This report was produced as a monitoring and progress evaluation report for the member governments within the Alliance of Downriver Watersheds. Funding for the project and monitoring was provided directly by the Alliance of Downriver Watersheds (ADW) – a legal umbrella governing body established to carry out stormwater policy and management across the Ecorse Creek, Combined Downriver and Lower Huron River watersheds. The ADW is comprised of the following member governments:

Allen Park          Romulus
Belleville          Southgate
Berlin Township     South Rockwood
Brownstown Township Sumpter Township
Dearborn Heights    Taylor
Ecorse              Van Buren Township
Flat Rock           Wayne County
Gibraltar           Wayne County
Grosse Ile Township Airport Authority
Huron Township      Westland
Inkster             Woodhaven
Lincoln Park        Woodhaven-Brownstown
Melvindale          School District
Riverview           Wyandotte
Rockwood

The report was compiled and written by the following individuals:

Ric Lawson, Huron River Watershed Council
Andra Mealy, Wayne County Department of Public Services
Dean Toumari, Wayne County Department of Public Services
Noel Mullett, Wayne County Department of Public Services
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1 Introduction

Monitoring Program Purpose and Goals
The monitoring program is consistent with the watershed management plans developed for the Alliance of Downriver Watersheds (ADW) by Huron River Watershed Council (HRWC), Wayne County, local communities, citizens, and other stakeholders. The program was designed with the purpose of establishing the environmental status of the watersheds and evaluating progress toward environmental goals. The program is designed to evaluate the following goals and objectives from the watershed plans:

<table>
<thead>
<tr>
<th>Goals</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduce Stream Flow Variability</td>
<td>Reduce runoff volume/rate</td>
</tr>
<tr>
<td>Increase Public Education, Understanding,</td>
<td>Create partnerships with institutions, schools, and</td>
</tr>
<tr>
<td>and Participation Regarding Watershed</td>
<td>the private sector</td>
</tr>
<tr>
<td>Issues</td>
<td>Foster relationships with the County and</td>
</tr>
<tr>
<td></td>
<td>neighboring communities</td>
</tr>
<tr>
<td>Improve Water Quality</td>
<td>Protect, expand and restore the riparian corridor</td>
</tr>
<tr>
<td></td>
<td>Improve erosion and sedimentation controls</td>
</tr>
<tr>
<td>Protect, Enhance, and Restore Riparian</td>
<td></td>
</tr>
<tr>
<td>Habitat</td>
<td></td>
</tr>
</tbody>
</table>

Evaluation Purpose
Environmental progress evaluation is recognized as a critical element of watershed planning and is critical to determining ultimate effectiveness of management strategies. To this end, a combination of staff, consultant resources and project partners were utilized to develop and implement the monitoring strategy and a quality assurance project plan (QAPP). A combination of desk top analysis, field physical measurements, photo documentation and biological indicator monitoring is ultimately used in the monitoring program.

Evaluation Approach
The current five-year monitoring strategy is presented in Table 1.
### Five Year Monitoring Plan Summary (2010-2014)

**Ecorse Creek, Combined Downriver, and Lower Huron River Watersheds**

<table>
<thead>
<tr>
<th>Monitoring Activity</th>
<th>Proposed Responsible Party</th>
<th>Sites/Frequency/Season</th>
<th>Year Performed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Planning &amp; Reporting</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ADW develops/refines monitoring plan</td>
<td>ADW Facilitator</td>
<td>Not applicable</td>
<td>X X X X X X</td>
</tr>
<tr>
<td>Data Handling, Data Management &amp; Analysis</td>
<td>WQD/HRWC</td>
<td>Not applicable</td>
<td>X X X X X X</td>
</tr>
<tr>
<td>Prepare Monitoring Report/Brochure/Press Release</td>
<td>ADW</td>
<td>Not applicable</td>
<td>X X</td>
</tr>
<tr>
<td><strong>Physical Monitoring</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precipitation</td>
<td>Communities</td>
<td>April - Oct at 5 sites</td>
<td>X X X X X X</td>
</tr>
<tr>
<td>Flow</td>
<td>HRWC/WQD/USGS</td>
<td>April - Oct at 7 sites</td>
<td>X X X X X X</td>
</tr>
<tr>
<td>Temperature</td>
<td>HRWC/WQD</td>
<td>April - Oct at 6 sites</td>
<td>X X X X X X</td>
</tr>
<tr>
<td>Geomorphology/stream classification</td>
<td>HRWC/Stream Team/WQD</td>
<td>28 sites, 5-year returns</td>
<td>X X X X X</td>
</tr>
<tr>
<td><strong>Biological Monitoring</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Macrroinvertebrates</td>
<td>HRWC/Stream Team/WQD</td>
<td>3x per year at 28 sites</td>
<td>X X X X X X</td>
</tr>
<tr>
<td>Green Infrastructure Monitoring</td>
<td>WQD</td>
<td>Across ADW</td>
<td>X X</td>
</tr>
<tr>
<td>Fish, Macrroinvertebrates, Habitat</td>
<td>MDNRE</td>
<td>As selected by MDEQ/DNR</td>
<td>X X X ? ?</td>
</tr>
<tr>
<td><strong>Water Quality</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dissolved Oxygen (DO)</td>
<td>ADW</td>
<td>April - September at 10 sites 2x per month</td>
<td>X X X</td>
</tr>
<tr>
<td>E. Coli</td>
<td>MDNRE</td>
<td>April - September at 10 sites 2x per month; wet event sampling</td>
<td>X X X</td>
</tr>
<tr>
<td>Total Phosphorus (TP)</td>
<td>ADW</td>
<td>April - September at 10 sites 2x per month; wet event sampling</td>
<td>X X</td>
</tr>
<tr>
<td>Total Suspended Solids (TSS)</td>
<td>ADW</td>
<td>April - September at 10 sites 2x per month; wet event sampling</td>
<td>X X</td>
</tr>
<tr>
<td><strong>Public Education/Involvement</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public Survey</td>
<td>SEMCOG</td>
<td>Not applicable</td>
<td>X X X X X ?</td>
</tr>
<tr>
<td>Summary of Volunteer Restoration Efforts</td>
<td>HRWC/Stream Team/WQD</td>
<td>Not applicable</td>
<td>X X X X X X</td>
</tr>
<tr>
<td><strong>Pollution Prevention</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Illicit Discharges Identified &amp; Eliminated</td>
<td>WQD/Communities</td>
<td>Not applicable</td>
<td>X X X X X X</td>
</tr>
</tbody>
</table>

**HRWC = Huron River Watershed Council**  
**WQD = Wayne County Department of Public Works, Water Quality Division**  
**USGS = United States Geological Survey**  
**MDEQ = Michigan Department of Environmental Quality**  
**DNR = Michigan Department of Natural Resources**  
**SEMCOG = Southeast Michigan Council of Governments**
For monitoring in 2010, three different evaluation techniques are reported. Reporting through 2009 included monitoring of three additional elements. The watersheds were evaluated through the use of benthic surveys, geomorphological surveys, and flow monitoring. Staff and qualified volunteer partners conducted this work. Each method was described in the Quality Assurance Project Plan (QAPP). These methods provided quantitative and qualitative evaluation of the success of ADW efforts to improve stormwater management.

Benthic sampling events took place in the spring and fall. Sampling was conducted as a team activity. Each team consisted of 1-2 experienced team leaders and 1-3 inexperienced staff or volunteers. Each team visited and sample 2 - 3 sites on sampling days.

Stream discharge or flow monitoring was conducted to provide data that can be used to evaluate the flow dynamics of target streams within the ADW system. It involved the collection of continuous water level data at a fixed point using a pressure sensor, accompanied by regular discharge measurement across a range of flow conditions to calibrate water level to stream discharge. Discharge was measured during the growing season (roughly April through October) at eight sites over two years. Statistics are computed to determine the stream’s flashiness, peak and base flows over that period. These statistics will be used to assess trends over time with the goal being to realize decreases in the streams’ flashiness and peak flows and increased baseflows.

Channel morphology was measured to compute the “tractive force” of the channel reach and establish a baseline for evaluating change in channel structure. Tractive force is an indicator of channel stability. At each site the monitoring team performed three channel morphology field measurements and use the results to track changes in channel dimensions and to assess channel stability via tractive force calculations. The three channel morphology measurements are:

- Bankfull depth, recorded along a cross-channel transect,
- Channel slope, calculated from measurements of water level along a longitudinal profile of the stream reach surveyed, and
- Pebble count of the substrate within stream reach.
2 Stream Discharge (Flow)

Evaluation Approach
Pressure sensors and staff gages were deployed at two monitoring locations in each watershed (see Figure 1) to monitor stream water levels. The pressure sensors recorded water levels every ten minutes. In order to translate pressure (water level) data to stream discharge, staff and volunteers measured discharge during a range of flow levels. Rating curves were developed for both staff gages and pressure sensors to estimate discharge from water level.

![Figure 1. Map showing flow monitoring locations in the ADW.](image)

Stream discharge over time is averaged to generate average daily discharge. A Richards-Baker Flashiness Index was computed for each year’s set of daily mean discharges, based on the method from the Michigan Department of Environmental Quality (MDEQ) study.\(^1\) An increase in flashiness, due to higher peak flows and lower base flows, will likely result in measurable changes to the channel shape – width, depth, sinuosity, and slope. Seasonal average, peak and base flow estimates were determined utilizing the Indicators of Hydrologic Alteration (IHA) software.\(^2\)

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Ultimately, a before and after approach will be used to evaluate changes in stream flow dynamics. Comparisons of the above measures before and after management actions are taken should yield a measure of their impact on stream flow dynamics. However, with most efforts, it will take years to show such an effect.

**Stream Discharge (Flow) Results**

Table 2 below presents some important measures of stream flow characteristics for the flow monitoring sites evaluated by the monitoring program.

<table>
<thead>
<tr>
<th>Site</th>
<th>Period Monitored</th>
<th>Drainage Area (sq. mi.)</th>
<th>Median Flow (cfs)</th>
<th>Peak Flow* (cfs) (Event Precip. (in))</th>
<th>Minimum flow* (cfs)</th>
<th>Flashiness (Quartile)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Blakely</td>
<td>Jul-Dec/2008, Jul-Nov/2009, Jun-Nov/2010</td>
<td>32</td>
<td>2.80</td>
<td>113 7/25/10 (0.49)</td>
<td>0</td>
<td>0.47 (4)</td>
</tr>
<tr>
<td>4. SB Ecorse</td>
<td>Jul-Dec/2008, Jul-Nov/2009, Jun-Nov/2010</td>
<td>12</td>
<td>3.82</td>
<td>290 0.49</td>
<td>0.33</td>
<td>0.43 (4)</td>
</tr>
<tr>
<td>5. NB Ecorse</td>
<td>Jul-Dec/2008, Jul-Sep/2009, Jun-Nov/2010</td>
<td>18</td>
<td>1.2</td>
<td>408 2.59</td>
<td>0.16</td>
<td>0.97 (4)</td>
</tr>
<tr>
<td>5. NB Ecorse (full record)</td>
<td>2002-10 (all months)</td>
<td>18</td>
<td>2.3</td>
<td>446^</td>
<td>0.08</td>
<td>0.83 (4)</td>
</tr>
<tr>
<td>6. Woods</td>
<td>Jul-Nov/2008, May-Oct/2009, Apr-Oct/2010</td>
<td>21</td>
<td>1.66</td>
<td>44.8 2.6</td>
<td>0</td>
<td>0.31 (2)</td>
</tr>
</tbody>
</table>

* Peak flow and minimum flow are extracted from the complete, sub-daily flow record, whereas the other statistics are based on mean daily discharge.

^ Peak flow occurred in 2004, prior to precipitation records obtained by the author.

**North Branch Ecorse Creek**
The US Geological Survey has maintained a flow gage on the North Branch of Ecorse Creek since July 2002. The gage station operates continuously and is the only one in the ADW to do so. This gage can therefore serve as a reference gage for comparison with all other short-term flow monitoring stations.
Table 2 includes key discharge statistics for all active ADW flow monitoring stations. In the case of North Branch of Ecorse Creek, statistics are included for the warm season monitoring periods of 2008-10, as well as the entire period of record. The largest storm event during the 2008-10 monitoring period occurred on June 6, 2010. Compared to the full discharge record, the event in 2010 (peak flow of 408 cfs) had an annual probability of 0.082 or a return frequency of 3.7 years.

To provide a wider basis for comparison, a similar analysis was conducted on data from the gage station on the Lower River Rouge. This station has a 62-year period of record. The 2009 event were calculated to have return frequencies of 8.1 years. Thus, events of the size observed in the monitoring period, and the associated peak flows, should not occur at least on an annual basis. Events of the size that return annually are known to be the driving events causing channel formation. If the channel is not large enough to contain such events, erosion will likely occur. Alternatively, if the channel is much bigger, sedimentation will likely occur. Thus, the peak flows listed in Table 2 represent flows beyond annual channel shaping events. This will be discussed further in the section on Geomorphology.

Based on the discharge data obtained through the monitoring program, the North Branch of Ecorse Creek appears to be the flashiest stream that was measured. Over the 2008-10 period, it produced a flashiness index of 0.97. The long-term (2002-10) flashiness index for the site is 0.83, which is one of the highest index values in the state of Michigan and among the highest quartile in the Midwest. Further, the creek appears to be becoming more flashy. 12-month flashiness index values declined from initial launch until 2006 at which point index values have increased to their current levels (see Figure 2). By this metric, North Branch of Ecorse Creek can be used as a reference of a highly impacted stream for comparing with other ADW streams. Other references should be sought for comparing to more natural flow conditions.

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3 Lower River Rouge at Inkster. USGS station number 04168000. See http://waterdata.usgs.gov for more details.

North Branch of Ecorse Creek is characterized by a small drainage area (18 square miles) that generates large peak flows following storm events (Figure 3). Peak flows exceeded those of other monitoring sites that drained larger areas and can reach over 100 cfs. These high peak flows are quickly followed by very low (almost negligible) flow for most of the time.
Figure 1. Hydrographs for North Branch of Ecorse Creek.
Frank & Poet Drain (within the Combined Downriver Watershed)
The site in the Frank & Poet Drain accumulates flow from a 27.1 square mile drainage area. It produces a median flow of 2.44 cfs. Like the North Branch of Ecorse Creek, the drain is also characterized by low base flow followed by sharp increases in discharge in response to storm events (Figure 4). The highest peak flow measured was 207 cfs. The Frank & Poet tends to maintain higher flows over a longer period of time than other monitored streams, however, and thus has a somewhat lower flashiness index of 0.65. This index value is still among the highest (most flashy/least natural) quartile in Michigan.
Figure 2. Hydrographs for Frank & Poet Drain for 2008-2010.

Alliance of Downriver Watersheds
2010 Monitoring Report
Blakely Drain (within the Combined Downriver Watershed)
The site in the Blakely Drain accumulates flow from a 31.8 square mile drainage area. It produces a median flow of 2.80 cfs. It also maintains a low base flow followed by sharp increases to peak flows in response to storm events (Figure 5). The highest peak flow measured was 113 cfs. Blakely Drain also declines to zero discharge during dry periods. However, it has a comparatively moderate flashiness index of 0.53. This index value places the Blakely Drain site among the highest (most flashy/least natural) quartile in Michigan. However, it is lower than the median for streams of comparable size in the wider Midwestern region.
Figure 3. Hydrographs for Blakely Drain.

Alliance of Downriver Watersheds
2010 Monitoring Report
Brownstown Creek (within the Combined Downriver Watershed)
The flow station in Brownstown Creek measures streamflow from a 27 square mile catchment. The sensor measured flow through most of the growing season, however, the flow declines to zero during intermittent drought periods during the summer. The median flow across the period of record was 2.73 cfs. The peak flow during the period of record was 214 cfs, recorded following the 3-inch storm event (Figure 6). A flashiness index of 0.70 was calculated for the monitoring period. Compared to other small gaged streams in Michigan, the Brownstown Creek would rank among the fourth or highest (most flashy/least natural quartile). It is in the third (above median) quartile in the Midwest.
Figure 4. Hydrographs for Brownstown Creek.
South Branch, Ecorse Creek
The site in the South Branch of Ecorse Creek accumulates flow from a 11.8 square mile drainage area. It produces a median flow of 3.82 cfs – the highest median flow of all stations monitored. This site maintains a perennial base flow, declining only to a minimum of 0.33 cfs – one of the only creek sites in the ADW with constant flow. The discharge increases to a peak flow of 290 cfs, which was the largest discharge rate monitored of all ADW streams (Figure 7). The higher base flow helps contribute to a relatively low flashiness index of 0.43. This index value still places the site among the highest in Michigan and in the Midwest.

Some factors that may influence the peak flow are the controlled stormwater discharges from the Detroit Metropolitan Airport and the large areas of less developed land in the headwaters of the South Branch of Ecorse Creek as compared to the other branches of Ecorse Creek.
Figure 5. Hydrographs for South Branch, Ecorse Creek.
Woods Creek
The site in Woods Creek accumulates flow from a 21 square mile drainage area. It produces a median flow of 1.66 cfs, which is comparatively low. It maintains a low base flow, which declines to zero during dry points in the season. Responses to storm events are more gradual in Woods Creek (Figure 8). The highest peak flow measured was 44.8 cfs, which is considerably lower than other ADW sites. Woods Creek also has a longer decline to base flow than some of the other sites. This contributes to a relatively low flashiness index of 0.31. This index value places the Woods Creek site near the median of sites with similar catchment size in Michigan. The flashiness index would place it in the lowest (most natural) quartile in the wider Midwestern region.
Figure 6. Hydrographs for Woods Creek.

Alliance of Downriver Watersheds
2010 Monitoring Report
Silver Creek
A newer site was established in August 2009 in Silver Creek. The site accumulates flow from a 7.9 square mile drainage area. It produces a median flow of 1.26 cfs, which is comparatively low (Figure 9). It maintains a low base flow, which declines to zero during dry points in the season. Responses to storm events are rapid. The highest peak flow measured was 193 cfs, which is similar to other flashy ADW sites. Silver Creek has a typically high flashiness index of 0.77. This index value places the Silver Creek site among the most flashy of sites with similar catchment size in Michigan.
Figure 7. Hydrograph for Silver Creek.
Conclusions
This flow data represents a baseline measure of flow conditions in ADW streams. The results generally show ADW streams to be quite flashy, characterized by rapid increases to extremely high peak flows following storms and a rapid decline to little or no base flow. Such streams are typical of highly urbanized areas and present a challenge for living organisms trying to establish a home.

There has not been enough time or data collected to determine if stormwater/watershed restoration activities have had an effect on stream hydrology. The ADW currently plans to return to monitoring sites on a five year rotational basis to determine if flow statistics have changed. A positive change in stream flow would be exhibited by lower peak flows for a given storm, higher base flow and a lower flashiness index. In general, discharge measures show ADW sites to have highly altered flow, characterized by high peak flows and low to no base flow.
3  Geomorphology

Evaluation Approach
This survey approach included three channel morphology field measurements at sites that were consistent with the flow monitoring or benthic macroinvertebrate locations. The three channel morphology measurements were:
- Bankfull depth, measured along a cross-channel transect and equal to top of bank for incised streams typical for modified streams as exist in the ADW;
- Channel slope, calculated from measurements of water level at two points (upstream & downstream) along a longitudinal profile; and
- Pebble count of the substrate within the stream reach.

The results from these measurements are used initially to assess channel stability via tractive force calculations. Tractive force is a rapid measure of stream channel stability. Bankfull depth and channel slope are used to compute the incipient particle diameter (IPD), which is the particle size that is mobile at bankfull discharges. This is then compared, via the tractive force ratio, to the measured D₈₄ pebble size, which is equivalent to the observed mobile pebble size. IPD will be compared to the measured D₈₄ obtained from the pebble count, and values of a ratio of the IPD to the D₈₄ will be interpreted as follows:

- IPD / D₈₄ between 0.5 and 1.5 indicates a stable stream channel,
- IPD / D₈₄ > 1.5 indicates an unstable, probably eroding stream channel, and
- IPD / D₈₄ << 0.5 indicates an unstable, stream channel that may be filling in with sediment.

Initial measures will indicate stream segments in need of hydrologic controls. The long-term plan is to revisit sites to track temporal trends in channel dimensions and determine if stream channels are stabilizing due to management efforts.

Geomorphology of Stream Sites
The map in Figure 10 shows the seven sites that were evaluated for tractive force stability in 2010.
Figure 8. Stream channel sites in the ADW that were evaluated in 2010 for tractive force stability along with initial assessment results.

These initial assessment results are included in much more detail in Table 2 and the figures that follow for each stream segment. One of the sites was measured to have tractive force ratio between 0.5 and 1.5, indicating that the channel was stable. Six sites had ratios that were above 1.5, indicating unstable, probably eroding channels. Each site is discussed below.
A site by site summary along with channel profiles are provided below for each of the 2010 sites that were evaluated for tractive force stability.

**Blakely Drain at Merriman Road**
The geomorphological evaluation of the Blakely Drain site indicated that the channel is unstable with a tractive force ratio of 5.3. This suggests that bankfull events, which usually occur on at least an annual basis, are likely to cause erosion. The bankfull event is probably around the peak flow measured directly at 113 cfs. This stream channel appears to be unstable at peak flows near or above this flow.
Figure 9. Stream channel profile of the Blakely Drain at Merriman Road. The blue line is the bankfull depth and the red line is the flood prone area.

Frank & Poet Drain at Southland Mall
Tractive force calculations suggest that the Frank & Poet Drain is stable at the monitoring site. Its tractive force ratio was calculated at 1.2, the lowest of the sites measured in 2010. The measured peak flow downstream of this site was 207 cfs is likely near the bankfull discharge. It appears that very little erosion may be occurring at this site near or above bankfull discharge.
Figure 10. Stream channel profile of the Frank & Poet Drain at Southland Mall. The blue line is the bankfull depth and the red line is the flood prone area.

South Branch, Ecorse Creek at Beech Daly Road
The tractive force calculation for the South Branch of Ecorse Creek was 108, an amount well above the stability threshold. This suggests that the stream channel may be very unstable. The site has a bankfull depth of 4.47 ft. The measured peak flowdownstream of this reach was 290 cfs. Flows around this discharge or lower may be leading to sediment erosion in the stream channel.
Figure 11. Stream channel profile of the South Branch of Ecorse Creek at Beech Daly Road. The blue line is the bankfull depth and the red line is the flood prone area.

North Branch, Ecorse Creek at Inkster Road
The tractive force for the North Branch of Ecorse Creek site was 5 over the stability threshold. This calculation suggests an unstable eroding channel. The measured peak flow downstream of this site was 446 cfs. Flows around this discharge or lower may be leading to sediment erosion in the stream channel.
**Figure 12.** Stream channel profile of the North Branch of Ecorse Creek at Inkster Road. The blue line is the bankfull depth and the red line is the flood prone area.

**Brownstown Creek at King Road**

The tractive force for the Brownstown Creek site was 512 – well over the stability threshold. This calculation suggests an unstable eroding channel is present. The measured peak flow downstream of this site was 214 cfs. Flows around this discharge or lower may be leading to sediment erosion in the stream channel.
Figure 13. Stream channel profile of the Brownstown Creek at Hall Road. The blue line is the bankfull depth and the red line is the flood prone area.

Smith Creek at Flat Rock Community Center
The tractive force for the Smith Creek site was 55 – above the stability threshold. This calculation suggests a somewhat unstable channel that may eroding. The site has a bankfull depth of 6.6 ft, is incised and has a small D84. Peak flow data is not available for this reach.
Figure 14. Stream channel profile of Smith Creek. The blue line is the bankfull depth and the red line is the flood prone area.

**Reagan Drain-Willow Metropark**

The calculated tractive force ratio for the Reagan Drain site was 4.8. This calculation suggests a slightly unstable channel. No flow measurements were performed on the Reagan Drain in 2010.
Figure 15. Stream channel profile of the Reagan Drain at Willow Metropark. The blue line is the bankfull depth and the red line is the flood prone area.

Conclusions
Most of the geomorphology monitoring sites have unstable stream channels. Six of seven sites appear to be eroding, while none of the seven are aggrading (i.e. accumulating sediment). Only one site was identified as stable. No conclusions can yet be drawn regarding the effectiveness of Grow Zone installations. However, the ADW plans to return to these sites to measure changes in stream channels following complete establishment of Grow Zones. Changes in channel stability should suggest improvements in the contributing watershed, including Green Infrastructure improvements such as Grow Zones.
4 Benthic Macroinvertebrates

Evaluation Approach
Monitoring the diversity of benthic macroinvertebrates is a staple of the ADW monitoring program. Monitoring changes in macroinvertebrates over time also provides a basic measure of stream habitat and water quality. The ADW has been monitoring macroinvertebrate diversity at many sites across the ADW for several years at some sites.

Macroinvertebrate diversity is measured twice a year (augmented by winter stonefly collections in January). Multiple diversity measures provide a reasonable estimate of stream conditions. Stream habitat is also evaluated directly every 3-5 years. Changes in site quality measures may indicate habitat improvements. Two metrics have been evaluated for this report. First, the Stream Quality Index (SQI) is a composite biotic integrity score developed for the Michigan Clean Water Corps (MiCorps). The SQI is based on order-level identification, however, and does not take advantage of family-level identification performed by ADW programs. The second metric is total taxa diversity, which counts the number of different families of aquatic macroinvertebrates found at each site. This measure utilizes the higher resolution of family identification, but does not account for the sensitivities of different families. Taken in combination, these two metrics provide a good measure of aquatic biotic integrity over time.

Aquatic Diversity and Habitat Quality
Over 30 sites across the ADW have been monitored for benthic macroinvertebrates. Many of the sites have been monitored since 2004, though a number of sites were added over the past few years. Figure 18 shows the location of these sites along with the macroinvertebrate status as of Spring 2010. The map shows the location of the monitoring site along with its most recent 3-sample mean of the MiCorps Stream Quality Index (SQI), for fall samples.

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Across all sites, fall SQI ratings are significantly higher than spring ratings, so it would be inappropriate to combine fall and spring samples. Similar three-sample means for Fall SQI ratings are depicted in Figure 19.

The geographic pattern of these results suggests that upstream sites appear to have higher SQI ratings than downstream sites across each of the three watersheds. This pattern could also reflect a difference in land uses or impervious cover. This pattern should be assessed further in future analysis.
Figure 17. Three-sample fall sample mean Stream Quality Index ratings for ADW macroinvertebrate sites through 2010.

These maps also illustrate the range of ratings across sites in the ADW. Most of the sites (69% in Spring; 75% in Fall) are impacted (with ratings of fair or poor) according to the SQI. It is also important to note that ratings are generally higher on the whole for fall samples, and that results for sites with fewer than 3 samples for each season are considered preliminary. Results from each of the three watersheds varied a bit. On average, sites in the Lower Huron had higher SQI ratings (Spring=36, Fall=32) than Combined Downriver (Spring=25, Fall=29) and Ecorse Creek (Spring=23, Fall=28).
Figure 20. Three-sample spring sample mean Total Diversity ratings for ADW macroinvertebrate sites through 2010. Ratings are based on relative distribution of TD scores.

Total Diversity measures (see Figure 20 and Figure 21) show a similar spread across ADW sites. Most of the sites that had high SQI ratings also have high taxa counts. Mean total diversity measures were more widely spread for Spring sampling than for Fall sampling, which was also true for SQI ratings. In Spring, the diversity of the best site was just over four times greater than that for the worst site. As with the SQI, Lower Huron sites had greater diversity (Spring=15, Fall=15), on average, than Combined Downriver (Spring=10, Fall=14) and Ecorse Creek (Spring=10, Fall=14).
Figure 21. Three-sample fall sample mean Total Diversity ratings for ADW macroinvertebrate sites through 2010. Ratings are based on relative distribution of TD scores.

**Trends in Aquatic Quality and Diversity**

The macroinvertebrate data was assessed for trends over time by simple regression of Spring and Fall data for each site, and collectively for sites across each watershed. Overall, the mean SQI rating across all sites sampled for each event has increased over time. While this is a positive result, it should be noted that mean ratings can differ each year based on the specific sites sampled, so each point is not truly independent. Also note the difference between Spring and Fall ratings. Still, these results suggest improving conditions overall.
Sites in the Lower Huron River watershed show a strong upward trend in spring monitoring for both SQI and TD (Figure 22). The trend for both measures is statistically significant. This is an encouraging result that indicates improvement in macroinvertebrate colonization and suggests improvements or stabilization of habitat over time. However, as more sites have been sampled over time, the spread of scores has increased.

The fall trend for both measures across Lower Huron sites is decidedly different (Figure 23). The trend appears to be declining, but the trend is not significant. The spread of data across sites appears to be much greater in the fall versus spring sampling. Also, variability year-to-year is greater, suggesting environmental events are affecting scores for all sites.

Figure 18. SQI and TD ratings for all Lower Huron sites for spring sampling events with best fit trend line included. Data points in the SQI chart are color coded by individual site.
For Ecorse Creek watershed sites, the spring trend is strongly positive, similar to that for Lower Huron sites (Figure 24). The trend is significant for both measures, again indicating that macroinvertebrate taxa are colonizing stream sites in greater numbers and diversity.
Figure 20. SQI and TD ratings for all Ecorse Creek sites for spring sampling events with best fit trend line included. Data points in the SQI chart are color coded by individual site.

Again the trend for fall SQI scores in Ecorse Creek sites is insignificant (Figure 25). However, the trend in total diversity is significantly positive. This suggests that the recovery of Ecorse Creek sites may be more consistent across seasons. It also could be, however, due to differences in sampling dates or sampling site selection.
Trends for Combined Downriver watershed sites are similar to the other two watersheds (Figure 26). In the Spring, the trend over time is strongly upward, illustrating greater number and diversity of benthic biota. The trend for Combined Downriver sites is more highly significant and explains a greater amount of the variance (as measured by R²) than with the other two watersheds.


Figure 26. SQI and TD ratings for all Lower Huron sites for spring sampling events with best fit trend line included. Data points in the SQI chart are color coded by individual site.

Fall trends for Combined Downriver sites are similarly less emphatic, but the trend for both SQI and TD is significantly positive. Again, Combined Downriver sites appear to be recovering across both sampling seasons.
Conclusions

Overall, many stream segments across the ADW appear to be impacted such that the stream habitat is not able to sustain populations of a very diverse range of aquatic macroinvertebrates. Many of the sites in the ADW are designated county drains and as such the stream channels and habitat have been highly modified. Sites within watersheds with a greater proportion of imperviousness (i.e. less green infrastructure) are more highly degraded than those with less imperviousness (i.e. more green infrastructure). Thus, site habitat conditions are more likely to be directly (i.e. negatively) affected by stormwater discharges.

On the positive side, conditions appear to be improving in many of the sites being monitored. Both stream quality and macroinvertebrate diversity show improving trends over time across all...
sites in the ADW. This may suggest that stream habitats are recovering somewhat. Future analysis should investigate regional trends.
5 Summary of Evaluation Results

Three methods are reported on here to evaluate environmental progress in the Alliance of Downriver Watersheds. These methods have provided a solid baseline of information on the stream conditions at target sites across the watersheds. The results, which were discussed in the preceding sections indicate that some stream segments are highly impacted by previous urbanization, with imperviousness exceeding 30 and 40% in Ecorse Creek and Combined Downriver watersheds respectively (see 2009 monitoring report). Creek sites within the more highly urbanized areas show evidence of degradation of several functions. Stream sites like those on the Blakely and Frank & Poet Drains suffer from flashy flows – high peak flows followed by low or no base flow – and have unstable stream beds. Their banks and beds are susceptible to erosion. Not surprisingly, those sites also exhibit some of the lowest stream quality ratings and have the lowest macroinvertebrate diversity in the ADW.

The evaluation also illustrated some streams that are faring well in the ADW. Sites in Woods Creek and the South Branch of Ecorse Creek have relatively natural flow dynamics along with relatively stable stream beds. It follows that those sites also exhibit higher stream quality ratings and have a diverse array of aquatic macroinvertebrates living within them. Also, the early results suggest that most of the stream sites monitored for macroinvertebrates are showing signs of improving diversity and habitat quality. As the ADW continues to implement stormwater controls and engage in green infrastructure improvements like Grow Zones, tree planting and broader initiatives, it will be important to return to these evaluation metrics to determine if conditions continue to improve. It is too early in the monitoring process to determine any trends in methods other than macroinvertebrate sampling. However, the current results provide an excellent basis for future comparison to determine progress in stormwater and non-point source management.