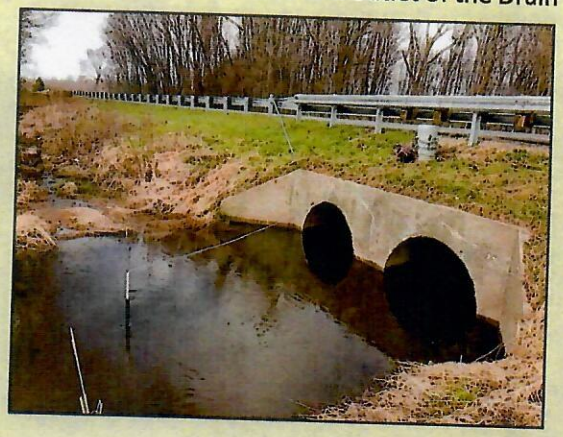
SUMMARY OF WATER QUALITY RESULTS
BRANCH & DERBY INTERCOUNTY DRAIN

This document is intended to concisely summarize recent Branch & Derby Intercounty water quality monitoring efforts. The complete database of water quality results and supporting documents is maintained by Spicer Group.

SUMMARY OF 2017 – 2018 RESULTS
BRANCH & DERBY INTERCOUNTY DRAIN
BERRIEN COUNTY, MI
JANUARY 18, 2019

SAMPLING PLAN

Three autosamplers were installed along a stretch of the Branch & Derby Intercounty Drain during 2017 and 2018. The stretch of Drain monitored included the detention basin on M-140 and outlet of the Drain into Paw Paw Lake. Autosamplers were programmed to start sampling once water levels started to rise due to rainfall and runoff. This sampling allowed for a better understanding of the effects of the Branch & Derby Intercounty Drain on Paw Paw Lake. Parameters monitored in the Drain were the following:



- **Water Level**
- **Rainfall**
- **Total Suspended Solids (TSS):** Quantifies the number of **solid particles** transported by the watercourse. TSS concentrations provide insight on erosion and pollutant loads within the watershed. As concentrations of TSS increase, a wide range of other pollutants may increase in mobilization and concentration (for example, phosphorus).
- **Total Phosphorus (TP) and Soluble Reactive Phosphorus (SRP):** Total phosphorus and soluble reactive phosphorus are variant forms of phosphorus, the limiting nutrient that **contributes to algal blooms**. In the form of SRP, phosphorus is readily available for plant and algae uptake. TP is typically bound to soils and other organic substances, and is not 100% available for vegetation and algal uptake.
- **Nitrate (NO_3^-):** Nitrate is also a nutrient used by plants for growth. There is usually an excess of this compound in Michigan waterways compared to phosphorus. For that reason, **algal blooms are generally not a result of increased nitrate levels**, however, that does not mean it cannot happen.
- **Ammonia (NH_3):** Ammonia may be produced from nitrate through a series of natural chemical reactions. Typically, ammonia concentration is impacted by low dissolved oxygen in a watercourse, over fertilization of land in a watershed, animal waste, and leaky septic systems. **Ammonia (at elevated concentrations) is toxic to many forms of aquatic life.** Understanding its fluctuations is crucial to protecting water quality.

SAMPLING SITE LOCATIONS

The Branch & Derby Intercounty Drain services the region north and east of Paw Paw Lake, and extends into Van Buren County. Sites sampled in 2017 include:

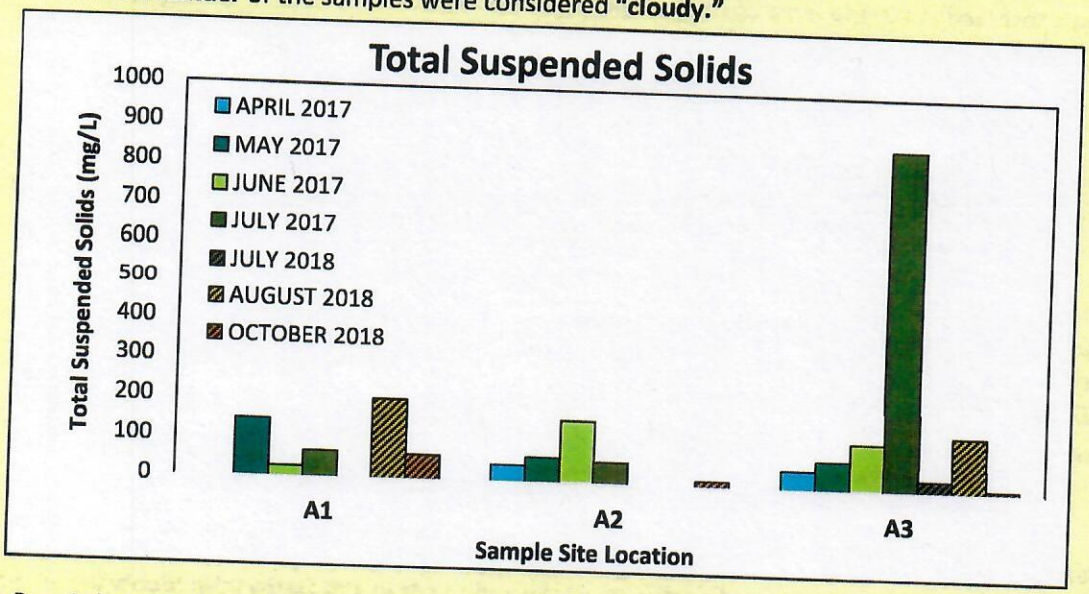
- **A3** – Sample site furthest upstream, and is located at inlet of M-140 detention basin.
- **A2** – Located downstream of detention basin, immediately west of M-140 culvert.
- **A1** – Downstream most site, ~300 feet upstream of Branch & Derby Intercounty Drain outlet into Paw Paw Lake.

TOTAL SUSPENDED SOLIDS

Total suspended solids are small particles that consist of organic material, clay, and other **particulate matter suspended in the water** and are measured in milligrams per liter (mg/L). Often times, TSS carries with it other types of contaminants including nutrients, metals, and hydrocarbons (which is more common in urban areas). While TSS occurs naturally in some waterways, an excessive increase in TSS can lead to a decrease in visibility and an increase in other undesired contaminants previously mentioned, in addition to smothering fish eggs and other aquatic wildlife. Therefore, **low concentrations of TSS are desired.**

The State of Michigan has a **"narrative standard" for TSS; meaning, the water should not have un-natural physical characteristics** (MDEQ Rule 50, Part 4 of Act 451). Typically, water with TSS concentrations at >20 mg/L is clear, 40 – 80 mg/L is cloudy, and >150 mg/L appears dirty.

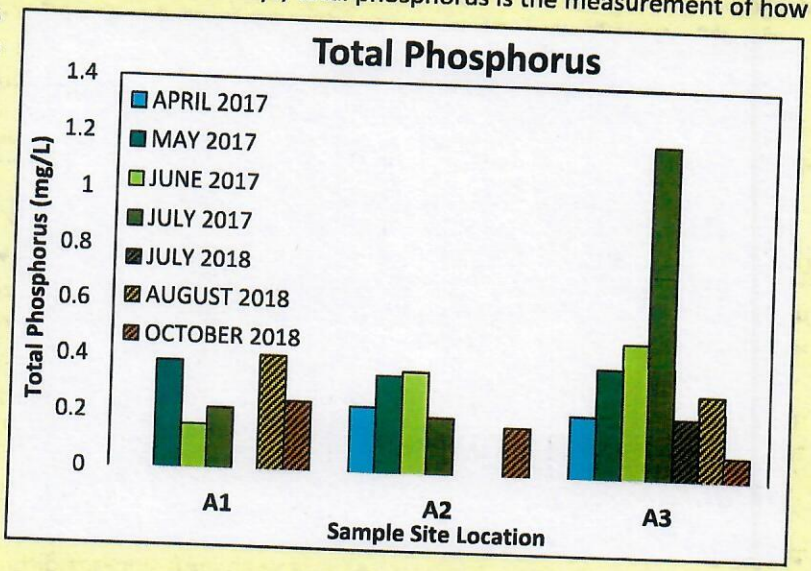
- **29%** of samples collected on the Branch & Derby Intercounty in 2018 had TSS concentrations considered **"clear,"**
- **14%** of samples were considered **"dirty"** according to this metric,
- And **remainder** of the samples were considered **"cloudy."**



Paw Paw Lake sample points NL 2 and NL 3, are relatively close to the outlet of the Branch & Derby Intercounty Drain, and may be compared to the outlet sample point of the Drain, A1. The average concentration of TSS at A1 in 2018 was 130.5 mg/L, compared to NL 2 and NL 3's averages at U mg/L. "U" means that the water had concentrations below 2.5 mg/L.

TOTAL PHOSPHORUS

Phosphorus is an element that is a major component in all lifeforms. Phosphorus can also be found in inorganic forms like in rocks. Therefore, as the name says, total phosphorus is the measurement of how much of all types of phosphorus (both organic and inorganic) are within the water, and is measured in milligrams per liter (mg/L). **Low TP concentrations that provide a balanced environment for aquatic wildlife are desired.** If there is too much phosphorus within the water, **it can lead to excess algal and plant growth.** Excess algal growth can lead to reduced dissolved oxygen, reduced clarity, unpleasant odors/discolored water, and many more undesirable water quality issues.



In comparison to Paw Paw Lake sample points NL 2 and NL 3, TP in the Branch & Derby Intercounty Drain near its outlet was approximately **15x more concentrated than Paw Paw Lake during 2018.** TP tends to decrease or remain about the same as water moves downstream in the Drain. The highest concentrations have been observed at A3, the most upstream sample site location.

SOLUBLE REACTIVE PHOSPHORUS

Soluble reactive phosphorus, or SRP, was not detected in 13 of the 16 samples collected in 2017 – 2018. This indicated that SRP loading from the Branch & Derby Intercounty Drain is an **unlikely threat to water quality** in Paw Paw Lake.

Note: The storm event near 7/13/2017 recorded the second highest gage height in all of 2017. The increased depth and flow of the Drain increased nutrient and suspended solids concentrations. During this event, the highest concentration of SRP was measured at 0.15 mg/L; the highest concentrations of TP and TSS during 2017 were also measured during this event.

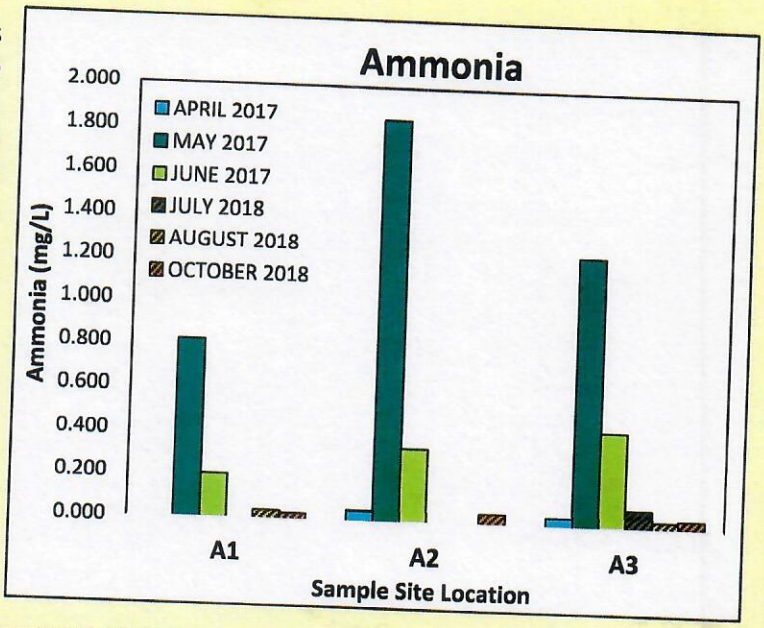
NITRATE AND AMMONIA

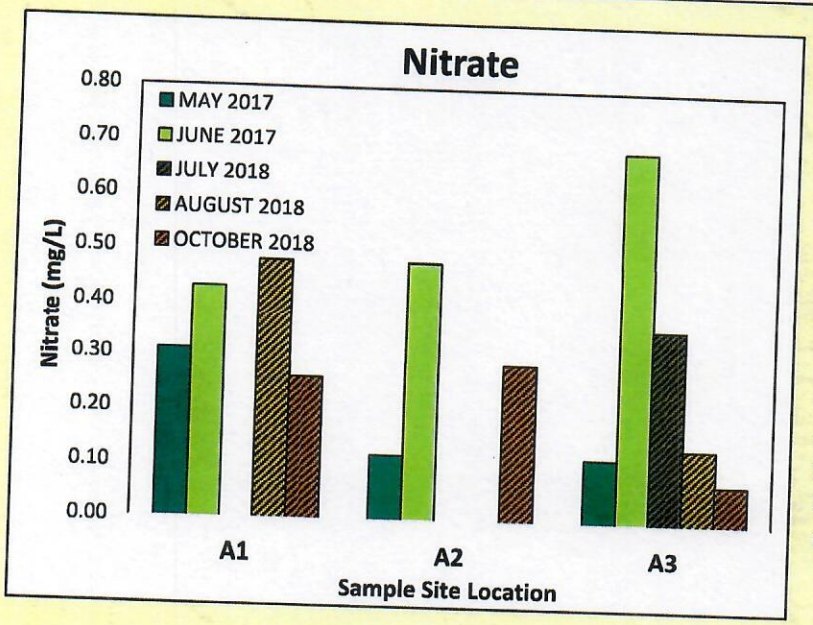
Nitrogen may be found in many forms in the environment; nitrate (NO_3^-) and ammonia (NH_4^+) are two components that have been monitored on Paw Paw Lake and the Branch & Derby Intercounty Drain. Both components are important parts of the nitrogen cycle that happens naturally; however, too much nitrogen can cause the over growth of algae and aquatic plants, and too much nitrate may result in harmful effects to humans. Excess exposure to nitrate in drinking water cay cause the restriction of oxygen transport in the bloodstream in infants and young livestock.

NITRATE AND AMMONIA, CONTINUED

Nitrogen is used in agriculture to improve yield of a crop, and excess nitrogen may runoff through tile Drainage or sheet flow. Other ways that nitrogen may be introduced to the environment include atmospheric deposition, fertilizers, sewage effluent, and the breakdown of organic materials.

The **highest** ammonia concentrations were observed in **May of 2017** in the Branch & Derby Intercounty Drain. Monitoring results from **2018 exhibited ammonia concentrations significantly lower than 2017 results**. This change may be attributed to the time of the year that samples were collected. More samples will need to be collected over time to fully understand why concentrations fluctuate. In 2018, ammonia concentrations at the outlet of the Branch & Derby Intercounty Drain were **approximately three times higher** than Paw Paw Lake sample sites NL 2 and NL 3.

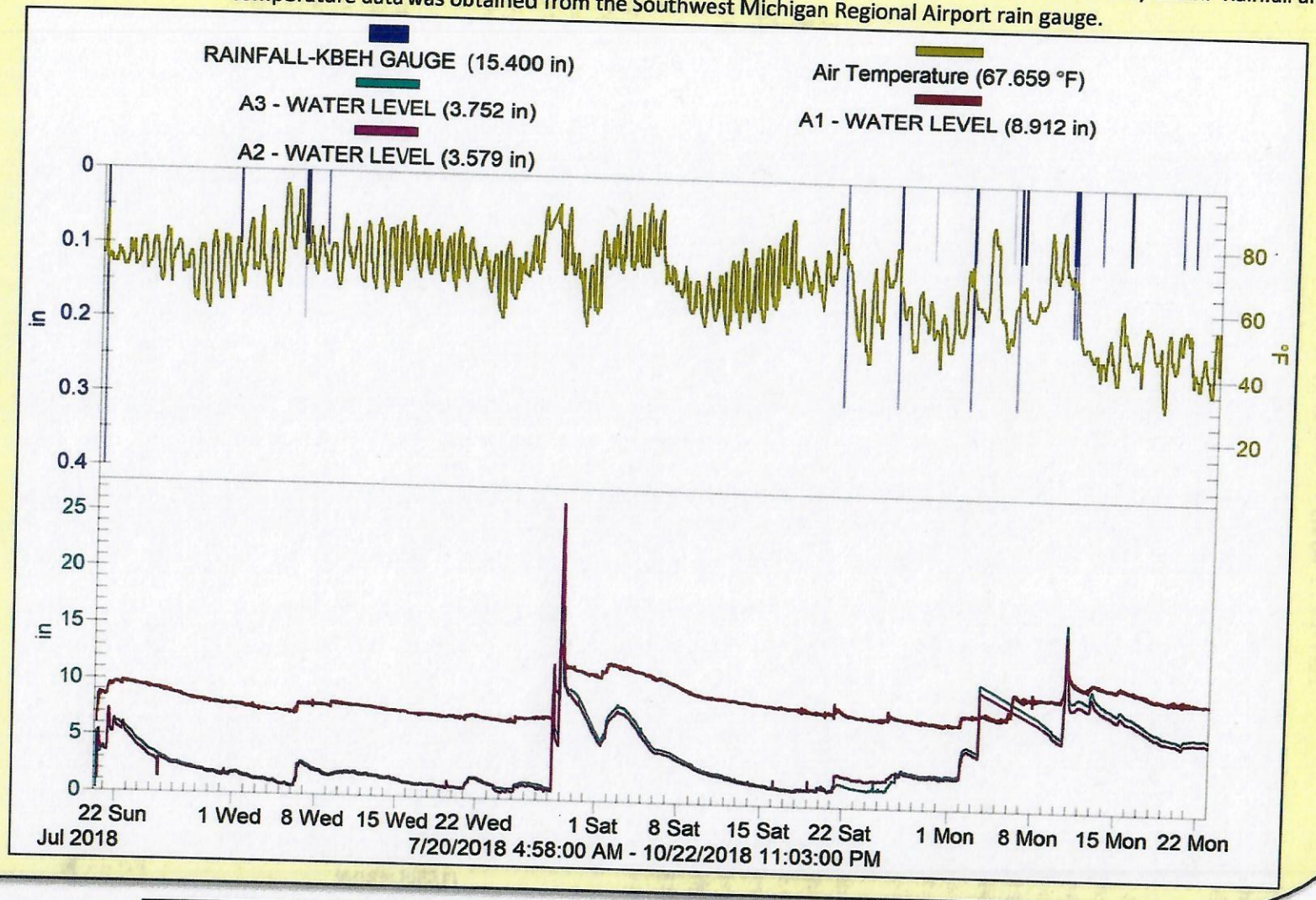




During the majority of sample events in 2017 and 2018, nitrate tends to increase in concentration the further downstream the sample site is. Again, more samples will need to be collected over time to solidify or refute this observation. **In 2018, the outlet of the Drain had an average nitrate concentration of 0.37 mg/L**, where **Paw Paw Lake had an average concentration less than <0.023 mg/L** (which is at least **16 times lower** nitrate concentration than the Drain).

WATER LEVEL – 2018

Water level at each of the three sites was monitored from **July through October 2018** on the Branch & Derby Intercounty Drain. Rainfall and air temperature data was obtained from the Southwest Michigan Regional Airport rain gauge.



TAKEAWAY POINTS

- In **2017** there was a total of **85 samples** collected, whereas in **2018**, there were **35 samples** collected. With half the data resolution, 2018 data will serve to give clues into the changes in loading over the year but is not sufficient enough to make solid claims. This was due in part to the lack of rain events in the summer and fall of 2018.
- The sampling timeframe in 2017 was from April to September, whereas the timeframe in 2018 was from July through October.
- Spring months tend to have the highest concentrations of nutrient and suspended solids loading due to the increase in precipitation and runoff and the return of agricultural activity.
- On average, ammonia, total phosphorus, and total suspended solids concentrations dropped from 2017 to 2018. Nitrate concentrations slightly increased from 2017 to 2018.

Secondly, the timeframe for both sampling years did not correlate, this may cause misrepresentation of each yearly average. In general, **the spring months will have the highest concentrations of nutrient and solids due to increased precipitation, return of agricultural activity, and the spring thaw**. The 2017 data was collected April through September, involving the spring period of elevated loading.

LEGEND

- Autosampler Sites
- Watercourses
- Paw Paw Lake
- Municipality Boundary

SAMPLE SITE COORDINATES

A1 (41.21848, -86.26546)
A2 (42.22981, -86.25281)
A3 (42.22954, -86.25132)

LEVEL TRIGGERED, TIME PACED AUTOSAMPLING EMPLOYED AT THESE THREE LOCATIONS.

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DRAWING #1 *DATE: APRIL 2017*