:00PM	23.016
315	11/03/19 10:00:00PM	22.776
316	11/03/19 10:30:00PM	23.16
317	11/03/19 11:00:00PM	22.896
318	11/03/19 11:30:00PM	22.92
319	11/04/19 12:00:00AM	22.896
320	11/04/19 12:30:00AM	22.872
321	11/04/19 01:00:00AM	23.016
322	11/04/19 01:30:00AM	23.016
323	11/04/19 02:00:00AM	22.992
324	11/04/19 02:30:00AM	22.824
325	11/04/19 03:00:00AM	22.776
326	11/04/19 03:30:00AM	22.848
327	11/04/19 04:00:00AM	22.92
328	11/04/19 04:30:00AM	22.92
329	11/04/19 05:00:00AM	23.064
330	11/04/19 05:30:00AM	22.92
331	11/04/19 06:00:00AM	22.872
332	11/04/19 06:30:00AM	23.04
333	11/04/19 07:00:00AM	22.992
334	11/04/19 07:30:00AM	22.896
335	11/04/19 08:00:00AM	22.824
336	11/04/19 08:30:00AM	22.872
337	11/04/19 09:00:00AM	22.896
338	11/04/19 09:30:00AM	23.04
339	11/04/19 10:00:00AM	23.232
340	11/04/19 10:30:00AM	23.184
341	11/04/19 11:00:00AM	23.208
342	11/04/19 11:30:00AM	23.184
343	11/04/19 12:00:00PM	23.256
344	11/04/19 12:30:00PM	22.92
345	11/04/19 01:00:00PM	22.92
346	11/04/19 01:30:00PM	23.208
347	11/04/19 02:00:00PM	23.088
348	11/04/19 02:30:00PM	22.968
349	11/04/19 03:00:00PM	23.04
350	11/04/19 03:30:00PM	23.112
351	11/04/19 04:00:00PM	23.28
352	11/04/19 04:30:00PM	23.28
353	11/04/19 05:00:00PM	23.208
354	11/04/19 05:30:00PM	23.112
355	11/04/19 06:00:00PM	22.92
356	11/04/19 06:30:00PM	22.944
357	11/04/19 07:00:00PM	22.968

358	11/04/19 07:30:00PM	22.992
359	11/04/19 08:00:00PM	23.064
360	11/04/19 08:30:00PM	23.208
361	11/04/19 09:00:00PM	23.328
362	11/04/19 09:30:00PM	22.944
363	11/04/19 10:00:00PM	22.992
364	11/04/19 10:30:00PM	22.968
365	11/04/19 11:00:00PM	22.992
366	11/04/19 11:30:00PM	22.92
367	11/05/19 12:00:00AM	22.992
368	11/05/19 12:30:00AM	22.992
369	11/05/19 01:00:00AM	22.944
370	11/05/19 01:30:00AM	23.136
371	11/05/19 02:00:00AM	23.112
372	11/05/19 02:30:00AM	22.944
373	11/05/19 03:00:00AM	23.016
374	11/05/19 03:30:00AM	22.992
375	11/05/19 04:00:00AM	23.112
376	11/05/19 04:30:00AM	23.016
377	11/05/19 05:00:00AM	23.064
378	11/05/19 05:30:00AM	23.136
379	11/05/19 06:00:00AM	22.944
380	11/05/19 06:30:00AM	22.92
381	11/05/19 07:00:00AM	22.944
382	11/05/19 07:30:00AM	22.968
383	11/05/19 08:00:00AM	22.968
384	11/05/19 08:30:00AM	22.92
385	11/05/19 09:00:00AM	23.064
386	11/05/19 09:30:00AM	23.112
387	11/05/19 10:00:00AM	23.04
388	11/05/19 10:30:00AM	23.136
389	11/05/19 11:00:00AM	23.184
390	11/05/19 11:30:00AM	23.088
391	11/05/19 12:00:00PM	22.92
392	11/05/19 12:30:00PM	22.92
393	11/05/19 01:00:00PM	23.208
394	11/05/19 01:30:00PM	23.208
395	11/05/19 02:00:00PM	23.16
396	11/05/19 02:30:00PM	23.064
397	11/05/19 03:00:00PM	23.088
398	11/05/19 03:30:00PM	23.088
399	11/05/19 04:00:00PM	23.016
400	11/05/19 04:30:00PM	23.016
401	11/05/19 05:00:00PM	23.04
402	11/05/19 05:30:00PM	23.112
403	11/05/19 06:00:00PM	22.92
404	11/05/19 06:30:00PM	22.968

405	11/05/19 07:00:00PM	23.088
406	11/05/19 07:30:00PM	22.968
407	11/05/19 08:00:00PM	23.064
408	11/05/19 08:30:00PM	23.064
409	11/05/19 09:00:00PM	23.064
410	11/05/19 09:30:00PM	23.16
411	11/05/19 10:00:00PM	23.064
412	11/05/19 10:30:00PM	22.992
413	11/05/19 11:00:00PM	23.16
414	11/05/19 11:30:00PM	23.088
415	11/06/19 12:00:00AM	22.992
416	11/06/19 12:30:00AM	23.016
417	11/06/19 01:00:00AM	22.92
418	11/06/19 01:30:00AM	23.04
419	11/06/19 02:00:00AM	23.136
420	11/06/19 02:30:00AM	22.968
421	11/06/19 03:00:00AM	23.112
422	11/06/19 03:30:00AM	23.184
423	11/06/19 04:00:00AM	22.92
424	11/06/19 04:30:00AM	23.184
425	11/06/19 05:00:00AM	23.16
426	11/06/19 05:30:00AM	22.872
427	11/06/19 06:00:00AM	23.136
428	11/06/19 06:30:00AM	22.968
429	11/06/19 07:00:00AM	22.968
430	11/06/19 07:30:00AM	23.088
431	11/06/19 08:00:00AM	23.016
432	11/06/19 08:30:00AM	22.992
433	11/06/19 09:00:00AM	22.944
434	11/06/19 09:30:00AM	22.848
435	11/06/19 10:00:00AM	23.088
436	11/06/19 10:30:00AM	22.992
437	11/06/19 11:00:00AM	23.16
438	11/06/19 11:30:00AM	23.136
439	11/06/19 12:00:00PM	22.92
440	11/06/19 12:30:00PM	23.16
441	11/06/19 01:00:00PM	23.088
442	11/06/19 01:30:00PM	22.944
443	11/06/19 02:00:00PM	22.968
444	11/06/19 02:30:00PM	23.016
445	11/06/19 03:00:00PM	23.064
446	11/06/19 03:30:00PM	23.112
447	11/06/19 04:00:00PM	23.064
448	11/06/19 04:30:00PM	22.992
449	11/06/19 05:00:00PM	22.992
450	11/06/19 05:30:00PM	23.064
451	11/06/19 06:00:00PM	23.112

452	11/06/19 06:30:00PM	23.04
453	11/06/19 07:00:00PM	22.992
454	11/06/19 07:30:00PM	23.064
455	11/06/19 08:00:00PM	23.208
456	11/06/19 08:30:00PM	23.136
457	11/06/19 09:00:00PM	23.304
458	11/06/19 09:30:00PM	23.256
459	11/06/19 10:00:00PM	22.968
460	11/06/19 10:30:00PM	22.944
461	11/06/19 11:00:00PM	22.992
462	11/06/19 11:30:00PM	23.088
463	11/07/19 12:00:00AM	22.968
464	11/07/19 12:30:00AM	23.208
465	11/07/19 01:00:00AM	23.256
466	11/07/19 01:30:00AM	23.232
467	11/07/19 02:00:00AM	23.088
468	11/07/19 02:30:00AM	23.064
469	11/07/19 03:00:00AM	23.04
470	11/07/19 03:30:00AM	22.992
471	11/07/19 04:00:00AM	22.944
472	11/07/19 04:30:00AM	23.16
473	11/07/19 05:00:00AM	23.088
474	11/07/19 05:30:00AM	23.064
475	11/07/19 06:00:00AM	23.064
476	11/07/19 06:30:00AM	23.04
477	11/07/19 07:00:00AM	23.28
478	11/07/19 07:30:00AM	23.304
479	11/07/19 08:00:00AM	23.112
480	11/07/19 08:30:00AM	22.968
481	11/07/19 09:00:00AM	23.136
482	11/07/19 09:30:00AM	23.16
483	11/07/19 10:00:00AM	23.136
484	11/07/19 10:30:00AM	22.944
485	11/07/19 11:00:00AM	23.136
486	11/07/19 11:30:00AM	23.16
487	11/07/19 12:00:00PM	22.968
488	11/07/19 12:30:00PM	22.944
489	11/07/19 01:00:00PM	23.016
490	11/07/19 01:30:00PM	23.208
491	11/07/19 02:00:00PM	23.04
492	11/07/19 02:30:00PM	23.112
493	11/07/19 03:00:00PM	22.968
494	11/07/19 03:30:00PM	22.944
495	11/07/19 04:00:00PM	22.968
496	11/07/19 04:30:00PM	23.016
497	11/07/19 05:00:00PM	22.944
498	11/07/19 05:30:00PM	22.992

499	11/07/19 06:00:00PM	22.968
500	11/07/19 06:30:00PM	23.064
501	11/07/19 07:00:00PM	23.064
502	11/07/19 07:30:00PM	23.112
503	11/07/19 08:00:00PM	23.136
504	11/07/19 08:30:00PM	23.136
505	11/07/19 09:00:00PM	23.136
506	11/07/19 09:30:00PM	23.208
507	11/07/19 10:00:00PM	23.16
508	11/07/19 10:30:00PM	23.04
509	11/07/19 11:00:00PM	23.112
510	11/07/19 11:30:00PM	23.16
511	11/08/19 12:00:00AM	23.184
512	11/08/19 12:30:00AM	23.16
513	11/08/19 01:00:00AM	23.184
514	11/08/19 01:30:00AM	22.992
515	11/08/19 02:00:00AM	22.92
516	11/08/19 02:30:00AM	23.184
517	11/08/19 03:00:00AM	23.256
518	11/08/19 03:30:00AM	23.04
519	11/08/19 04:00:00AM	22.944
520	11/08/19 04:30:00AM	23.064
521	11/08/19 05:00:00AM	23.16
522	11/08/19 05:30:00AM	22.968
523	11/08/19 06:00:00AM	22.944
524	11/08/19 06:30:00AM	22.848
525	11/08/19 07:00:00AM	23.088
526	11/08/19 07:30:00AM	22.896
527	11/08/19 08:00:00AM	22.896
528	11/08/19 08:30:00AM	22.896
529	11/08/19 09:00:00AM	22.992
530	11/08/19 09:30:00AM	22.92
531	11/08/19 10:00:00AM	23.112
532	11/08/19 10:30:00AM	22.848
533	11/08/19 11:00:00AM	22.968
534	11/08/19 11:30:00AM	23.136
535	11/08/19 12:00:00PM	22.992
536	11/08/19 12:30:00PM	23.064
537	11/08/19 01:00:00PM	22.992
538	11/08/19 01:30:00PM	22.896
539	11/08/19 02:00:00PM	22.896
540	11/08/19 02:30:00PM	22.992
541	11/08/19 03:00:00PM	23.016
542	11/08/19 03:30:00PM	22.944
543	11/08/19 04:00:00PM	23.136
544	11/08/19 04:30:00PM	23.208
545	11/08/19 05:00:00PM	23.328

546	11/08/19 05:30:00PM	23.448
547	11/08/19 06:00:00PM	23.376
548	11/08/19 06:30:00PM	23.232
549	11/08/19 07:00:00PM	23.208
550	11/08/19 07:30:00PM	23.184
551	11/08/19 08:00:00PM	23.376
552	11/08/19 08:30:00PM	23.256
553	11/08/19 09:00:00PM	23.208
554	11/08/19 09:30:00PM	23.304
555	11/08/19 10:00:00PM	23.4
556	11/08/19 10:30:00PM	23.376
557	11/08/19 11:00:00PM	23.376
558	11/08/19 11:30:00PM	23.376
559	11/09/19 12:00:00AM	23.376
560	11/09/19 12:30:00AM	23.256
561	11/09/19 01:00:00AM	23.208
562	11/09/19 01:30:00AM	23.136
563	11/09/19 02:00:00AM	23.28
564	11/09/19 02:30:00AM	23.28
565	11/09/19 03:00:00AM	23.208
566	11/09/19 03:30:00AM	23.136
567	11/09/19 04:00:00AM	23.232
568	11/09/19 04:30:00AM	23.28
569	11/09/19 05:00:00AM	23.232
570	11/09/19 05:30:00AM	23.16
571	11/09/19 06:00:00AM	23.256
572	11/09/19 06:30:00AM	23.208
573	11/09/19 07:00:00AM	23.28
574	11/09/19 07:30:00AM	23.352
575	11/09/19 08:00:00AM	23.569
576	11/09/19 08:30:00AM	23.28
577	11/09/19 09:00:00AM	23.28
578	11/09/19 09:30:00AM	23.184
579	11/09/19 10:00:00AM	23.232
580	11/09/19 10:30:00AM	23.28
581	11/09/19 11:00:00AM	23.376
582	11/09/19 11:30:00AM	23.328
583	11/09/19 12:00:00PM	23.376
584	11/09/19 12:30:00PM	23.16
585	11/09/19 01:00:00PM	23.04
586	11/09/19 01:30:00PM	23.16
587	11/09/19 02:00:00PM	23.256
588	11/09/19 02:30:00PM	23.352
589	11/09/19 03:00:00PM	22.944
590	11/09/19 03:30:00PM	22.992
591	11/09/19 04:00:00PM	23.232
592	11/09/19 04:30:00PM	23.424

593	11/09/19 05:00:00PM	23.545
594	11/09/19 05:30:00PM	23.593
595	11/09/19 06:00:00PM	23.4
596	11/09/19 06:30:00PM	23.424
597	11/09/19 07:00:00PM	23.376
598	11/09/19 07:30:00PM	23.424
599	11/09/19 08:00:00PM	23.4
600	11/09/19 08:30:00PM	23.641
601	11/09/19 09:00:00PM	23.472
602	11/09/19 09:30:00PM	23.545
603	11/09/19 10:00:00PM	23.569
604	11/09/19 10:30:00PM	23.569
605	11/09/19 11:00:00PM	23.569
606	11/09/19 11:30:00PM	23.521
607	11/10/19 12:00:00AM	23.448
608	11/10/19 12:30:00AM	23.497
609	11/10/19 01:00:00AM	23.545
610	11/10/19 01:30:00AM	23.545
611	11/10/19 02:00:00AM	23.304
612	11/10/19 02:30:00AM	23.184
613	11/10/19 03:00:00AM	23.112
614	11/10/19 03:30:00AM	23.112
615	11/10/19 04:00:00AM	23.208
616	11/10/19 04:30:00AM	23.184
617	11/10/19 05:00:00AM	23.184
618	11/10/19 05:30:00AM	23.521
619	11/10/19 06:00:00AM	23.497
620	11/10/19 06:30:00AM	23.376
621	11/10/19 07:00:00AM	23.088
622	11/10/19 07:30:00AM	23.448
623	11/10/19 08:00:00AM	23.4
624	11/10/19 08:30:00AM	23.232
625	11/10/19 09:00:00AM	23.112
626	11/10/19 09:30:00AM	23.497
627	11/10/19 10:00:00AM	23.472
628	11/10/19 10:30:00AM	23.569
629	11/10/19 11:00:00AM	23.593
630	11/10/19 11:30:00AM	23.593
631	11/10/19 12:00:00PM	23.593
632	11/10/19 12:30:00PM	23.641
633	11/10/19 01:00:00PM	23.665
634	11/10/19 01:30:00PM	23.545
635	11/10/19 02:00:00PM	23.448
636	11/10/19 02:30:00PM	23.617
637	11/10/19 03:00:00PM	23.569
638	11/10/19 03:30:00PM	23.593
639	11/10/19 04:00:00PM	23.376

640	11/10/19 04:30:00PM	23.328
641	11/10/19 05:00:00PM	23.352
642	11/10/19 05:30:00PM	23.376
643	11/10/19 06:00:00PM	23.352
644	11/10/19 06:30:00PM	23.352
645	11/10/19 07:00:00PM	23.328
646	11/10/19 07:30:00PM	23.424
647	11/10/19 08:00:00PM	23.448
648	11/10/19 08:30:00PM	23.304
649	11/10/19 09:00:00PM	23.352
650	11/10/19 09:30:00PM	23.497
651	11/10/19 10:00:00PM	23.521
652	11/10/19 10:30:00PM	23.569
653	11/10/19 11:00:00PM	23.328
654	11/10/19 11:30:00PM	23.521
655	11/11/19 12:00:00AM	23.28
656	11/11/19 12:30:00AM	23.256
657	11/11/19 01:00:00AM	23.28
658	11/11/19 01:30:00AM	23.256
659	11/11/19 02:00:00AM	23.256
660	11/11/19 02:30:00AM	23.352
661	11/11/19 03:00:00AM	23.256
662	11/11/19 03:30:00AM	23.28
663	11/11/19 04:00:00AM	23.28
664	11/11/19 04:30:00AM	23.4
665	11/11/19 05:00:00AM	23.328
666	11/11/19 05:30:00AM	23.352
667	11/11/19 06:00:00AM	23.208
668	11/11/19 06:30:00AM	23.304
669	11/11/19 07:00:00AM	23.232
670	11/11/19 07:30:00AM	23.304
671	11/11/19 08:00:00AM	23.184
672	11/11/19 08:30:00AM	23.232
673	11/11/19 09:00:00AM	23.28
674	11/11/19 09:30:00AM	23.665
675	11/11/19 10:00:00AM	23.665
676	11/11/19 10:30:00AM	23.713
677	11/11/19 11:00:00AM	23.28
678	11/11/19 11:30:00AM	23.304
679	11/11/19 12:00:00PM	23.472
680	11/11/19 12:30:00PM	23.689
681	11/11/19 01:00:00PM	23.304
682	11/11/19 01:30:00PM	23.497
683	11/11/19 02:00:00PM	23.448
684	11/11/19 02:30:00PM	23.424
685	11/11/19 03:00:00PM	23.545
686	11/11/19 03:30:00PM	23.232

687	11/11/19 04:00:00PM	23.232
688	11/11/19 04:30:00PM	23.256
689	11/11/19 05:00:00PM	23.304

Appendix E

Laboratory Benchsheets

QC'd by:_____

2487-00
Mad Scientist
Chironomus dilutus WEIGHT DATA

Project Number:	**2487-00**	Type/Model of Drying Oven: **Blue M**	Type/Model of Muffle Furnace: **F6020 Thermolyne MOD.**
Project Name:	**Mad Scientist**	Oven Temperature: **60 °C**	Muffle Furnace Temperature: **550 °C**
GLC#:		Drying Duration (Hours): **~24 hrs**	Drying Duration (Hours): **2 hrs**
Sample ID:	**Con 1**	Date/Time in: 11/11/19 1725	Date/Time in: 11/13/19 1340
		Date/Time out: 11/13/19 0810	Date/Time out: 11/13/19 1651
Test Species:	***Chironomus dilutus***	Dessicator: # 1	Dessicator: # 2
Test Date:	**11/1/2019**	Date/Time in: 11/13/19 0810	Date/Time in: 11/13/19 1651
	11/11/2019	Date/Time out: 11/13/19 1140	Date/Time out: 11/18/19 1126
		Dry Weigh Date/Technician's Initials: 11/13/19 SR	Ashed Weigh Date/Technician's Initials: 11/18/19

	Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Ashed Weight of Pan and Organisms (g)	B-C Total Ash-Free Dry Weight (g)	D Number of Organisms Weighed	B-C/D Average Ash-Free Dry Weight (mg)	E Number of Pupae and Midges at Day 10	(B-C) / (A-E) *Biomass weight (mg)
Sample ID:	1	10	1.13673	1.13454	0.00219	2	1.095	0	0.219
Con 1	2	10	1.11932	1.10976	0.00956	10	0.956	0	0.956
GLC Number:	3	10	1.14903	1.14030	0.00873	9	0.970	1	0.970
	4	10	1.12303	1.11376	0.00927	10	0.927	0	0.927
	5	10	1.14894	1.13989	0.00905	10	0.905	0	0.905
	6	10	1.13190	1.12198	0.00992	10	0.992	0	0.992
	7	10	1.14295	1.13465	0.00830	10	0.830	0	0.830
	8	10	1.14572	1.13658	0.00914	10	0.914	0	0.914
						AVERAGE:	0.94862		0.83912

*Biomass weight (mg) : defined as the total ash-free dry weight of surviving organisms divided by the initial number of organisms minus pupae and midges

Day 0 weights	40	1.12688	1.11488	0.012	40	Average at Day 0 (mg)		0.3

See Attached sheet for calculated weights.

QC'd by:_____

2487-00
Mad Scientist
Chironomus dilutus WEIGHT DATA

Project Number:	**2487-00**	Type/Model of Drying Oven: **Blue M**	Type/Model of Muffle Furnace: **F6020 Thermolyne MOD.**
Project Name:	**Mad Scientist**	Oven Temperature: **60 °C**	Muffle Furnace Temperature: **550 °C**
GLC#:	~~43745~~	Drying Duration (Hours): **~24 hrs**	Drying Duration (Hours): **2 hrs**
Sample ID:	**Con 1**	Date/Time in: 11/11/19 ~~09~~ 1725	Date/Time in: 11/13/19 1340
		Date/Time out: 11/13/19 0810	Date/Time out: 11/13/19 1651
Test Species:	***Chironomus dilutus***	Dessicator: # 1	Dessicator: # 2
Test Date:	**11/1/2019**	Date/Time in: 11/13/19 0810	Date/Time in: 11/13/19 1651
	11/11/2019	Date/Time out: 11/13/19 1140	Date/Time out: 11/18/19 1120
		Dry Weigh Date/Technician's Initials: 11/13/19 ~~9~~	Ashed Weigh Date/Technician's Initials: 11/18/19 S/L

	Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Ashed Weight of Pan and Organisms (g)	B-C Total Ash-Free Dry Weight (g)	D Number of Organisms Weighed	B-C/D Average Ash-Free Dry Weight (mg)	E Number of Pupae and Midges at Day 10	(B-C) / (A-E) *Biomass weight (mg)
Sample ID:	1	10	1.13673	1.13452		2		0	
Con 1	2	10	1.11932	1.10976		10		0	
GLC Number:	3	10	1.14903	1.14030		9		1	
~~43745~~	4	10	1.12303	1.11376		10		0	
	5	10	1.14894	1.13989		10		0	
	6	10	1.13190	1.12198		10		0	
	7	10	1.14295	1.13165		10		0	
	8	10	1.14572	1.13658		10		0	
						AVERAGE:			

*Biomass weight (mg) : defined as the total ash-free dry weight of surviving organisms divided by the initial number of organisms minus pupae and midges

Day 0 weights	A ~~40~~ 40	1.12684	1.11488	0	~~40~~ 40 A	Average at Day 0 (mg)	0

See Attached sheet for calculated weights.

* entry error S/L 11/13/19

A 40 organisms archived instead of 80 due to lack of organisms S/L 11/18/19

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

QC'd by: SR

Project Number: **2487-00**	Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#: **43745**		Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID: **Con 1**		Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Species: ***Chironomus dilutus***		Test Temperature: **23± 1°C**	
Date Addition of Sediment: **10/31/2019**		Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date: **11/1/2019**		Test Termination Date:	**11/11/2019**

Test Day: **Day 0**		Number Daily Renewals: **2**	Air: □ yes □ no
Date: **11/1/2019**		□ ~~1545 DAY~~ renewal time/Initials	□ renewal time/Initials
Overlying Water: **Smith Water**	1545 DAY 1	□ ~~1545 DAY~~ renewal time/Initials	□ renewal time/Initials
Overlying Water Batch ID (GLC Number):		Food: **TFS# (4g/L)**	□ Feed 1.5 ml/replicate
□ SR 0905 chemistries time/Initial		Screens Cleaned: □ **yes** □ **no**	

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ 10 organisms per replicate
Record Meter ID	#48	**GLC 004**	**GLC 097**	**GLC 092**	N/A	**GLC 004**	**GLC 081**	**Init:** SR
1	22.4	7.72	7.7	347	120	100	1.48 SR	10
2					end: 26.2	end: 42.0		10
3					start: 23.2	start: 39.5		10
4					Titrant used (mL): 3.0 KHO	Titrant used (mL): 2.5 KHO		10
5					Sample volume (mL): 25	Sample volume (mL): 25		10
6								10
7								10
8								10

Relative % Difference: RPD ≤15%

$$RPD = \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits: ; entry error SR 11/18/19
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 2/2019
U = Below MDL. J = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

QC'd by:

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

Project Number:	**2487-00**	Project Name:	**Mad Scientist**
GLC#:	**43745**		
Sample ID:	**Con 1**		
Test Species:	***Chironomus dilutus***		
Date Addition of Sediment:	**10/31/2019**		
Test Initiation Date:	**11/1/2019**		

Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
Test Photoperiod: **16:8**	Lux: **100-1000**
Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Temperature: **23± 1°C**	
Test Organism Source/Age:	**ABS: 10-11 days old**
Test Termination Date:	**11/11/2019**

Test Day: **1**
Date: **11/2/2019**
Overlying Water: **Smith**
Overlying Water Batch ID (GLC Number):
Number Daily Renewals: Air: □ yes □ no
□ renewal time/Initials □ renewal time/Initials
□ renewal time/Initials □ renewal time/Initials
Food: **TFS# (4g/L)** ☑ Feed 1.5 ml/replicate
Screens Cleaned: □ **yes** ☑ **no**
□ chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	418	**GLC 097**	**Init:**
1	22.6	5.3	NAV
2			"
3			BHV
4			NAV
5	22.7	5.3	BHV
6			"
7			"
8			NAV

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or if Temperature is out of range.

Test Day: **2**
Date: **11/3/2019**
Overlying Water: **Smith Water**
Overlying Water Batch ID (GLC Number):
Number Daily Renewals: Air: □ yes □ no
☑ renewal time/Initials □ renewal time/Initials
☑ renewal time/Initials □ renewal time/Initials
Food: **TFS# (4g/L)** ☑ Feed 1.5 ml/replicate
Screens Cleaned: □ **yes** ☑ **no**
chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	#42 (-.3)	**GLC 097**	**Init:**
1			NAV
2	22.9	5.1	NAV
3			BHV
4			BHV
5			NAV
6			BHV
7	22.9	5.1	BHV
8			NAV

KEY:

AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

QC'd by: SF

Project Number:	2487-00	Project Name:	Mad Scientist
GLC#:	43745		
Sample ID:	Con 1		
Test Species:	*Chironomus dilutus*		
Date Addition of Sediment:	10/31/2019		
Test Initiation Date:	11/1/2019		

Test Method-Manual:	EPA 100.2-EPA/600/R-99/064
Test Photoperiod: 16:8	Lux: 100-1000
Test System:	Sediment-100 mL and Overlying Water-175mL Manual Delivery
Test Temperature:	23± 1°C
Test Organism Source/Age:	ABS: 10-11 days old
Test Termination Date:	11/11/2019

Test Day: 3
Date: 11/4/2019
Overlying Water: MAD Smith Water
Overlying Water Batch ID (GLC Number):
Number Daily Renewals: 2 Air: □ yes ☑ no
□ SF 0825 renewal time/Initials □ renewal time/Initials
□ WKT 1930 renewal time/Initials □ renewal time/Initials
Food: TFS# (4g/L) 0.01g ☑ Feed 1.5 ml/replicate
Screens Cleaned: □ yes ☑ no
□ WKT 1400 chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	4 8 (10.1)	GLC 097	Init: WKT
1	22.7	4.8	NAV
2			11-11
3	22.7	4.8	11-11
4			11-11
5			11-11
6			11-11
7			11-11
8			

Test Day: 4
Date: 11/5/2019
Overlying Water: MAD Smith Water
Overlying Water Batch ID (GLC Number):
Number Daily Renewals: Air: □ yes ☑ no
□ 0835 SF renewal time/Initials □ renewal time/Initials
□ 1850 WKT renewal time/Initials □ renewal time/Initials
Food: TFS# (4g/L) 0.01g ☑ Feed 1.5 ml/replicate
Screens Cleaned: □ yes ☑ no
□ 1300 SF chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	4 8 (10.1)	GLC 097	Init: SF
1			NAV
2			11
3	22.7	4.0	BHV
4			NAV
5	22.7	4.3	BHV
6			NAV
7			11
8			11

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or if Temperature is out of range.

KEY:

AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

QC'd by: SG

Project Number:	**2487-00**	Project Name:	**Mad Scientist**
GLC#:	**43745**		
Sample ID:	**Con 1**		
Test Species:	***Chironomus dilutus***		
Date Addition of Sediment:	**10/31/2019**		
Test Initiation Date:	**11/1/2019**		

Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
Test Photoperiod: **16:8**	Lux: **100-1000**
Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Temperature: **23± 1°C**	
Test Organism Source/Age:	**ABS: 10-11 days old**
Test Termination Date:	**11/11/2019**

Test Day: **5**
Date: **11/6/2019**
Overlying Water: **Smith Water**
Overlying Water Batch ID (GLC Number):
Number Daily Renewals: 2 Air: ☐ yes ☑ no
☐ 0915 GH renewal time/Initials ☐ renewal time/Initials
☐ 1905 LWT renewal time/Initials ☐ renewal time/Initials
Food: **TFS# (4g/L)** 0807 ☐ Feed 1.5 ml/replicate
Screens Cleaned: ☐ **yes** ☑ **no**
☐ 1440 GH chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	4.8 (+0.1)	GLC 097	Init: GH
1			NAV
2			"
3			"
4	22.7	4.4	"
5			"
6	22.7	4.7	"
7			"
8			"

Test Day: **6**
Date: **11/7/2019**
Overlying Water: **Smith Water**
Overlying Water Batch ID (GLC Number):
Number Daily Renewals: 2 Air: ☐ yes ☑ no
☐ 0830 GH renewal time/Initials ☐ renewal time/Initials
☐ 1830 DAW renewal time/Initials ☐ renewal time/Initials
Food: **TFS# (4g/L)** 0807 ☐ Feed 1.5 ml/replicate
Screens Cleaned: ☐ **yes** ☑ **no**
☐ 1545 CAD chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
	~~24.9 (-0.5)~~		
Meter ID	~~+1.8 (+0.1)~~	GLC 097	Init: GH
1			BHV
2	22.8	4.8	NAV
3			BHV
4			NAV
5			"
6			"
7	22.9	4.5	"
8			"

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or if Temperature is out of range.

revised: June 2012

KEY: = entry error GH 11/18/19

AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

QC'd by: GF

Project Number:	**2487-00**	Project Name:	**Mad Scientist**
GLC#:	**43745**		
Sample ID:	**Con 1**		
Test Species:	***Chironomus dilutus***		
Date Addition of Sediment:	**10/31/2019**		
Test Initiation Date:	**11/1/2019**		

Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
Test Photoperiod: **16:8**	Lux: **100-1000**
Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Temperature: **23± 1°C**	
Test Organism Source/Age:	**ABS: 10-11 days old**
Test Termination Date:	**11/11/2019**

Test Day: 7
Date: **11/8/2019**
Overlying Water: ~~MSB~~ **Smith Water**
Overlying Water Batch ID (GLC Number):
Number Daily Renewals: 2 Air: ☐ yes ☑ no
☐ 0840 GF renewal time/Initials ☐ renewal time/Initials
☐ 1615 DAW renewal time/Initials ☐ renewal time/Initials
Food: **TFS# (4g/L)** 0007 ☐ Feed 1.5 ml/replicate
Screens Cleaned: ☐ **yes** ☑ **no**
☐ 1555 GF chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	47 +0.1	**GLC 097**	**Init:** GF
1			NAV
2			11
3			11
4			BHV
5			NAV
6	22.7	4.2	AV
7			NAV
8	22.6	3.8	11

Test Day: 8
Date: **11/9/2019**
Overlying Water: ~~MSB~~ **Smith Water**
Overlying Water Batch ID (GLC Number):
Number Daily Renewals: 2 Air: ☐ yes ☒ no
☒ 8:00 YBK renewal time/Initials ☐ renewal time/Initials
☒ 1910 CMW renewal time/Initials ☐ renewal time/Initials
Food: **TFS# (4g/L)** ☑ Feed 1.5 ml/replicate
Screens Cleaned: ☐ **yes** ☐ **no**
☑ 1134 11.00 chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	49 (-0.3)	**GLC 097**	**Init:** YBK
1	22.7	4.3	NAV
2			11-11
3	22.7	4.5	11-11
4			11-11
5			11-11
6			11-11
7			11-11
8			11-11

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or if Temperature is out of range.

revised: June 2012

KEY:

AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

QC'd by: SG

Project Number: **2487-00**	Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#: **43745**		Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID: **Con 1**		Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Species: ***Chironomus dilutus***		Test Temperature: **23± 1°C**	
Date Addition of Sediment:	**10/31/2019**	Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date:	**11/1/2019**	Test Termination Date:	**11/11/2019**

Test Day: **9**

Date: **11/10/2019**

Overlying Water: **Smith Water**

Overlying Water Batch ID (GLC Number):

Number Daily Renewals: 2 Air: ☐ yes ☑ no

☐ 0800 SG renewal time/Initials ☐ renewal time/Initials

☐ SG 1459 renewal time/Initials ☐ renewal time/Initials

Food: **TFS# (4g/L)** 0007 ☑ Feed 1.5 ml/replicate

Screens Cleaned: ☑ **yes** ☐ **no**

☐ 0720 SG chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	47 (+0.1)	**GLC 097**	**Init** SG
1			BHV
2			NAV
3	22.9	3.9	BHV
4			NAV
5		~~4.0~~	"
6	22.9	4.9	"
7			"
8			BHV

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or Temperature is out of range.

revised: June 2012

, entry error SG 11/10/19

KEY:

AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

QC'd by: VR

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

Project Number: **2487-00**	Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#: **43745**		Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID: **Con 1**		Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Species: ***Chironomus dilutus***		Test Temperature: **23± 1°C**	
Date Addition of Sediment:	**10/31/2019**	Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date:	**11/1/2019**	Test Termination Date:	**11/11/2019**

Test Day: **Day 10**	Number Daily Renewals: Air: ☐ yes ☐ no
Date: **11/11/2019**	☐ [redacted] renewal time/Initials ~~☐ renewal~~
Overlying Water: **Smith Water**	~~☐ renewal time/Initials ☐ renewal~~
Overlying Water Batch ID (GLC Number):	Food: ~~TFS# (4g/L)~~ ~~☐ Feed 1.5 ml/replicate~~
☑ AE0905 chemistries time/Initial	Screens Cleaned: ☐ **yes** ☐ **no**

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ # Surviving Organisms
Record Meter ID	49	**GLC 004**	**GLC 097**	**GLC 092**	N/A	**GLC 004**	**GLC 081**	**Init:** VR
1	22.6	7.58	5.8	373	108	100	1.210	Larvae: 1 Pupae: 10 Midge: 89 /10
2					end: 30.2	end: 30.0		Larvae: 10 Pupae: 0 Midge: 0 /10
3					start: 27.5	start: 27.5		Larvae: 9 Pupae: 1 Midge: 0 /10
4					Titrant used (mL): 2.7	Titrant used (mL): 2.5		Larvae: 10 Pupae: 0 Midge: 0 /10
5					Sample volume (mL): 25	Sample volume (mL): 25		Larvae: 10 Pupae: 0 Midge: 0 /10
6								Larvae: 10 Pupae: 0 Midge: 0 /10
7								Larvae: 10 Pupae: 0 Midge: 0 /10
8								Larvae: 10 Pupae: 0 Midge: 0 /10

Relative % Difference: RPD ≤15%

$$RPD = \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 2/2019
U = Below MDL. *J* = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

*early delivery Date 11/9/19

QC'd by:_____

2487-00
Mad Scientist
Chironomus dilutus WEIGHT DATA

Project Number:	**2487-00**	Type/Model of Drying Oven: **Blue M**		Type/Model of Muffle Furnace: **F6020 Thermolyne MOD.**	
Project Name:	**Mad Scientist**	Oven Temperature: **60 °C**		Muffle Furnace Temperature: **550 °C**	
GLC#:		Drying Duration (Hours): **~24 hrs**		Drying Duration (Hours): **2 hrs**	
Sample ID:	**H2O**	Date/Time in: 11/01/19 1725		Date/Time in: 11/13/19 1340	
		Date/Time out: 11/13/19 0810		Date/Time out: 11/13/19 1651	
Test Species:	***Chironomus dilutus***	Dessicator: # 1		Dessicator: # 2	
Test Date:	**11/1/2019**	Date/Time in: 11/13/19 0810		Date/Time in: 11/13/19 1651	
	11/11/2019	Date/Time out: 11/13/19 1155		Date/Time out: 11/15/19 1100	
		Dry Weigh Date/Technician's Initials: 11/13/19 SR		Ashed Weigh Date/Technician's Initials: 11/18/19	

	Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Ashed Weight of Pan and Organisms (g)	B-C Total Ash-Free Dry Weight (g)	D Number of Organisms Weighed	B-C/D Average Ash-Free Dry Weight (mg)	E Number of Pupae and Midges at Day 10	(B-C) / (A-E) *Biomass weight (mg)
Sample ID:	**1**	10	1.14485	1.14234	0.00251	9	0.279	0	0.251
H2O	**2**	10	1.14509	1.14128	0.00381	8	0.476	0	0.381
GLC Number:	**3**	10	1.13318	1.12917	0.00401	10	0.401	0	0.401
	4	10	1.11551	1.11118	0.00433	8	0.541	0	0.433
	5	10	1.12323	1.11919	0.00404	7	0.577	0	0.404
	6	10	1.13086	1.12742	0.00344	8	0.430	0	0.344
	7	10	1.11579	1.11255	0.00324	7	0.463	0	0.324
	8	10	1.11939	1.11553	0.00386	9	0.429	0	0.386
						AVERAGE:	0.44953		0.36550

*Biomass weight (mg) : defined as the total ash-free dry weight of surviving organisms divided by the initial number of organisms minus pupae and midges

Day 0 weights	40	1.12688	1.11488	0.012	40	Average at Day 0 (mg)		0.3

See Attached sheet for calculated weights.

2487-00
Mad Scientist
Chironomus dilutus WEIGHT DATA

Project Number:	**2487-00**	Type/Model of Drying Oven: **Blue M**	Type/Model of Muffle Furnace: **F6020 Thermolyne MOD.**
Project Name:	**Mad Scientist**	Oven Temperature: **60 °C**	Muffle Furnace Temperature: **550 °C**
GLC#:		Drying Duration (Hours): **~24 hrs**	Drying Duration (Hours): **2 hrs**
Sample ID:	**H2O**	Date/Time in: 11/11/19 1725	Date/Time in: 11/13/19 1340
		Date/Time out: 11/13/19 0810	Date/Time out: 11/13/19 1657
Test Species:	***Chironomus dilutus***	Dessicator: # 1	Dessicator: # 2
Test Date:	**11/1/2019**	Date/Time in: 11/13/19 0819	Date/Time in: 11/13/19 1657
	11/11/2019	Date/Time out: 11/13/19 1155	Date/Time out: 11/13/19 1800
		Dry Weigh Date/Technician's Initials: 11/13/19 SG	Ashed Weigh Date/Technician's Initials: 11/18/19 SG

	Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Ashed Weight of Pan and Organisms (g)	B-C Total Ash-Free Dry Weight (g)	D Number of Organisms Weighed	B-C/D Average Ash-Free Dry Weight (mg)	E Number of Pupae and Midges at Day 10	(B-C) / (A-E) *Biomass weight (mg)
Sample ID:	1	10	1.14485	1.14234		9		0	
H2O	2	10	1.14509	1.14128		8		0	
GLC Number:	3	10	1.13318	1.12917		10		0	
	4	10	1.11551	1.11118		8		0	
	5	10	1.12323	1.11919		7		0	
	6	10	1.13086	~~1.12755~~ 1.12742		8		0	
	7	10	1.11579	~~1.11253~~ 1.11553		7		0	
	8	10	1.11939	1.11553		9		0	
						AVERAGE:			

*Biomass weight (mg) : defined as the total ash-free dry weight of surviving organisms divided by the initial number of organisms minus pupae and midges

Day 0 weights	~~20~~ 40 Δ ~~-80~~	~~1.12688~~ 1.12668	1.11488	0	~~20~~ 40 Δ ~~-80~~	Average at Day 0 (mg)		0

Δ only 40 organisms archived due to lack of organisms SG 11/18/19
* entry error SG 11/18/19, 11/19/19

See Attached sheet for calculated weights.

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

QC'd by: KZ

Project Number: **2487-00**	Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#:		Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID: **H2O**		Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Species: ***Chironomus dilutus***		Test Temperature: **23± 1°C**	
Date Addition of Sediment: **10/31/2019**		Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date: **11/1/2019**		Test Termination Date:	**11/11/2019**

Test Day: **Day 0**		Number Daily Renewals: **2**	Air: ☐ yes ☑ no
Date: **11/1/2019**		☐ renewal time/Initials	☐ renewal time/Initials
Overlying Water: (MW) **Smith Water**		☐ TAW/845 renewal time/Initials	☐ renewal time/Initials
Overlying Water Batch ID (GLC Number):		Food: **TFS# (4g/L)**	☐ Feed 1.5 ml/replicate
☐ AT 0900 chemistries time/Initial		Screens Cleaned: ☐ **yes** ☑ **no**	

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ 10 organisms per replicate
Record Meter ID	#48	GLC 004	GLC 097	GLC 092	N/A	GLC 004	GLC 081	Init: CJ
1	22.7	7.71	8.6	276	100	60	0.017 AT	10
2					end: 23.2	end: 39.3		10
3					start: 20.7	start: 37.6		10
4					Titrant used (mL): 2.5 KM	Titrant used (mL): 1.5 KM		10
5					Sample volume (mL): 25	Sample volume (mL): 25		10
6								10
7								10
8								10

Relative % Difference: RPD ≤15%

$$RPD = \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 2/2019
U = Below MDL. J = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

QC'd by: SR

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

Project Number: **2487-00**	Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#:		Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID: **H2O**		Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Species: ***Chironomus dilutus***		Test Temperature: **23± 1°C**	
Date Addition of Sediment:	**10/31/2019**	Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date:	**11/1/2019**	Test Termination Date:	**11/11/2019**

Test Day: **1**
Date: **11/2/2019**
Overlying Water: **Smith** MW
Overlying Water Batch ID (GLC Number):
Number Daily Renewals: 2 Air: ☐ yes ☑ no
☐ 11/2 0820 renewal time/Initials ☐ renewal time/Initials
☐ CMR 2100 renewal time/Initials ☐ renewal time/Initials
Food: **TFS# (4g/L)** ☑ Feed 1.5 ml/replicate 0016
Screens Cleaned: ☐ **yes** ☑ **no**
☐ 0800 CM chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	418	GLC 097	Init: CM
1	22.6	6.5	NAV
2			"
3			"
4			"
5	22.6	6.8	"
6			"
7			"
8			"

Test Day: **2**
Date: **11/3/2019**
Overlying Water: **Smith Water** MW
Overlying Water Batch ID (GLC Number):
Number Daily Renewals: 2 Air: ☐ yes ☑ no
~~CMR~~ 0745 renewal time/Initials ☐ renewal time/Initials
☐ CMR 2100 renewal time/Initials ☐ renewal time/Initials
Food: **TFS# (4g/L)** ☑ Feed 1.5 ml/replicate 0006
Screens Cleaned: ☐ **yes** ☒ **no**
☒ 0700 CM chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	#99 (-.3)	GLC 097	Init: CM
1	22.7	7.0	~~NAV~~
2			
3			
4			
5			
6	22.8	7.1	
7			
8			

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or if Temperature is out of range.

KEY:

AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

• entry error CM 11/3/19

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

QC'd by: EK

Project Number: **2487-00**	Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#:		Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID: **H2O**		Test System:	**Sediment-100 mL and Overlying Water-175mL Manual Delivery**
Test Species: ***Chironomus dilutus***		Test Temperature:	**23± 1°C**
Date Addition of Sediment:	**10/31/2019**	Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date:	**11/1/2019**	Test Termination Date:	**11/11/2019**

Test Day: **3**
Date: **11/4/2019**
Overlying Water: MCD **Smith Water**
Overlying Water Batch ID (GLC Number):
Number Daily Renewals: 2 Air: ☐ yes ☑ no
☐ 0825 EK renewal time/Initials ☐ renewal time/Initials
☐ 1930 MR renewal time/Initials ☐ renewal time/Initials
Food: **TFS# (4g/L)** 0206 ☑ Feed 1.5 ml/replicate
Screens Cleaned: ☐ **yes** ☑ **no**
☑ 1314 1400 chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	48 (+0.1)	GLC 097	Init: YBK
1	22-7	7-4	AV
2			11-11
3	22-7	7-4	11-11
4			11-11
5			11-11
6			11-11
7			11-11
8			11-11

Test Day: **4**
Date: **11/5/2019**
Overlying Water: MCD **Smith Water**
Overlying Water Batch ID (GLC Number):
Number Daily Renewals: 2 Air: ☐ yes ☑ no
☐ 0835 EK renewal time/Initials ☐ renewal time/Initials
☐ 1850 DMS renewal time/Initials ☐ renewal time/Initials
Food: **TFS# (4g/L)** 0206 ☑ Feed 1.5 ml/replicate
Screens Cleaned: ☐ **yes** ☑ **no**
☐ 1300 EK chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	48 (+0.1)	GLC 097	Init: EK
1			AV
2			11
3	22.8	6.6	11
4			11
5	22.8	6.5	11
6			11
7			11
8			11

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or if Temperature is out of range.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

QC'd by: S/R

Project Number: **2487-00**	Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#:		Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID: **H2O**		Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Species: ***Chironomus dilutus***		Test Temperature: **23± 1°C**	
Date Addition of Sediment:	**10/31/2019**	Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date:	**11/1/2019**	Test Termination Date:	**11/11/2019**

Test Day: **5**	Test Day: **6**
Date: **11/6/2019**	Date: **11/7/2019**
Overlying Water: MHS **Smith Water**	Overlying Water: MHS **Smith Water**
Overlying Water Batch ID (GLC Number):	Overlying Water Batch ID (GLC Number):
Number Daily Renewals: 2 Air: ☐ yes ☑ no	Number Daily Renewals: 2 Air: ☐ yes ☐ no
☐ 0915 S/R renewal time/Initials ☐ renewal time/Initials	☐ 0830 S/R renewal time/Initials ☐ renewal time/Initials
☐ 1905 LAT renewal time/Initials ☐ renewal time/Initials	☐ 1830 DAW renewal time/Initials ☐ renewal time/Initials
Food: TFS# (4g/L) 0007 ☐ Feed 1.5 ml/replicate	Food: TFS# (4g/L) 0007 ☐ Feed 1.5 ml/replicate
Screens Cleaned: ☐ **yes** ☑ **no**	Screens Cleaned: ☐ **yes** ☑ **no**
☐ 1410 S/R chemistries time/Initial	☐ 1545 CAD chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	48 (±0.1)	GLC 097	Init: S/R
1			AV
2			"
3			"
4	22.7	6.7	"
5			"
6	22.7	6.7	"
7			"
8	12		"

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	~~48 (±0.1)~~ 49 (±0.3)	GLC 097	Init: S/R
1			AV
2	22.8	6.09	"
3			"
4			"
5			"
6			"
7	22.9	5.98	"
8			"

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or if Temperature is out of range.

revised: June 2012

• entry error S/R 11/6/19

KEY: • entry error S/R 11/18/19

AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

QC'd by: SR

Project Number: **2487-00**	Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#:		Test Photoperiod: **16:8** Lux: **100-1000**	
Sample ID: **H2O**		Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Species: ***Chironomus dilutus***		Test Temperature: **23± 1°C**	
Date Addition of Sediment:	**10/31/2019**	Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date:	**11/1/2019**	Test Termination Date:	**11/11/2019**

Test Day: 7	Test Day: 8
Date: **11/8/2019**	Date: **11/9/2019**
Overlying Water: MSD **Smith Water**	Overlying Water: MSD **Smith Water**
Overlying Water Batch ID (GLC Number):	Overlying Water Batch ID (GLC Number):
Number Daily Renewals: 2 Air: □ yes ☑ no	Number Daily Renewals: 2 Air: □ yes ☑ no
□ 0810 GF renewal time/Initials □ renewal time/Initials	☑ 0820 YBK renewal time/Initials □ renewal time/Initials
□ KRISTEN renewal time/Initials □ renewal time/Initials	☑ 1910 CMW renewal time/Initials □ renewal time/Initials
Food: **TFS# (4g/L)** 007 ☑ Feed 1.5 ml/replicate	Food: **TFS# (4g/L)** 007 ☑ Feed 1.5 ml/replicate
Screens Cleaned: □ **yes** ☑ **no**	Screens Cleaned: □ **yes** ☑ **no**
□ 1555 GF chemistries time/Initial	☑ 4134 1100 chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	17 (±0.1)	**GLC 097**	**Init:** GF
1			AV
2			"
3			"
4			"
5			"
6	22.8	6.7	"
7			"
8	22.4	6.6	"

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	49 (-0.3)	**GLC 097**	**Init:** YBK
1	22.8	7.5	AV
2			"
3	22.8	7.2	"
4			"
5			"
6			"
7			"
8			"

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or if Temperature is out of range.

KEY:

AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

QC'd by: SR

Project Number: **2487-00**	Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#:		Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID: **H2O**		Test System:	**Sediment-100 mL and Overlying Water-175mL Manual Delivery**
Test Species: ***Chironomus dilutus***		Test Temperature:	**23± 1°C**
Date Addition of Sediment:	**10/31/2019**	Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date:	**11/1/2019**	Test Termination Date:	**11/11/2019**

Test Day: **9**

Date: **11/10/2019**

Overlying Water: **Smith Water**

Overlying Water Batch ID (GLC Number):

Number Daily Renewals: 2 Air: ☐ yes ☑ no

☐ 0800 SR renewal time/Initials ☐ renewal time/Initials

☐ 1950 SR renewal time/Initials ☐ renewal time/Initials

Food: **TFS# (4g/L)** 0007 ☑ Feed 1.5 ml/replicate

Screens Cleaned: ☐ **yes** ☑ **no**

☐ 0720 SR chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	17 (±0.1)	**GLC 097**	**Init** SR
1			AV
2			11
3	23.1	7.1	11
4			11
5			11
6	23.9	7.3	11
7			11
8			11

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or Temperature is out of range.

revised: June 2012

KEY:

AV: Animals Visible *FOV*: Foreign Organism Visible

NAV: No Animals Visible *BHV*: Bore Holes Visible

QC'd by: SR

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

Project Number: **2487-00**	Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#:		Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID: **H2O**		Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Species: ***Chironomus dilutus***		Test Temperature: **23± 1°C**	
Date Addition of Sediment:	**10/31/2019**	Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date:	**11/1/2019**	Test Termination Date:	**11/11/2019**

Test Day: **Day 10**	Number Daily Renewals: Air: ☐ yes ☐ no
Date: **11/11/2019**	* ☐ [redacted] renewal time/Initials ~~☐ renewal~~
Overlying Water: **Smith Water**	~~☐ renewal time/Initials ☐ renewal~~
Overlying Water Batch ID (GLC Number):	Food: ~~TFS# (4g/L)~~ ~~☐ Feed 1.5 ml/replicate~~
☑ AE0905 chemistries time/Initial	Screens Cleaned: ☐ **yes** ☑ **no**

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ # Surviving Organisms
Record Meter ID	#49	**GLC 004**	**GLC 097**	**GLC 092**	N/A	**GLC 004**	**GLC 081**	**Init:** CLD
1	22.8	7.65	7.5	330	84	44	0.438	Larvae: Pupae: 9 Midge: /10
2					end: 27.5	end: 27.5		Larvae: Pupae: 8 Midge: /10
3					start: 25.4	start: 26.4		Larvae: Pupae: 10 Midge: /10
4					Titrant used (mL): 2.1	Titrant used (mL): 1.1		Larvae: Pupae: 8 Midge: /10
5					Sample volume (mL): 25	Sample volume (mL): 25		Larvae: Pupae: 7 Midge: /10
6								Larvae: Pupae: 8 Midge: /10
7								Larvae: Pupae: 7 Midge: /10
8								Larvae: Pupae: 9 Midge: /10

Relative % Difference: RPD ≤15%

$$RPD = \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 2/2019
U = Below MDL. *J* = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

* entry deleted DLW 11/19/19

revised: June 2012

QC'd by:_____

2487-00
Mad Scientist
Chironomus dilutus WEIGHT DATA

Project Number:	**2487-00**	Type/Model of Drying Oven: **Blue M**	Type/Model of Muffle Furnace: **F6020 Thermolyne MOD.**
Project Name:	**Mad Scientist**	Oven Temperature: **60 °C**	Muffle Furnace Temperature: **550 °C**
GLC#:	**SS416** ~~SS417~~ SS416	Drying Duration (Hours): **~24 hrs**	Drying Duration (Hours): **2 hrs**
Sample ID:	**Alum Creek ~~Upstream~~** Downstream	Date/Time in: 11/11/19 1725	Date/Time in: 11/13/19 1340
		Date/Time out: 11/13/19 0510	Date/Time out: 11/13/19 1651
Test Species:	***Chironomus dilutus***	Dessicator: # 1	Dessicator: # 2
Test Date:	**11/1/2019**	Date/Time in: 11/13/19 0810	Date/Time in: 11/13/19 1651
	11/11/2019	Date/Time out: 11/13/19 1250	Date/Time out: 11/18/19 1140
		Dry Weigh Date/Technician's Initials: 11/13/19 GA	Ashed Weigh Date/Technician's Initials: 11/18/19 GA

	Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Ashed Weight of Pan and Organisms (g)	B-C Total Ash-Free Dry Weight (g)	D Number of Organisms Weighed	B-C/D Average Ash-Free Dry Weight (mg)	E Number of Pupae and Midges at Day 10	(B-C) / (A-E) *Biomass weight (mg)
Sample ID:	1	10	1.13031	1.12686	0.00345	4	0.862	0	0.345
Alum Creek Upstream	2	10	1.15450	1.14894	0.00556	8	0.695	0	0.556
GLC Number:	3	10	1.14783	1.14263	0.00520	8	0.650	0	0.520
SS416	4	10	1.14672	1.13932	0.00740	9	0.822	0	0.740
	5	10	1.14002	1.13519	0.00483	8	0.604	0	0.483
	6	10	1.13338	1.12819	0.00519	8	0.649	0	0.519
	7	10	1.15862	1.15556	0.00306	5	0.612	0	0.306
	8	10	1.14769	1.14299	0.00470	8	0.588	0	0.470
						AVERAGE:	0.68522		0.49238

*Biomass weight (mg) : defined as the total ash-free dry weight of surviving organisms divided by the initial number of organisms minus pupae and midges

Day 0 weights	40	1.12688	1.11488	0.012	40	Average at Day 0 (mg)		0.3

See Attached sheet for calculated weights.

QC'd by:_____

2487-00
Mad Scientist
Chironomus dilutus WEIGHT DATA

Project Number:	**2487-00**	Type/Model of Drying Oven: **Blue M**	Type/Model of Muffle Furnace: **F6020 Thermolyne MOD.**
Project Name:	**Mad Scientist**	Oven Temperature: **60 °C**	Muffle Furnace Temperature: **550 °C**
GLC#:	5546 ~~SS416 SS4119~~	Drying Duration (Hours): **~24 hrs**	Drying Duration (Hours): **2 hrs**
Sample ID:	**Alum Creek ~~Upstream~~** Downstream	Date/Time in: 11/11/19 1725	Date/Time in: 11/13/19 1340
		Date/Time out: 11/13/19 ~~0910~~ 0810	Date/Time out: 11/13/19 1657
Test Species:	***Chironomus dilutus***	Dessicator: # 3	Dessicator: # 2
Test Date:	**11/1/2019**	Date/Time in: 11/13/19 0810	Date/Time in: 11/13/19 1657
	11/11/2019	Date/Time out: 11/13/19 1250	Date/Time out: 11/15/19 1140
		Dry Weigh Date/Technician's Initials: SG 11/13/19	Ashed Weigh Date/Technician's Initials: 11/18/19 SG

	Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Ashed Weight of Pan and Organisms (g)	B-C Total Ash-Free Dry Weight (g)	D Number of Organisms Weighed	B-C/D Average Ash-Free Dry Weight (mg)	E Number of Pupae and Midges at Day 10	(B-C) / (A-E) *Biomass weight (mg)
Sample ID:	1	10	1.13031	1.12686		4		0	
Alum Creek Upstream	2	10	1.15450	1.14894		8		0	
GLC Number:	3	10	1.14783	1.14263		8		0	
SS416	4	10	1.14672	1.13932		9		0	
	5	10	1.14002	1.13519		8		0	
	6	10	1.13338	1.12819		8		0	
	7	10	1.15862	1.15556		5		0	
	8	10	1.14769	1.14299		8		0	
						AVERAGE:			

*Biomass weight (mg) : defined as the total ash-free dry weight of surviving organisms divided by the initial number of organisms minus pupae and midges

Day 0 weights	Δ ~~80~~ 40	1.12688	1.11498	0	Δ ~~80~~ 40	Average at Day 0 (mg)	0

See Attached sheet for calculated weights.

Δ 40 organisms archived instead of 80 due to lack of organisms

reentry error SG 11/13/19

QC'd by: SA

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

Project Number: **2487-00**	Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#: ~~**SS416**~~ 35779 SS416		Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID: **Alum Creek ~~Upstream~~** Downstream		Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Species: ***Chironomus dilutus***		Test Temperature: **23± 1°C**	
Date Addition of Sediment:	**10/31/2019**	Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date:	**11/1/2019**	Test Termination Date:	**11/11/2019**

Test Day: **Day 0**		Number Daily Renewals: **2**	Air: □ yes □ no
Date: **11/1/2019**		□	renewal time/Initials □ renewal time/Initials
Overlying Water: **Smith Water**		□ 1545 DAW	renewal time/Initials □ renewal time/Initials
Overlying Water Batch ID (GLC Number):		Food: **TFS# (4g/L)**	□ Feed 1.5 ml/replicate
□ 1110910 chemistries time/Initial		Screens Cleaned: □ **yes** ☑ **no**	

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ 10 organisms per replicate
Record Meter ID	#42	**GLC 004**	**GLC 097**	**GLC 092**	N/A	**GLC 004**	**GLC 081**	**Init:** SA
1	22.4	7.84	8.1	350	120	92	0.376 SA	10
2					end: 29.2	end: 6.8		10
3					start: 26.2	start: 4.5		10
4					Titrant used (mL): 3.0X40	Titrant used (mL): 2.3X40		10
5					Sample volume (mL): 25	Sample volume (mL): 25		10
6								10
7								10
8								10

Relative % Difference: RPD ≤15%

$$RPD = \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 2/2019
U = Below MDL. J = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

QC'd by:_____

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

Project Number:	**2487-00**	Project Name:	**Mad Scientist**
GLC#:	~~SS416~~ ~~SS417~~ SS416		
Sample ID:	**Alum Creek ~~Upstream~~** Downstream		
Test Species:	***Chironomus dilutus***		
Date Addition of Sediment:	**10/31/2019**		
Test Initiation Date:	**11/1/2019**		

Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
Test Photoperiod: **16:8**	Lux: **100-1000**
Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Temperature: **23± 1°C**	
Test Organism Source/Age:	**ABS: 10-11 days old**
Test Termination Date:	**11/11/2019**

Test Day: **1**
Date: **11/2/2019**
Overlying Water: **Smith**
Overlying Water Batch ID (GLC Number):
Number Daily Renewals: 2 Air: ☐ yes ☑ no
☐ 1440820 renewal time/Initials ☑ renewal time/Initials
☐ 0001600 renewal time/Initials ☐ renewal time/Initials
Food: **TFS# (4g/L)** 0006 ☑ Feed 1.5 ml/replicate 0006
Screens Cleaned: ☐ **yes** ☑ **no**
☐ 1440800 chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	48 (+0.1)	GLC 097	Init: LA
1	22,6	8,4	AV
2			11
3			11
4			11
5	22,8	8,3	11
6			11
7			11
8			11

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or if Temperature is out of range.

Test Day: **2**
Date: **11/3/2019**
Overlying Water: **Smith Water**
Overlying Water Batch ID (GLC Number):
Number Daily Renewals: 2 Air: ☐ yes ☑ no
☒ ~~1440745~~ 0745 renewal time/Initials ☑ renewal time/Initials
☐ 1440 2120 renewal time/Initials ☐ renewal time/Initials
Food: **TFS# (4g/L)** ☑ Feed 1.5 ml/replicate 0006
Screens Cleaned: ☐ **yes** ☐ **no**
☒ 0730 chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	49 (-0.3)	GLC 097	Init: AM
1	22.7	6.6	AV
2			
3			
4			
5			
6	22.8	6.4	
7			
8			√

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

QC'd by: SJ

Project Number:	2487-00	Project Name:	Mad Scientist
GLC#:	~~SS416~~ 35477SS416		
Sample ID:	Alum Creek ~~Upstream~~ Downstream		
Test Species:	*Chironomus dilutus*		
Date Addition of Sediment:	10/31/2019		
Test Initiation Date:	11/1/2019		

Test Method-Manual:	EPA 100.2-EPA/600/R-99/064
Test Photoperiod: 16:8	Lux: 100-1000
Test System: Sediment-100 mL and Overlying Water-175mL Manual Delivery	
Test Temperature: 23± 1°C	
Test Organism Source/Age:	ABS: 10-11 days old
Test Termination Date:	11/11/2019

Test Day: 3
Date: 11/4/2019
Overlying Water: Smith Water
Overlying Water Batch ID (GLC Number):
Number Daily Renewals: 2 Air: □ yes ☑ no
□ 0825 SJ renewal time/Initials □ renewal time/Initials
□ WK1930 renewal time/Initials □ renewal time/Initials
Food: TFS# (4g/L) 0006 ☑ Feed 1.5 ml/replicate
Screens Cleaned: □ yes ☑ no
☑ YBJ 1400 chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	48(70.1)	GLC 097	Init: YBJC
1	22.7	5.9	NAV
2			11-11
3	22.7	6.0	11-11
4			11-11
5			11-11
6			11-11
7			11-11
8			11-11

Test Day: 4
Date: 11/5/2019
Overlying Water: Smith Water
Overlying Water Batch ID (GLC Number):
Number Daily Renewals: Air: □ yes ☑ no
□ 0835 SJ renewal time/Initials □ renewal time/Initials
□ 1550 DAW renewal time/Initials □ renewal time/Initials
Food: TFS# (4g/L) 0006 ☑ Feed 1.5 ml/replicate
Screens Cleaned: □ yes ☑ no
□ 1500 SJ chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	48(70.1)	GLC 097	Init: SJ
1			NAV
2			BHV
3	22.7	5.5	11
4			11
5	22.7	5.6	11
6			11
7			11
8			11

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or if Temperature is out of range.

KEY:

AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

2487-00
Mad Scientist

QC'd by:_____

Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

Project Number: **2487-00**	Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#:	**~~SS416~~** ~~SS-TT-SS416~~	Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID:	**Alum Creek ~~Upstream~~** Downstream	Test System:	**Sediment-100 mL and Overlying Water-175mL Manual Delivery**
Test Species:	***Chironomus dilutus***	Test Temperature:	**23± 1°C**
Date Addition of Sediment:	**10/31/2019**	Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date:	**11/1/2019**	Test Termination Date:	**11/11/2019**

Test Day: **5**	Test Day: **6**
Date: **11/6/2019**	Date: **11/7/2019**
Overlying Water: **Smith Water**	Overlying Water: **Smith Water**
Overlying Water Batch ID (GLC Number):	Overlying Water Batch ID (GLC Number):
Number Daily Renewals: 2 Air: ☐ yes ☑ no	Number Daily Renewals: 2 Air: ☐ yes ☑ no
☐ 0915 CH renewal time/Initials ☐ renewal time/Initials	☐ 0830 CH renewal time/Initials ☐ renewal time/Initials
☐ 1705 SWKT renewal time/Initials ☐ renewal time/Initials	☐ 1830 DAW renewal time/Initials ☐ renewal time/Initials
Food: **TFS# (4g/L)** 0007 ☐ Feed 1.5 ml/replicate	Food: **TFS# (4g/L)** 0007 ☐ Feed 1.5 ml/replicate
Screens Cleaned: ☐ **yes** ☑ **no**	Screens Cleaned: ☐ **yes** ☑ **no**
☐ 1410 CH chemistries time/Initial	☐ 1545 CH chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	48 (+0.1)	**GLC 097**	**Init:** CH
1			BHV
2			11
3			11
4	22.6	6.0	11
5			AV
6	22.6	6.3	NAV
7			11
8			BHV

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	49 (-0.3)	**GLC 097**	**Init:** CH
1			NAV
2	22.8	5.20	BHV
3			AV
4	* ~~2~~		* ~~BHV~~ NAV
5			AV
6			* ~~NAV~~ BHV
7	22.9	5.22	11
8			11

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or if Temperature is out of range.

revised: June 2012

KEY:

AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

* entry error CH 11/8/19
CH 11/7/19

2487-00
Mad Scientist

QC'd by: KA

Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

Project Number: **2487-00**	Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#:	~~SS416~~ SS417-SS416	Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID:	**Alum Creek ~~Upstream~~** Downstream	Test System:	**Sediment-100 mL and Overlying Water-175mL Manual Delivery**
Test Species:	***Chironomus dilutus***	Test Temperature:	**23± 1°C**
Date Addition of Sediment:	**10/31/2019**	Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date:	**11/1/2019**	Test Termination Date:	**11/11/2019**

Test Day:	7
Date:	**11/8/2019**
Overlying Water:	**Smith Water**
Overlying Water Batch ID (GLC Number):	
Number Daily Renewals: 2	Air: ☐ yes ☑ no
☐ 0840 KA renewal time/Initials	☐ renewal time/Initials
☐ BISDAV renewal time/Initials	☐ renewal time/Initials
Food: **TFS# (4g/L)** 0007	☐ Feed 1.5 ml/replicate
Screens Cleaned: ☐ **yes** ☑ **no**	
☐ 1555 KA chemistries time/Initial	

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	47(+0.1)	**GLC 097**	**Init:** KA
1			BHV
2			11
3			AV
4			~~NAV~~ AV
5			AV
6	22.4	5.5	NAV
7			AV
8	22.5	5.8	BHV

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or if Temperature is out of range. entry error KA 11/8/19

Test Day:	8
Date:	**11/9/2019**
Overlying Water:	**Smith Water**
Overlying Water Batch ID (GLC Number):	
Number Daily Renewals: 2	Air: ☐ yes ☑ no
☑ 1300 MK renewal time/Initials	☐ renewal time/Initials
☐ 1410 CW renewal time/Initials	☐ renewal time/Initials
Food: **TFS# (4g/L)**	☑ Feed 1.5 ml/replicate
Screens Cleaned: ☐ **yes** ☐ **no**	
☑ MBK 1100 chemistries time/Initial	

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	49(-0.3)	**GLC 097**	**Init:** MBK
1	22.7	5.2	NAV
2			11-11
3	22.7	5.6	11-11
4			11-11
5			11-11
6			11-11
7			11-11
8			11-11

KEY:

AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

QC'd by: VF

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

Project Number: **2487-00**	Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#: ~~SS416~~ ~~SS417~~ SS416		Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID: **Alum Creek ~~Upstream~~** Downstream		Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Species: ***Chironomus dilutus***		Test Temperature: **23± 1°C**	
Date Addition of Sediment:	**10/31/2019**	Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date:	**11/1/2019**	Test Termination Date:	**11/11/2019**

Test Day: **9**

Date: **11/10/2019**

Overlying Water: **Smith Water**

Overlying Water Batch ID (GLC Number):

Number Daily Renewals: 2 Air: □ yes ☑ no

□ 0800 VF renewal time/Initials □ renewal time/Initials

□ 1450 VF renewal time/Initials □ renewal time/Initials

Food: **TFS# (4g/L)** 0007 □ Feed 1.5 ml/replicate

Screens Cleaned: □ **yes** ☑ **no**

□ 0720 VF chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	47(10.1)	**GLC 097**	**Init** VF
1			BHV
2			"
3	22.9	5.8	"
4			"
5		~~6.7~~	NAV
6	22.9	6.1	"
7			BHV
8			"

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or Temperature is out of range.

revised: June 2012

• entry error VF 11/12/19

KEY:

AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

QC'd by: KK

Project Number: **2487-00**	Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#: ~~**SS416**~~ 554775416		Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID: **Alum Creek ~~Upstream~~** Downstream		Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Species: ***Chironomus dilutus***		Test Temperature: **23± 1°C**	
Date Addition of Sediment:	**10/31/2019**	Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date:	**11/1/2019**	Test Termination Date:	**11/11/2019**

Test Day: **Day 10**	Number Daily Renewals: Air: ☐ yes ☐ no
Date: **11/11/2019**	☐ [redacted] renewal time/Initials ~~☐ renewal~~
Overlying Water: **Smith Water**	~~☐ renewal time/Initials ☐ renewal~~
Overlying Water Batch ID (GLC Number):	Food: ~~TFS# (4g/L)~~ ~~☐ Feed 1.5 ml/replicate~~
☑ AE0905 chemistries time/Initial	Screens Cleaned: ☐ **yes** ☑ **no**

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ # Surviving Organisms
Record Meter ID	49	**GLC 004**	**GLC 097**	**GLC 092**	N/A	**GLC 004**	**GLC 081**	**Init:** CRM
1	22.7	7.73	6.7	365	104	80	0.134	Larvae: Pupae: Midge: 4 /10
2					end: 32.8	end: 32.0		Larvae: Pupae: Midge: 8 /10
3					start: 30.2	start: 30.0		Larvae: Pupae: Midge: 8 /10
4					Titrant used (mL): 2.6	Titrant used (mL): 2.0		Larvae: Pupae: Midge: 9 /10
5					Sample volume (mL): 25	Sample volume (mL): 25		Larvae: Pupae: Midge: 8 /10
6								Larvae: Pupae: Midge: 8 /10
7								Larvae: Pupae: Midge: 5 /10
8								Larvae: Pupae: Midge: 8 /10

Relative % Difference: RPD ≤15%

$$RPD = \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 2/2019
U = Below MDL. *J* = ≥ MDL and < RL.

* entry deleted DMD 11/19/19

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

QC'd by:_____

2487-00
Mad Scientist
Chironomus dilutus WEIGHT DATA

Project Number:	**2487-00**	Type/Model of Drying Oven: **Blue M**	Type/Model of Muffle Furnace: **F6020 Thermolyne MOD.**
Project Name:	**Mad Scientist**	Oven Temperature: **60 °C**	Muffle Furnace Temperature: **550 °C**
GLC#:	~~SS417~~ ~~SS417C~~ SS417	Drying Duration (Hours): **~24 hrs**	Drying Duration (Hours): **2 hrs**
Sample ID:	**Alum Creek ~~Downstream~~** Upstream	Date/Time in: 11/11/19 1725	Date/Time in: 11/13/19 1340
		Date/Time out: 11/13/19 0810	Date/Time out: 11/13/19 1651
Test Species:	***Chironomus dilutus***	Dessicator: # 1	Dessicator: # 2
Test Date:	**11/1/2019**	Date/Time in: 11/13/19	Date/Time in: 11/13/19 1651
	11/11/2019	Date/Time out: 11/13/19	Date/Time out: 11/18/19 1200
		Dry Weigh Date/Technician's Initials: SP 11/13/19	Ashed Weigh Date/Technician's Initials: 11/18/19 S/J

	Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Ashed Weight of Pan and Organisms (g)	B-C Total Ash-Free Dry Weight (g)	D Number of Organisms Weighed	B-C/D Average Ash-Free Dry Weight (mg)	E Number of Pupae and Midges at Day 10	(B-C) / (A-E) *Biomass weight (mg)
Sample ID:	1	10	1.14235	1.13625	0.00610	7	0.871	0	0.610
Alum Creek Downstream	2	10	1.15415	1.14891	0.00524	9	0.582	0	0.524
GLC Number:	3	10	1.14391	1.13778	0.00613	9	0.681	0	0.613
SS417	4	10	1.14527	1.14094	0.00433	9	0.481	0	0.433
	5	10	1.14780	1.14202	0.00578	7	0.826	0	0.578
	6	10	1.13404	1.12787	0.00617	8	0.771	0	0.617
	7	10	1.13839	1.13224	0.00615	9	0.683	0	0.615
	8	10	1.14949		1.14949	10		0	
						AVERAGE:	0.69945		0.57000

*Biomass weight (mg) : defined as the total ash-free dry weight of surviving organisms divided by the initial number of organisms minus pupae and midges

Day 0 weights	40	1.12688	1.11488	0.012	40	Average at Day 0 (mg)		0.3

See Attached sheet for calculated weights.

QC'd by: _____

2487-00
Mad Scientist
Chironomus dilutus WEIGHT DATA

Project Number:	**2487-00**	Type/Model of Drying Oven: **Blue M**	Type/Model of Muffle Furnace: **F6020 Thermolyne MOD.**
Project Name:	**Mad Scientist**	Oven Temperature: **60 °C**	Muffle Furnace Temperature: **550 °C**
GLC#:	~~SS417~~ ~~SS416~~ SS417	Drying Duration (Hours): **~24 hrs**	Drying Duration (Hours): **2 hrs**
Sample ID:	**Alum Creek ~~Downstream~~** Upstream	Date/Time in: 11/11/19 1725	Date/Time in: 11/13/19 1340
		Date/Time out: 11/13/19 0810	Date/Time out: 11/13/19 1651
Test Species:	***Chironomus dilutus***	Dessicator: # 1	Dessicator: # 2
Test Date:	**11/1/2019**	Date/Time in: 11/13/19 0810	Date/Time in: 11/13/19 1651
	11/11/2019	Date/Time out: 11/13/19 1340	Date/Time out: 11/18/19 ~~1445~~ 1205
		Dry Weigh Date/Technician's Initials: KF 11/13/19	Ashed Weigh Date/Technician's Initials: KF 11/18/19

	Replicate Number	A Number of Organisms at Test Initiation	B Dry Weight of Pan and Organisms (g)	C Ashed Weight of Pan and Organisms (g)	B-C Total Ash-Free Dry Weight (g)	D Number of Organisms Weighed	B-C/D Average Ash-Free Dry Weight (mg)	E Number of Pupae and Midges at Day 10	(B-C) / (A-E) *Biomass weight (mg)
Sample ID:	1	10	1.14235	1.13625		7		0	
Alum Creek Downstream	2	10	1.15415	1.14891		9		0	
GLC Number:	3	10	1.14391	1.13778		9		0	
SS417	4	10	1.14557	1.14094		9		0	
	5	10	1.14780	1.14202		7		0	
	6	10	1.13464	1.12787		8		0	
	7	10	1.13839	1.13224		9		0	
	8	10	1.14949	*		10		0	
						AVERAGE:			

*Biomass weight (mg) : defined as the total ash-free dry weight of surviving organisms divided by the initial number of organisms minus pupae and midges

Day 0 weights	Δ ~~80~~ 40	1.02688		0	Δ ~~80~~ 40	Average at Day 0 (mg)	0

See Attached sheet for calculated weights. ^ entry error KF 11/18/19

Δ 40 organisms archived instead of 80 due to lack of organisms KF 11/18/19

* Ash from organisms not on Pan KF 11/18/19

QC'd by: GA

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

Project Number:	**2487-00** Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#:	~~SS417~~ ~~SS416~~ SS417	Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID:	**Alum Creek ~~Downstream~~** Upstream	Test System:	**Sediment-100 mL and Overlying Water-175mL Manual Delivery**
Test Species:	***Chironomus dilutus***	Test Temperature:	**23± 1°C**
Date Addition of Sediment:	**10/31/2019**	Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date:	**11/1/2019**	Test Termination Date:	**11/11/2019**

Test Day:	**Day 0**	Number Daily Renewals: **2**	Air: ☐ yes ☑ no
Date:	**11/1/2019**	☐ renewal time/Initials	☐ renewal time/Initials
Overlying Water:	**Smith Water**	☐ 1545 DAW renewal time/Initials	☐ renewal time/Initials
Overlying Water Batch ID (GLC Number):		Food: **TFS# (4g/L)**	☐ Feed 1.5 ml/replicate
☐ 9/9 9110 chemistries time/Initial		Screens Cleaned: ☐ **yes** ☑ **no**	

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ 10 organisms per replicate
Record Meter ID	#48	**GLC 004**	**GLC 097**	**GLC 092**	N/A	**GLC 004**	**GLC 081**	**Init:** GA
1	22.5	7.81	7.8	379	124	84	0.107 GA	10
2					end: 32.3	end: 8.9		10
3					start: 29.2	start: 6.8		10
4					Titrant used (mL): 3.1	Titrant used (mL):		10
5					Sample volume (mL): 25	Sample volume (mL): 25		10
6								10
7								10
8								10

Relative % Difference: RPD ≤15%

$$RPD = \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 2/2019
U = Below MDL. J = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

2487-00
Mad Scientist
QC'd by:_____

Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

Project Number:	**2487-00**	Project Name:	**Mad Scientist**
GLC#:	~~SS417~~ ~~SS4116~~ SS417		
Sample ID:	**Alum Creek ~~Downstream~~** upstream		
Test Species:	***Chironomus dilutus***		
Date Addition of Sediment:	**10/31/2019**		
Test Initiation Date:	**11/1/2019**		

Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
Test Photoperiod: **16:8**	Lux: **100-1000**
Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Temperature: **23± 1°C**	
Test Organism Source/Age:	**ABS: 10-11 days old**
Test Termination Date:	**11/11/2019**

Test Day: **1**
Date: **11/2/2019**
Overlying Water: **Smith**
Overlying Water Batch ID (GLC Number):
Number Daily Renewals: Air: □ yes □ no
☑ MP 0820 renewal time/Initials □ renewal time/Initials
□ CMT 2100 renewal time/Initials □ renewal time/Initials
Food: **TFS# (4g/L)** ☑ Feed 1.5 ml/replicate 0806
Screens Cleaned: □ **yes** ☒ **no**
□ MP 0800 chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	418	**GLC 097**	**Init:** CJ
1	22.5	6.4	AV
2			BHV
3			11
4			11
5	22.5	6.4	11
6			11
7			11
8			11

Test Day: **2**
Date: **11/3/2019**
Overlying Water: **Smith Water**
Overlying Water Batch ID (GLC Number):
Number Daily Renewals: Air: □ yes □ no
☑ 0745 CMT renewal time/Initials □ renewal time/Initials
□ CMT 2100 renewal time/Initials □ renewal time/Initials
Food: **TFS# (4g/L)** □ Feed 1.5 ml/replicate 0806
Screens Cleaned: □ **yes** ☒ **no**
☑ 0745 CMT chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	419 (-0.3)	**GLC 097**	**Init:** CMT
1			AV
2	22.9	6.6	AV
3			AV
4			NAV
5			AV
6			↓
7	22.9	6.6	↓
8			↓

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or if Temperature is out of range.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

QC'd by: SR

Project Number:	**2487-00**	Project Name:	**Mad Scientist**
GLC#:	~~SS417~~ ~~SS416~~ SS417		
Sample ID:	**Alum Creek ~~Downstream~~** Upstream		
Test Species:	***Chironomus dilutus***		
Date Addition of Sediment:	**10/31/2019**		
Test Initiation Date:	**11/1/2019**		

Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
Test Photoperiod: **16:8**	Lux: **100-1000**
Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Temperature: **23± 1°C**	
Test Organism Source/Age:	**ABS: 10-11 days old**
Test Termination Date:	**11/11/2019**

Test Day: **3**

Date: **11/4/2019** MAJ

Overlying Water: **Smith Water**

Overlying Water Batch ID (GLC Number):

Number Daily Renewals: 2 Air: ☐ yes ☑ no

☐ 0825 SJ renewal time/Initials ☐ renewal time/Initials

☐ WRT 1830 renewal time/Initials ☐ renewal time/Initials

Food: **TFS# (4g/L)** 0006 ☑ Feed 1.5 ml/replicate

Screens Cleaned: ☐ **yes** ☑ **no**

☑ YBW 1400 chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	48 (10.1	**GLC 097**	**Init:** YBC
1	22.7	5.5	NAV
2			11-11
3	22.7	5.8	11-11
4			11-11
5			11-11
6			11-11
7			11-11
8			11-11

Test Day: **4**

Date: **11/5/2019** MAJ

Overlying Water: **Smith Water**

Overlying Water Batch ID (GLC Number):

Number Daily Renewals: 2 Air: ☐ yes ☑ no

☐ 0835 SJ renewal time/Initials ☐ renewal time/Initials

☐ 1850 DAW renewal time/Initials ☐ renewal time/Initials

Food: **TFS# (4g/L)** 0006 ☑ Feed 1.5 ml/replicate

Screens Cleaned: ☐ **yes** ☑ **no**

☐ 1800 SJ chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	48 (10.1)	**GLC 097**	**Init:** SJ
1			AV
2			BHV
3	22.7	5.6	AV 11
4			11
5	22.7	5.8	11
6			11
7			11
8			11

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or if Temperature is out of range.

KEY:

AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

QC'd by: SR

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

Project Number:	**2487-00**	Project Name:	**Mad Scientist**
GLC#:	~~SS417~~ ~~SS416~~ SS417		
Sample ID:	**Alum Creek ~~Downstream~~ Upstream**		
Test Species:	***Chironomus dilutus***		
Date Addition of Sediment:	**10/31/2019**		
Test Initiation Date:	**11/1/2019**		

Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
Test Photoperiod: **16:8**	Lux: **100-1000**
Test System:	**Sediment-100 mL and Overlying Water-175mL Manual Delivery**
Test Temperature:	**23± 1°C**
Test Organism Source/Age:	**ABS: 10-11 days old**
Test Termination Date:	**11/11/2019**

Test Day: **5**

Date: **11/6/2019**

Overlying Water: MB **Smith Water**

Overlying Water Batch ID (GLC Number):

Number Daily Renewals: 2 Air: ☐ yes ☑ no

☐ 0915 SR renewal time/Initials ☐ renewal time/Initials

☐ 1705 LMT renewal time/Initials ☐ renewal time/Initials

Food: **TFS# (4g/L)** 0007 ☐ Feed 1.5 ml/replicate

Screens Cleaned: ☐ **yes** ☑ **no**

☐ 1419 GH chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	48 (+0.1)	**GLC 097**	**Init:** SR
1			AV
2			BHV
3			11
4	22.5	6.2	11
5			11
6	22.6	6.0	AV
7			11
8			11

Test Day: **6**

Date: **11/7/2019**

Overlying Water: MB **Smith Water**

Overlying Water Batch ID (GLC Number):

Number Daily Renewals: 2 Air: ☐ yes ☑ no

☐ 0830 SR renewal time/Initials ☐ renewal time/Initials

☐ 1830 DAV renewal time/Initials ☐ renewal time/Initials

Food: **TFS# (4g/L)** 0007 ☑ Feed 1.5 ml/replicate

Screens Cleaned: ☐ **yes** ☑ **no**

☐ 1545 CLD chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	49 (-0.3)	**GLC 097**	**Init:** SR
1			BHV
2	22.8	5.23	AV
3			BHV
4			AV
5			BHV
6			AV
7	22.9	5.46	BHV
8			AV

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or if Temperature is out of range.

KEY:

AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

QC'd by: GK

Project Number: **2487-00**	Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#: ~~SS417~~ ~~SS476~~ SS417		Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID: **Alum Creek ~~Downstream~~** Upstream		Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Species: ***Chironomus dilutus***		Test Temperature: **23± 1°C**	
Date Addition of Sediment:	**10/31/2019**	Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date:	**11/1/2019**	Test Termination Date:	**11/11/2019**

Test Day: **7**	
Date:	**11/8/2019**
Overlying Water: MD **Smith Water**	
Overlying Water Batch ID (GLC Number):	
Number Daily Renewals: 2	Air: ☐ yes ☑ no
☐ 0840 GK renewal time/Initials	☐ renewal time/Initials
☐ 1515 DAW renewal time/Initials	☐ renewal time/Initials
Food: **TFS# (4g/L)** 0007	☐ Feed 1.5 ml/replicate
Screens Cleaned: ☐ **yes** ☑ **no**	
☐ 1555 GK chemistries time/Initial	

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID		GLC 097	Init: GK
1			BHV
2			AV
3			BHV
4			11
5			AV
6	22.5	5.2	11; FOV
7			11
8	22.5	5.0	11; FOV

Test Day: **8**	
Date:	**11/9/2019**
Overlying Water: MD **Smith Water**	
Overlying Water Batch ID (GLC Number):	
Number Daily Renewals: 2	Air: ☐ yes ☑ no
☑ 1300 NV renewal time/Initials	☐ renewal time/Initials
☐ 1910 CW renewal time/Initials	☐ renewal time/Initials
Food: **TFS# (4g/L)**	☐ Feed 1.5 ml/replicate
Screens Cleaned: ☐ **yes** ☐ **no**	
☑ 1834 1100 chemistries time/Initial	

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID		GLC 097	Init: YBK
1	22.7	6.0	NAV
2			11-11
3	22.7	6.1	11-11
4			11-11
5			11-11
6			11-11
7			11-11
8			11-11

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or if Temperature is out of range.

KEY:

AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

QC'd by: EB

Project Number: **2487-00**	Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#: **SS417** ~~SS416~~		Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID: **Alum Creek ~~Downstream~~** Upstream		Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Species: ***Chironomus dilutus***		Test Temperature: **23± 1°C**	
Date Addition of Sediment:	**10/31/2019**	Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date:	**11/1/2019**	Test Termination Date:	**11/11/2019**

Test Day: **9**

Date: **11/10/2019**

Overlying Water: **Smith Water**

Overlying Water Batch ID (GLC Number):

Number Daily Renewals: 2 Air: ☐ yes ☑ no

☐ 0800 EJ renewal time/Initials ☐ renewal time/Initials

☐ 1450 EJ renewal time/Initials ☐ renewal time/Initials

Food: **TFS# (4g/L)** 0907 ☑ Feed 1.5 ml/replicate

Screens Cleaned: ☐ **yes** ☑ **no**

☐ 0720 EJ chemistries time/Initial

Replicate	Temperature (23± 1°C)*	Dissolved Oxygen (mg/L)*	Observations
Meter ID	47 (10.1)	**GLC 097**	**Init** EJ
1			BHV
2			AV
3	22.4	6.4	"
4			BHV
5			"
6	22.8	5.9	"
7			AV
8			"

* Contact Laboratory Coordinator if Dissoved Oxygen level is < 2.5 mg/L or Temperature is out of range.

revised: June 2012

KEY:

AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

2487-00
Mad Scientist
Chironomus dilutus 10-Day Survival and Growth Whole Sediment Toxicity Test

QC'd by:_____

Project Number:	**2487-00** Project Name: **Mad Scientist**	Test Method-Manual:	**EPA 100.2-EPA/600/R-99/064**
GLC#:	~~SS417~~ ~~SS416~~ SS417	Test Photoperiod: **16:8**	Lux: **100-1000**
Sample ID:	**Alum Creek ~~Downstream~~** Upstream	Test System: **Sediment-100 mL and Overlying Water-175mL Manual Delivery**	
Test Species:	***Chironomus dilutus***	Test Temperature: **23± 1°C**	
Date Addition of Sediment:	**10/31/2019**	Test Organism Source/Age:	**ABS: 10-11 days old**
Test Initiation Date:	**11/1/2019**	Test Termination Date:	**11/11/2019**

Test Day:	**Day 10**	Number Daily Renewals:	Air: ☐ yes ☐ no
Date:	**11/11/2019**	☐ [redacted] renewal time/Initials	~~☐ renewal~~
Overlying Water:	**Smith Water**	~~☐ renewal time/Initials~~	~~☐ renewal~~
Overlying Water Batch ID (GLC Number):		Food: ~~TFS# (4g/L)~~	~~☐ Feed 1.5 ml/replicate~~
☑ AE0905	chemistries time/Initial	Screens Cleaned:	**☐ yes ☐ no**

Replicate	Temperature (23± 1°C)*	pH	Dissolved Oxygen (mg/L)*	Specific Conductance (µmhos/cm)	Hardness (mg/L $CaCO_3$)	Alkalinity (mg/L $CaCO_3$)	Ammonia (as N)	Observations/ # Surviving Organisms
Record Meter ID	49	**GLC 004**	**GLC 097**	**GLC 092**	N/A	**GLC 004**	**GLC 081**	**Init:**
1	22.8	7.90	7.0	369	104	76	0.116	Larvae: 7 Pupae: 0 Midge: 0 /10
2					end: 35.4	end: 33.9		Larvae: 9 Pupae: 0 Midge: 0 /10
3					start: 32.8	start: 32.0		Larvae: 9 Pupae: 0 Midge: 0 /10
4					Titrant used (mL): 2.6	Titrant used (mL): 1.9		Larvae: 9 Pupae: 0 Midge: 0 /10
5					Sample volume (mL): 25	Sample volume (mL): 25		Larvae: 7 Pupae: 0 Midge: 0 /10
6								Larvae: 8 Pupae: 0 Midge: 0 /10
7								Larvae: 9 Pupae: 0 Midge: 0 /10
8								Larvae: 10 Pupae: 0 Midge: 0 /10

Relative % Difference: RPD ≤15%

$$RPD = \frac{(s_1 - s_2)}{(s_1 + s_2)/2} \times 100 =$$

* Contact Laboratory Coordinator if Dissolved Oxygen level is < 2.5 mg/L or if Temperature is out of range.
*Alkalinity, hardness and ammonia analyzed from a composite sample of all 8 replicates.
Ammonia Reporting Limits:
RL = Reporting Limit (0.20 mg/L).
MDL = Minimum Detection Limit (0.02 mg/L) - last updated 2/2019
U = Below MDL. *J* = ≥ MDL and < RL.

KEY:
AV: Animals Visible
NAV: No Animals Visible
FOV: Foreign Organism Visible
BHV: Bore Holes Visible

* entry deleted DAW 11/19/19

APPENDIX H

Macroinvertebrate Sampling Sheets

Ohio EPA Macroinvertebrate Monitoring
Macroinvertebrate Field Sheet

Station ID: Upstream 1 | Sheet ID: | Date Collected: 9/30/19

Project: FACT Water Study | Sampler Type: HD & Qual | # HDs: 5 | Collected By: JLO & KG

ALP: | RM: 19.1 | Data Comments: | Date Analyzed:

Lat./Long.: 40.094088°, -82.930096° DA = 152 | Analyzed By:

Stream: Alum Creek | Location: downstream of 270

Flow: 1.33 ft/sec | Temp. C): 21.8°C | HDs - Current Set (fps): 1.00 A, 1.46 B | Ret. (fps): 1.33 A, 0.70 B | Ql. Time Sampled (min.): 115 (12:10pm – 2:05)

Sampling Method: HD(No. 5) - DN/HP - Surber - Grab (Type) - Other

HD Sampler Site: Depth 11" | Canopy 40+60 | Current (Set) 1.00 ft/sec | Current(Ret) 1.33 ft/sec

HD Condition: Disturbed Yes/No | Comment: Both in good shape

Debris Yes/No | Comment: stick & leaves

Silt/Solids None - Slight - Moderate - Heavy

DN/HP Sampling: Total Time 12:10 - 2:05 | Habitats: Pool - Riffle - Run - Margin - Backwater

---

Physical Characteristics

Flow Condition:	Flood	Above Normal	Normal	Low	Interstitial	Intermittent / Dry
Current Velocity:	Fast	Moderate	Slow	ND		
Channel Morphology:	Natural	Channelized	Channelized (Recovered)	Impounded		
Bank Erosion:	Extensive	Moderate	Slight	None		
Riffle Development:	Extensive	Moderate	Sparse	Absent		
Riffle Quality:	Good	Fair	Poor	Embedded: Yes/No		
Clarity:	Clear	Murky	Turbid	Temp: 21.8		
Color:	None	Green	Brown	Grey	Other ( )	
Canopy:	Open	75%	50%	25%	Closed	

Substrate Characteristics

	Pool	Riffle	Run
Bedrock( )			
Boulder( )			
Rubble( )	5	5	
Coarse Gravel		80	60
Fine Gravel		20	40
Sand			
Silt	80		
Clay/Hardpan			
Detritus	20 leaves		
Peat			
Muck			
Other( )			
Macrophytes			
Algae( )			present
Artifacts( )			
Compaction(F,M,S)	M	M	M
Depth(Average)	2'	3"	17"
Width(Average)	4'	10'	12'

Predominant Land Use (L,R,B)

Forest L&R	Open Pasture	Wetland
Shrub	Closed Pasture	Other ( )
Old Field	Urban	
Rowcrop	Residential/Park L – trail	
Industrial	Mining/Construction	

Predominant Riparian Vegetation Width

Left	Right	Type
✓	✓	Large Trees
✓	✓	Small Trees
		Shrubs
✓	✓	Grass/Weeds
		None

Margin Habitat

Undercut Banks, Root Mats, Grass, Water Willow, Shallows, Clay/Hardpan, Rip Rap, Bulkhead, Other( )

Margin Quality: Good - Fair - Poor

Biological Characteristics

Riffle: 12:15-12:55

Predominant Organisms: Baetidae hydropsychidae

Other Common Organisms: Simuliidae

Density: High - Moderate - Low

Diversity: High - Moderate - Low

Notebles: tipulidae heptageniidae riffle beetles (Elmidae)

Run:

Predominant Organisms: Baetidae, Chironomidae

Other Common Organisms:

Density: High - Moderate - Low

Diversity: High - Moderate - Low

Pool:

Predominant Organisms: chironomidae

Other Common Organisms: acari (mites)

Density: High - Moderate - Low

Diversity: High - Moderate - Low

Margin:

Predominant Organisms: coenagrionidae, riffle beetles, scuds

Other Common Organisms: Argia & calopteryx

Density: High - Moderate - Low

Diversity: High - Moderate - Low

Notebles macronych (riffle beetle w/ X) dragonfly nymph

Other Notable Collections: Mottled sculpin

Potential Pollution Sources: None noted

Evidence of Pollution: N/A

Photo Numbers: DSCN 0309 - DSCN 0330

Comments: Hand pick: Chironimidae, zebra mussel, limpit, caddisfly turbellarians Mussel: one non-living somewhat weathered Mucket (Actinonaias ligamentina) female was found ~200ft downstream of sampling reach

Ohio EPA Macroinvertebrate Monitoring
Macroinvertebrate Field Sheet

HD Qual

Station ID Downstream 4 Sheet ID _____ Date Collected 9-30-19 & 10/1/19

Project FACT Water Study Sampler Type HD & Qual # HDs 5 Collected By JLO, _____

ALP _____ RM 18.5 Data Comments _____ Date Analyzed 1/23/2020 JLO

Lat./Long. 40.100791°, -82.937043° DA - 152 Analyzed By _____

Stream Alum Creek Location downstream of Industrial plant

Flow 0.90 ft/s Temp. C) 23.8 HDs - Current Set (fps) 0.76 A, 1.20 B Ret. (fps) 0.90 A, N/A B Ql. Time Sampled (min.) 13:40 - 15:55 = 135

Sampling Method: HD(No. 5) - DN/HP - Surber - Grab (Type_____) - Other_____

HD Sampler Site: Depth 9.5" Canopy 80 Current (Set) 0.76 Current(Ret) 0.90

HD Condition: Disturbed Yes/No Comment: 4a used; 4b toppled over

Debris Yes/No Comment: _____

Silt/Solids None - Slight - Moderate - Heavy

DN/HP Sampling: Total Time 90min Habitats: Pool - Riffle - Run - Margin - Backwater

Notes: orgs seem tinier than upstream, have to look harder

Physical Characteristics

Flow Condition: Flood - Above Normal - Normal - Low - Interstitial - Intermittent - Dry

Current Velocity: Fast - Moderate - Slow - ND

Channel Morphology: Natural - Channelized - Channelized (Recovered) - Impounded

Bank Erosion: Extensive - Moderate - Slight - None

Riffle Development: Extensive - Moderate - Sparse - Absent

Riffle Quality: Good - Fair - Poor Embedded: Yes/No

Clarity: Clear - Murky - Turbid Temp: 23.8

Color: None - Green - Brown - Grey - Other (_____)

Canopy: Open - 75% - 50% - 25% - Closed

Substrate Characteristics

	Pool	Riffle	Run	
Bedrock( )				
Boulder( )				
Rubble( )		10		
Coarse Gravel		40	60	
Fine Gravel		60	40	
Sand				
Silt	100			
Clay/Hardpan				
Detritus				
Peat				
Muck	90			
Other( )				
Macrophytes				
Algae( )	present			
Artifacts( )				
Compaction(F,M,S)	S	M	M	
Depth(Average)	14"	10"	12"	
Width(Average)	2'	3'	5'	

& photo

Predominant Land Use (L,R,B)

Forest R	Open Pasture	Wetland
Shrub	Closed Pasture	Other
Old Field	Urban	( )
Rowcrop	Residential/Park R	
Industrial L	Mining/Construction	

Predominant Riparian Vegetation Width

Left	Right	Type
✓		Large Trees
✓		Small Trees
little		Shrubs
little		Grass/Weeds
		None

Margin Habitat

Undercut Banks	Root Mats
Grass	Water Willow
Shallows	Clay/Hardpan
Rip Rap → banks	Bulkhead
Other( )	

Margin Quality: Good - Fair - Poor

Biological Characteristics 140-220

Riffle: Sampled in fast riffle 12" deep & some smaller on each side of creek

Predominant Organisms: baetidae, hydropsychidae, simuliidae

Other Common Organisms: turbellarians, midges, Sphaeriidae, mites, heptageniidae limpets, Elmidae, most lacking x

Density: High - (Moderate) - Low

Diversity: High - Moderate - (Low)

Run: 3:00 - 3:20

Predominant Organisms: mites

Other Common Organisms: heptageniidae, rusty crayfish,

Density: High - Moderate - (Low)

Diversity: High - Moderate - (Low)

Pool: 3:20 - 3:38

Predominant Organisms: worms midges

Other Common Organisms: limpet snails

Density: High - Moderate - (Low)

Diversity: High - Moderate - (Low)

Margin: 220-250

Predominant Organisms: Coenagrionidae, scuds, worms

Other Common Organisms: calopterygidae, argia, Zebra mussels,

Density: High - (Moderate) - Low

Diversity: High - (Moderate) - Low

Other Notable Collections: Mottled sculpin, maybe petrophila?

Potential Pollution Sources: outfall: still dripping near asphalt plant

Evidence of Pollution: DSCN 0375, higher orthophosphate & 4x as high diesel & oil/range organics based on sampling on 8/19/2019

Photo Numbers: DSCN 0372-0395

Comments: organisms looked smaller

APPENDIX I

ICI Macroinvertebrate Taxa Lists

Upstream Macroinvertebrate Taxa List

Scientific Name	Common Name	Tolerance Category (Ohio EPA, 2015)
Ancyronyx variegata	Riffle beetle	F
Argia sp.	Damselfly	F
Baetis intercalaris	Small minnow mayfly	F
Boyeria vinosa	Fawn darner	F
Calopteryx sp.	Damselfly	F
Cardiocladius obscurus	Non-biting midge fly	MI
Ceratopsyche morosa group	Caddisfly	MI
Cheumatopsyche sp.	Netspinning caddisfly	F
Chimarra obscura	Fingernet caddisfly	MI
Chironomus (C.) *decorus* group	Non-biting midge fly	T
Coenagrionidae	Narrow-winged damselflies	T
Conchapelopia sp.	Non-biting midge fly	F
Corbicula fluminea	Asian clam	F
Corynoneura lobata	Non-biting midge fly	F
Crangonyx sp.	Amphipod	MT
Dreissena polymorpha	Zebra mussel	F
Dubiraphia sp.	Riffle beetle	F
Elimia sp.	Freshwater snail	MI
Ferrissia sp.	Freshwater limpet	F
Glossiphoniidae	Jawless leech	MT
Helopelopia sp.	Non-biting midge fly	F
Hemerodromia sp.	Dance fly	F
Hyalella sp.	Amphipod	F
Hydra sp.	Hydra	F
Hydrachnidia	Water mite	x
Hydropsyche depravata group	Caddisfly	F
Leucrocuta sp.	Mayfly	MI
Maccaffertium terminatum	Flatheaded mayfly	MI
Macronychus glabratus	Riffle beetle	F
Oecetis sp.	Long-horned caddisfly	F
Oligochaeta	Earthworm	T
Physella sp.	Left-handed snail	T
Platyhelminthes	Flatworm	x
Polypedilum (P.) *illinoense*	Non-biting midge fly	T
Polypedilum (*Uresipedilum*) *flavum*	Non-biting midge fly	F
Procladius (*Holotanypus*) sp.	Non-biting midge fly	MT

MI = moderately intolerant, MT= moderately tolerant, T=tolerant, VT=very tolerant, x= no tolerance group assigned, F = facultative

Scientific Name	Common Name	Tolerance Category (Ohio EPA, 2015)
Rheocricotopus (*Psilocricotopus*) *robacki*	Non-biting midge fly	F
Rheotanytarsus pellucidus	Non-biting midge fly	MI
Rheotanytarsus sp.	Non-biting midge fly	F
Simulium sp.	Black fly	F
Stenacron sp.	Mayfly	F
Stenelmis sp.	Beetle	F
Tanytarsus glabrescens group sp. 7	Non-biting midge fly	F
Tanytarsus sp.	Non-biting midge fly	F
Thienemanniella lobapodema	Non-biting midge fly	F
Thienemanniella similis	Non-biting midge fly	MI
Thienemanniella taurocapita	Non-biting midge fly	MI
Thienemanniella xena	Non-biting midge fly	F
Thienemannimyia sp.	Non-biting midge fly	F
Tipula sp.	Crane fly	F
Tricorythodes sp.	Mayfly	MI

MI = moderately intolerant, MT= moderately tolerant, T=tolerant, VT=very tolerant, x= no tolerance group assigned, F = facultative

Downstream Macroinvertebrate Taxa List

Scientific Name	Common Name	Tolerance Category (Ohio EPA, 2015)
Argia sp.	Damselfly	F
Baetis intercalaris	Small minnow mayfly	F
Boyeria vinosa	Fawn darner	F
Calopteryx sp.	Damselfly	F
Ceratopsyche morosa group	Caddisfly	MI
Cheumatopsyche sp.	Netspinning caddisfly	F
Chironomus (C.) *decorus* group	Non-biting midge fly	T
Cladotanytarsus vanderwulpi group	Non-biting midge fly	MI
Coenagrionidae	Narrow-winged damselflies	T
Corbicula fluminea	Asian clam	F
Corynoneura lobata	Non-biting midge fly	F
Corynoneura sp. (head only, not sculptured)	Non-biting midge fly	MI
Crangonyx sp.	Amphipod	MT
Cricotopus (C.) *bicinctus*	Non-biting midge fly	T
Cricotopus (C.) sp.	Non-biting midge fly	F
Cricotopus (C.) *tremulus* group	Non-biting midge fly	MT
Dreissena polymorpha	Zebra mussel	F
Elimia sp.	Freshwater snail	MI
Ferrissia sp.	Freshwater limpet	F
Glossiphoniidae	Jawless leech	MT
Helopelopia sp.	Non-biting midge fly	F
Hemerodromia sp.	Dance fly	F
Hetaerina sp.	Rubyspot	F
Hyalella sp.	Amphipod	F
Hydra sp.	Hydra	F
Hydrachnidia	Water mite	x
Hydropsyche depravata group	Caddisfly	F
Labrundinia pilosella	Non-biting midge fly	F
Leucrocuta sp.	Mayfly	MI
Maccaffertium terminatum	Flatheaded mayfly	MI
Macromia sp.	River cruiser dragonfly	MI
Macronychus glabratus	Riffle beetle	F
Nilotanypus fimbriatus	Non-biting midge fly	F
Oligochaeta	Earthworm	T
Orconectes rusticus	Rusty crayfish	x
Parachironomus sp.	Non-biting midge fly	MT

MI = moderately intolerant, MT= moderately tolerant, T=tolerant, VT=very tolerant, x= no tolerance group assigned, F = facultative

Scientific Name	Common Name	Tolerance Category (Ohio EPA, 2015)
Paratanytarsus sp.	Non-biting midge fly	F
Paratendipes albimanus or P. *duplicatus*	Non-biting midge fly	F
Physella sp.	Left-handed snail	T
Planorbidae micromenetus	Ramshorn snail	x
Platyhelminthes	Flatworm	x
Polypedilum (P.) *fallax* group	Non-biting midge fly	F
Polypedilum (*Uresipedilum*) *flavum*	Non-biting midge fly	F
Procladius (*Holotanypus*) sp.	Non-biting midge fly	MT
Rheocricotopus (*Psilocricotopus*) *robacki*	Non-biting midge fly	F
Rheotanytarsus sp.	Non-biting midge fly	F
Simulium sp.	Black fly	F
Stenacron sp.	Mayfly	F
Stenelmis sp.	Beetle	F
Stenochironomus sp.	Non-biting midge fly	F
Stenonema femoratum	Mayfly	F
Tanytarsus glabrescens group sp. 7	Non-biting midge fly	F
Tanytarsus sepp	Non-biting midge fly	F
Tanytarsus sp.	Non-biting midge fly	F
Thienemanniella lobapodema	Non-biting midge fly	F
Thienemanniella similis	Non-biting midge fly	MI
Thienemanniella taurocapita	Non-biting midge fly	MI
Thienemanniella xena	Non-biting midge fly	F
Thienemannimyia sp.	Non-biting midge fly	F
Tricorythodes sp.	Mayfly	MI

MI = moderately intolerant, MT= moderately tolerant, T=tolerant, VT=very tolerant, x= no tolerance group assigned, F = facultative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