"Excellence in Any Environment"

December 27, 2012

Ms. Chantelle Carroll
U.S. Army Corps of Engineers, Buffalo District
Regulatory Branch, Orwell Field Office
33 Grand Ave
Orwell, Ohio 44076

Re: As Built monitoring report for Haley's Ditch Restoration Project
USACE Application number 2008-01179

Dear Ms. Carroll:

Attached is the 3rd year monitoring report for the Haley's Ditch Restoration Project site in Akron, Ohio. If you have any questions, please call me at (330) 688-0111 or email me at jbingham@enviroscienceinc.com.

Respectfully,

Joel Bingham
Restoration Biologist

Attachments: As Built Monitoring report

Cc: Dave Gunnarson, Lockheed Martin Corporation
Steve Vardavas, Lockheed Martin Corporation

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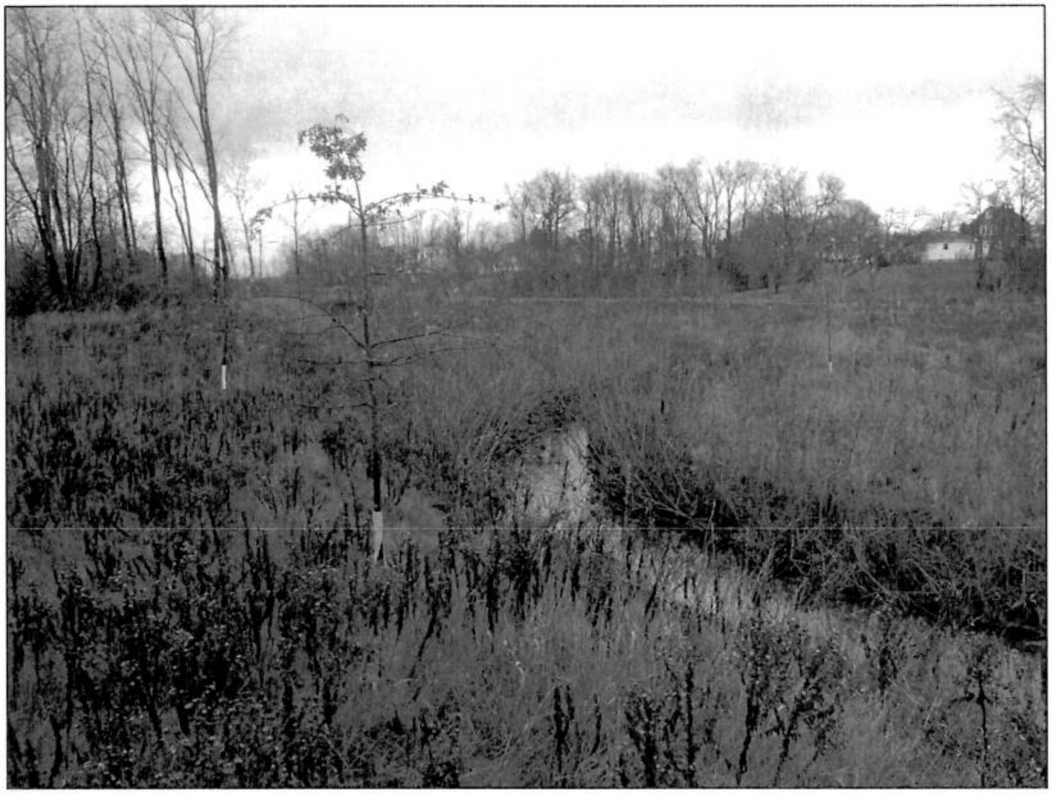
ES ENVIRO SCIENCE INCORPORATED

Haley's Run Restoration Report



Prepared By:

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A Partnership for Stream & Wetland Restoration

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December 31, 2012

Lockheed Martin
Haley's Run Restoration Report

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1.0 Introduction

The following information is the third year monitoring report for the restoration of Haley's Run, required by the USACE Nationwide 38 permit for the remediation and restoration of Haley's Run (permit number 2008-01179). EnviroScience Inc. and the RiverWorks Team completed the stream and wetland restoration of Haley's Ditch on June 30, 2010. The restoration of Haley's Run centered on enhancing the remediation area within the limits of contaminated sediment removal. Lockheed Martin made the conscious decision to spend additional resources to provide a functional stream valley, floodplain and riparian corridor as a foundation for ecological recovery. Therefore, the limits of remediation became the limits of restoration. The restoration also focused on repairing existing impairments and limitations of channel morphology, habitat and riparian zone that occurred historically to Haley's Ditch. For additional information on Haley's Run regarding existing conditions prior to remediation and restoration activities please refer to Haley's Ditch Stream and Wetland Restoration Plan dated May 18, 2009 which is located in Appendix A of the Nationwide 38 permit.

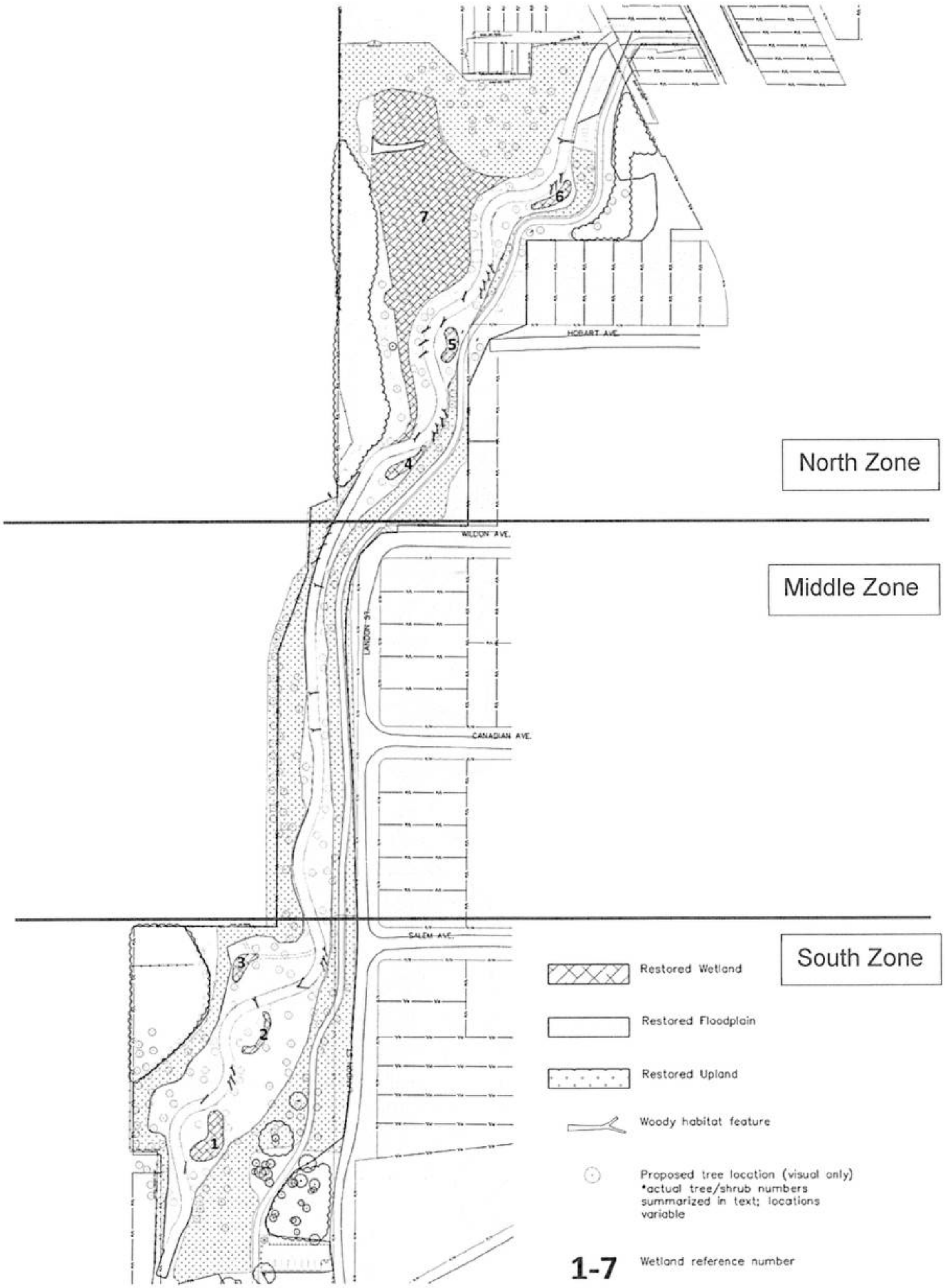
1.1 Restoration Summary

The restoration team mobilized and began work on September 14, 2009. Restoration work proceeded in an upstream to downstream direction through the three project zones; South, Middle and North. The South zone was completed on October 30, 2009 and the Middle zone was completed on November 25, 2009. Construction activities were suspended over the winter and resumed in the spring on April 14, 2010. The North Zone restoration was completed on June 30, 2010. Overall project summary details are provided in bullet form below but additional detail regarding the restoration is presented in the following sections; 2.0 Stream Restoration, 3.0 Wetland Restoration, 4.0 Native Plantings and5.0 Habitat Restoration.

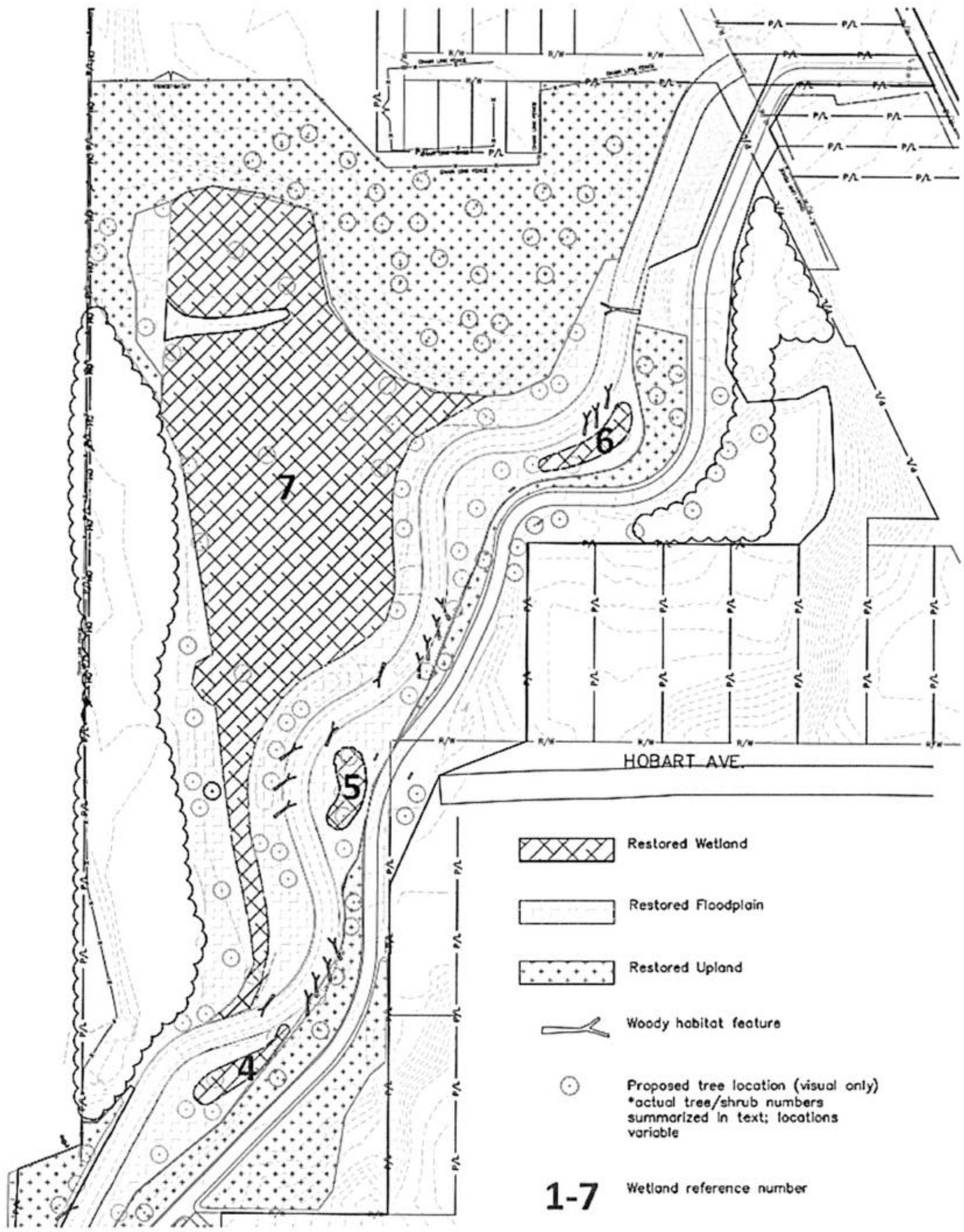
Total Restored Stream Length	2,039 linear feet
Total Restored Wetlands	1.02 acres 7 separate areas
Total Floodplain Restored	1.6 acres
Total Uplands Restored	3.4 acres
Total Native Pine Trees Planted	77
Total Native Deciduous Trees Planted	375
Total Native Deciduous Shrubs Planted	625
Total pounds of Native Seed	101
Topsoil	5719 cubic yards(229 truckloads)
Gravel/ Cobble	1049 tons
Bank run	1301 tons
Fill dirt	7221 tons

A series of as-built maps are included as Maps 1-4.

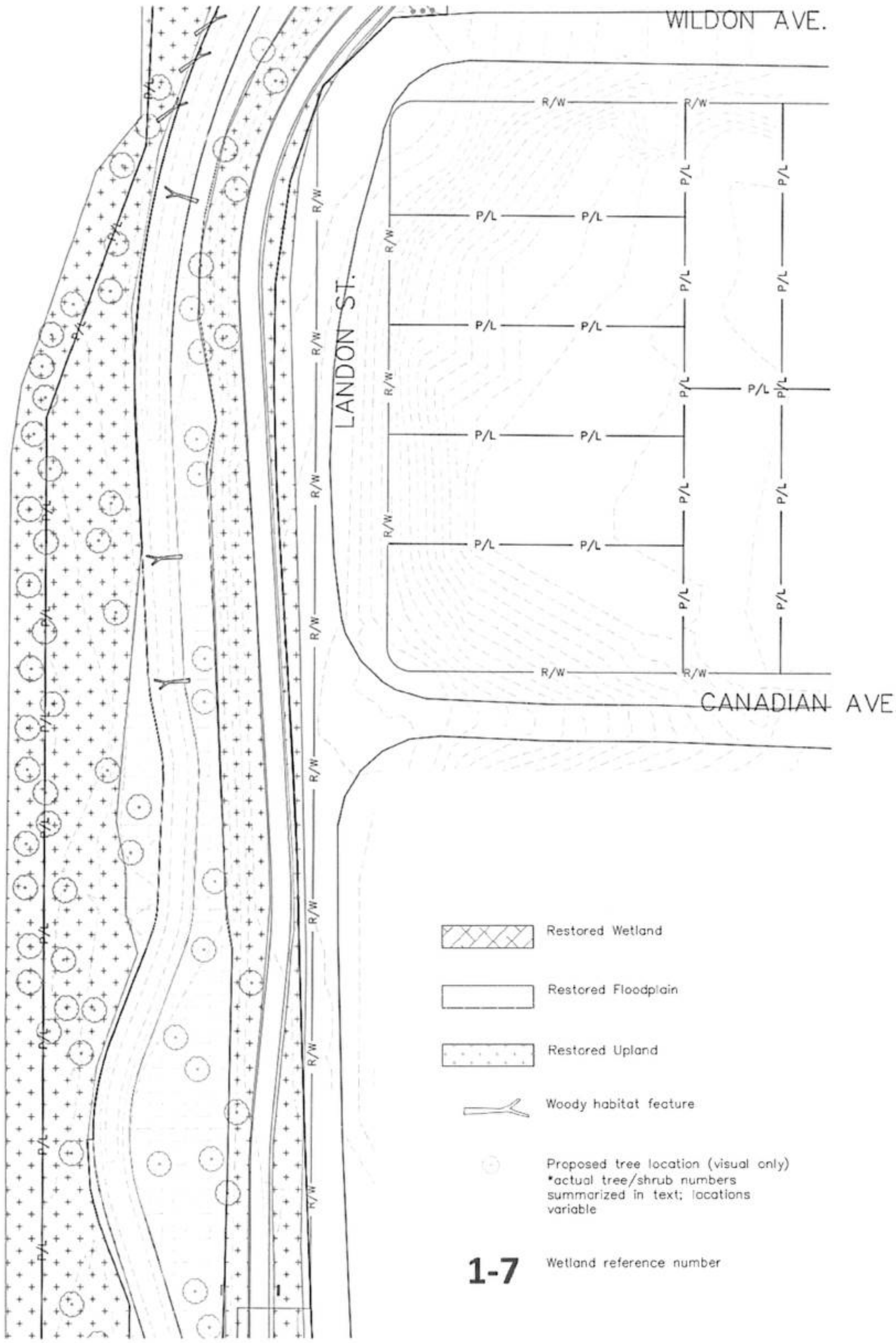
Map 1. Haley's Run Restoration Map.



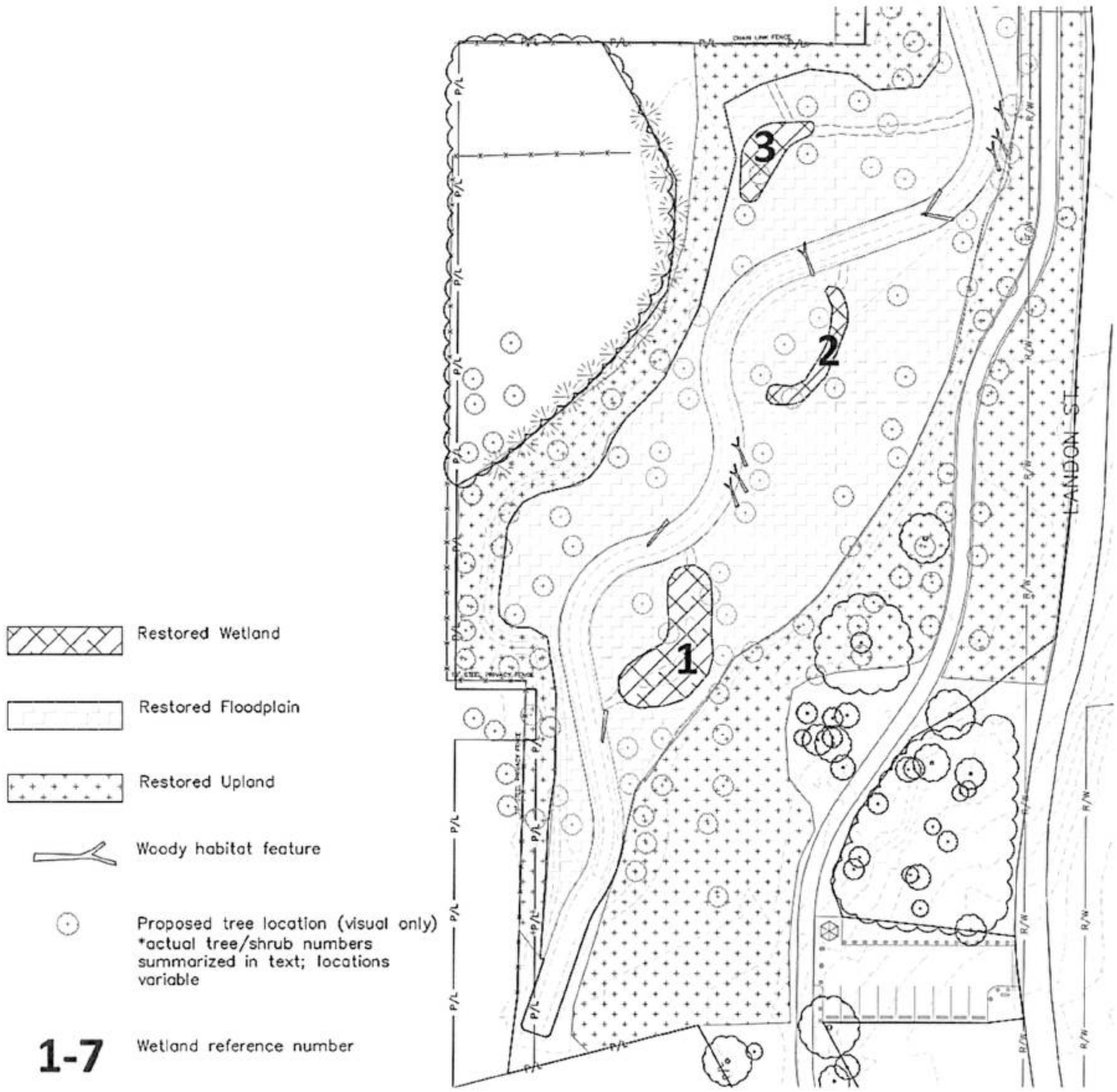
Map 2.Haley's Run Restoration Map North Zone.



Map 3.Haley's Run Restoration Map Middle Zone.



Map 4. Haley's Run Restoration Map South Zone.



2.0 Stream Restoration

A total of 2,039ft of restored channel was created following remediation. Once a remediation zone was complete, the subgrade channel and floodplain construction commenced. The subgrade was accomplished through a combination of excavation and fill depending on the existing elevation. Material to reach subgrade elevations was either imported, or existing verified material with PCB levels below the 1.0ppm was used. The finish grade of the stream, wetland and floodplains was achieved with 1.0ft of imported material of topsoil, fill or substrate. The restored channel construction was created through the following basic sequence:

1. Rough subgrade channel was cut on an average grade of ~0.0033 ft/ft.
2. Profile subgrade excavation created the riffle and pool widths/depths
3. Installed in-stream woody habitat
4. Bank shaping and final stream bottom contouring
5. Installation of 0.5-0.8 ft of imported bank run material
6. Bank run compaction using skid plate tamper
7. Installation of 0.3-0.5 ft of cobble/gravel mix to finish grade
8. Installation of erosion fabric at toe of banks
9. Install topsoil to finish floodplain grade
10. Seed and straw banks
11. Roll erosion fabric and fascine to banks per specifications

Figure 1. Haley's Flood Stage

To date, the restored stream is functioning very well. There have been significant precipitation events in 2012 and in 2011, and the channel and banks have demonstrated exceptional stability throughout different stages of channel maturity (i.e., vegetation growth). The erosion fabric and grass seed mix has performed well and minimized erosion. However, some erosion has occurred near the second pool downstream of the beginning of the project area in 2011. When this was first observed, willow live stakes were planted along the outside meander, as well as installation of layers of branches. This was done to help decrease sheer stress on the bank and reduce future erosion. The live stakes and branch layering techniques worked in that immediate area, but erosion has continued on the downstream side of the protection. Besides that, deposition has occurred along inside meander bends, maintaining point bars, and pools have maintained their depths. More importantly, floodwaters are able to access the floodplain which is evident by Figure 1.

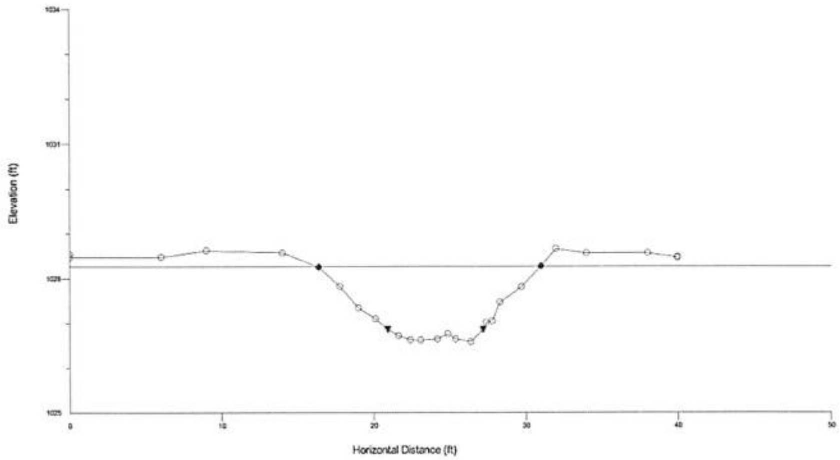
Table 1. Typical Riffle Design Parameters

Variable	Avg. Dimension
Bankfull Width	15.0 ft
Bankfull mean depth	1.32 ft
Width/Depth Ratio	15
Cross Sectional Area	20 sq ft.

2.1 As Built Cross Sections

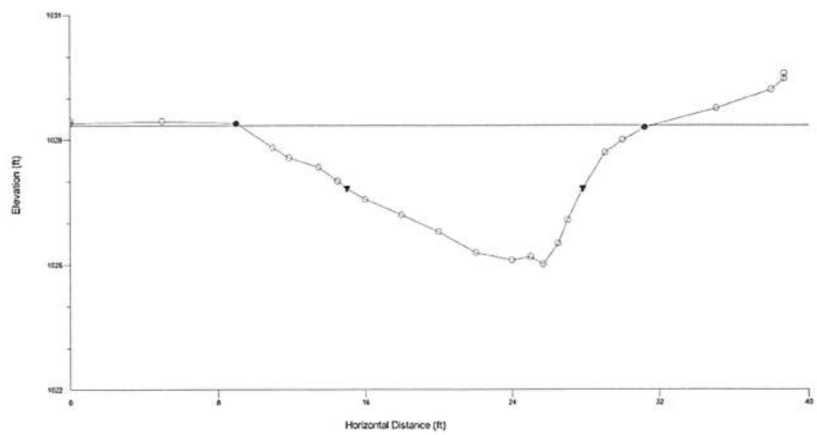
Several permanent monitoring stations were established through the project reach on April 1, 2010 and July 15, 2010. Cross sections were performed at these stations to display the condition of the channel during the third monitoring year. Details of each section are presented below. The average design criteria are listed in Table 1. However, one must keep in mind that the numbers are averages. Natural stream channels rarely have the same uniform dimensions and characteristics throughout a reach, as the variability provides a basis for stream function and habitat variability. The following Figures 2-6 provide the results of cross sections for Haley's Run during the third monitoring year.

Figure 2.Cross Section Station 17+25 I



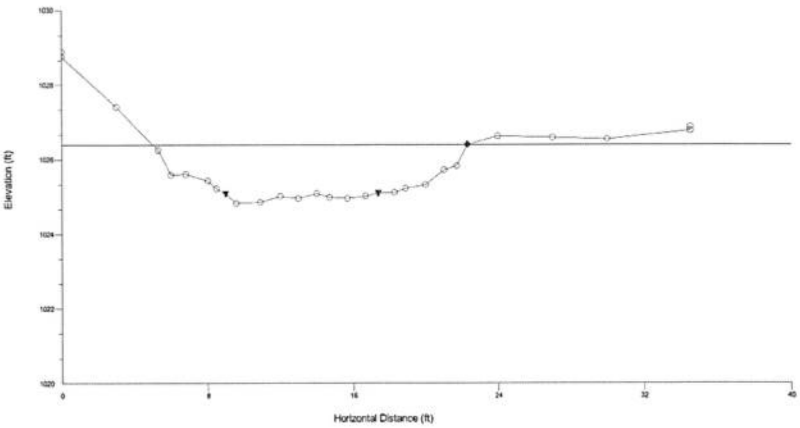
Variable	Value
Bankfull Width	15.8 ft
Bankfull mean depth	1.35 ft
Width/Depth Ratio	12
Cross Sectional Area	21.4 sq ft.

Figure 3.Cross Section Station 16+00 Pool



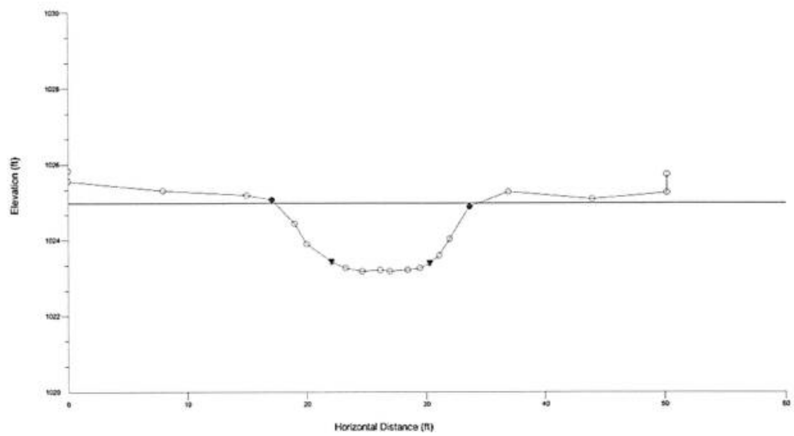
Variable	Value
Bankfull Width	24.9 ft
Bankfull mean depth	2.03 ft
Width/Depth Ratio	12.25
Cross Sectional Area	50.5 sq ft.

Figure 4. Cross Section Station 11+50 Riffle



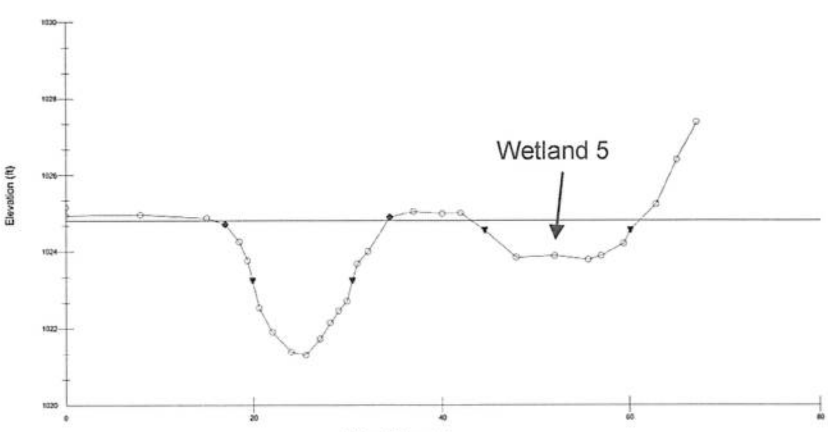
Variable	Value
Bankfull Width	18.4 ft
Bankfull mean depth	1.3 ft
Width/Depth Ratio	14.2
Cross Sectional Area	24.0 sq ft.

Figure 5. Cross Section Station 6+75 Riffle



Variable	Value
Bankfull Width	18.75 ft
Bankfull mean depth	1.27 ft
Width/Depth Ratio	14.75
Cross Sectional Area	23.8 sq ft.

Figure 6.Cross Section Station6+25 Pool



Variable	Value
Bankfull Width	19.7ft
Bankfull mean depth	1.78ft
Width/Depth Ratio	11.08
Cross Sectional Area	35.1 sq ft.

2.2 As Built Longitudinal Profile

Longitudinal profile data of the restored channel was performed on December 5, 2012 to document the streambed elevations for 2012. Elevations of the stream in the deepest point of the channel (thalweg) were recorded following typical stream morphological survey protocol (Figure 7-8). Note that longitudinal profile stationing begins at "0" upstream at the Triplett culvert invert and therefore is not a direct match to construction stationing. References are included where pertinent to assist in orientation.

The stream bed profile was constructed as per plan with only minor horizontal shifts in the start or end of a feature. No riffles/pools were eliminated or significantly altered from the design plan. The profile also indicates that the average bankfull slope 0.0033ft was achieved with bank construction and floodplain grading. Some profile adjustment was observed at the most upstream reach of the project area. This adjustment was limited to deposition in the pool immediately downstream of the Triplett Rd culvert, and did not adversely affect the project area downstream.

Figure 7. Haley's Run Longitudinal Profile Station 0+00-12+00

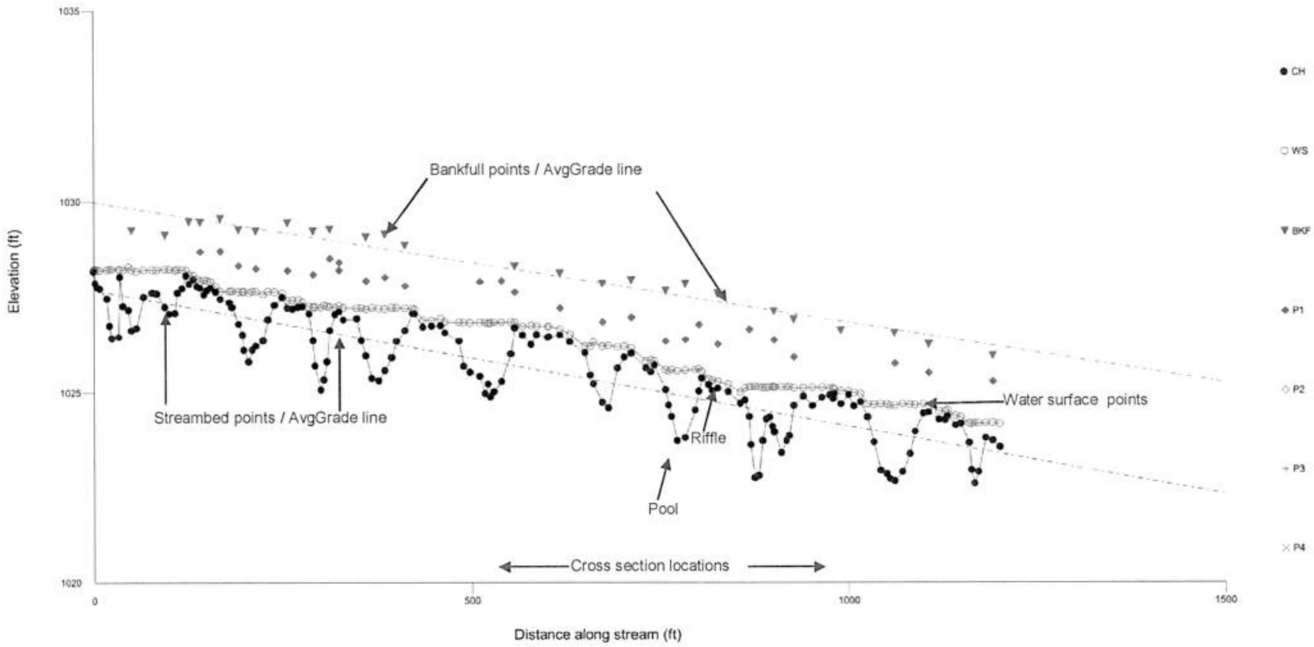
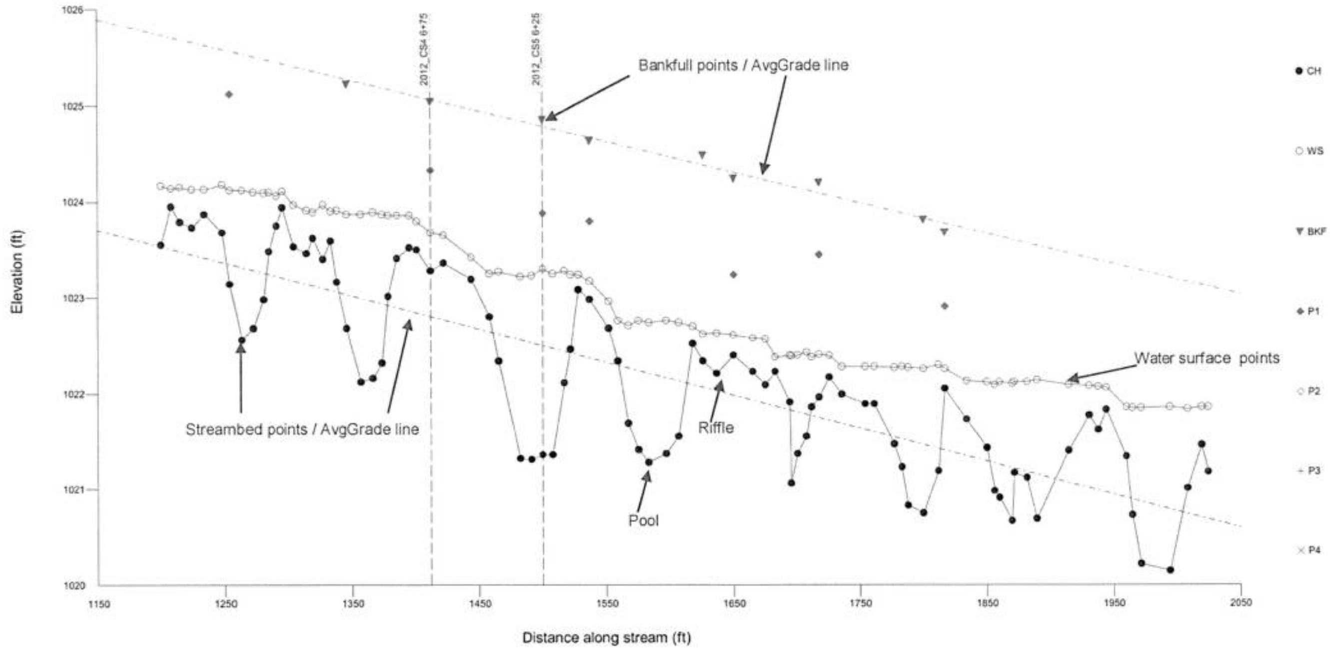


Figure 8. Haley's Run Longitudinal Profile Station 12+00-20+39



2.3 Substrate

Figure 9. Substrate Installation

Once a channel reached the appropriate subgrade elevation, a base foundation of bank run material 0.5-0.8ft (6-9.5 inches) was added. Bank run material has a high percentage of sand and small gravel that is typical of "sub-pavement" areas of stream beds. This material was compacted into place using a vibrating skid plate tamper. This was followed by the installation of cobble/gravel mix to achieve the final grade. Cobble/gravel material was shaped and compacted in place with an excavator bucket (Figure 9). The particle distribution sampled on 10/16/09 (Table 2) shows the gradation of cobble/gravel material that was typically installed to finish grade. This distribution is based on a 105 particle sample.

Table 2. Percent Particle Distribution

Type	Cobble/Gravel
Silt/Clay	0.95%
Sand	24.76%
Gravel	50.48%
Cobble	23.81%
Boulder	0%

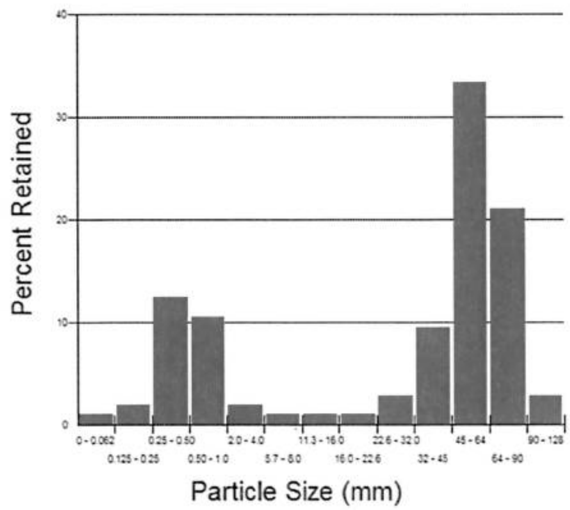


Figure 10. Cobble/Gravel Distribution

The results (Figure 10) indicate a distinct cohort of gravel/cobble material and sand component in the installed top layer of the substrate. The gap in the distribution relates to fine gravel (2.0-4.0 mm) and medium gravel (14.0-26.0 mm) that is anticipated to arrive from sediment transport upstream*. This is based on observations of the existing channel and of newly deposited material below the Triplett Rd culvert. The installed top layer of cobble/gravel material was intentionally biased towards larger particle sizes that would not be delivered from upstream bedload.

***2012 Update:** During the 2012 monitoring survey, the dominant substrate types observed were cobble, and both medium and fine gravel. As expected, sediment from upstream is being transported through the stream, contributing to more balanced substrate heterogeneity. No net aggradation or degradation was observed.

3.0 Wetland Restoration

The original design designated five separate areas for wetland restoration/creation. During the design-build process and minor expansion of the remediation area, observations of surface runoff warranted the creation of additional wetlands. Wetland 3 was added to alleviate runoff from the LKQ facility in the South zone and Wetland 4 was added to dissipate culvert drainage under the walking trail at the 90° bend of Landon Street. A total of 1.02-acres (44,451 sq ft) of wetland were created in seven separate areas. The wetlands are designed to be seasonally inundated and meant to mimic oxbow wetlands or frequently flooded wetlands. These types of riverine wetlands are prevalent in the Cuyahoga watershed and along intact areas of the Little Cuyahoga River corridor and its tributaries. The primary source of hydrology for the wetlands will be precipitation and over bank flooding. Observations of the wetlands during 2012 indicate that the wetlands sufficiently capture and retain water, and outlets function well. Photographs of all wetland areas are included as Figures 11-18.

Figure 11. Flood Debris at inlet

Wetland 1- Is a 0.045-ac riverine wetland constructed along the original alignment of Haley's Ditch. Floodwaters access this wetland on a regular basis evident by flood debris (Figure 11). Furthermore, the wetland has a groundwater source that maintains a fairly constant water level throughout the majority of the year (Figure 12). Because of this, the wetland community associated with this area will be slightly different from the seasonally inundated wetlands that have a more fluctuating hydrologic regime. Overall, this is a positive outcome and adds more diversity to the type of wetland habitat restored with the project.

Figure 12. Wetland 1

Wetland 2- Is a 0.012-ac riverine oxbow wetland constructed in the South zone also on the previous Haley's ditch alignment (Figure 13). However, this wetland does not have the groundwater input seen in Wetland 1, and has a more fluctuating hydrologic regime.

Figure 13. Wetland 2

Wetland 3 is a riverine 0.017-ac oxbow wetland constructed within the south zone western expansion area. This wetland receives surface water runoff from the LKQ facility. A small intermittent stream with a series of step-pools was constructed at a grade of approximately 10% to convey water from the upper slope to the wetland area. The outlet of this wetland is another small intermittent stream approximately 80ft in length that confluences with the main channel at the end of the South zone (~Station 16+50).

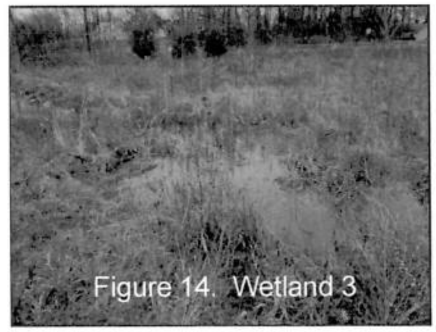


Figure 14. Wetland 3


Figure 15. Wetland 4

Wetland 4 is a 0.027-ac riverine oxbow wetland that was added during the restoration construction. Beside floodwaters, this wetland primarily intercepts surface runoff from Landon Street and provides dissipation for the drainage culvert crossing under the walking trail.


Figure 16. Wetland 5

Wetland 5 is a 0.017-ac river oxbow wetland that is positioned at the base of the walking trail near the end of Hobart Street. A drainage culvert under the walking trail intercepts drainage coming off Hobart Street. Prior to this project, drainage would discharge almost directly to Haley's Ditch.


Figure 17.Wetland 6

Wetland 6 is a 0.018-ac riverine oxbow wetland that is adjacent to the walking trail. A drainage culvert discharges to the wetland but drains only a small area and will ultimately rely on hydrology primarily from overbank flows and precipitation.

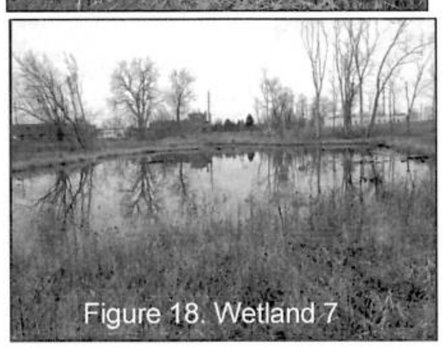


Figure 18. Wetland 7

Wetland 7 is a 0.90-ac riverine wetland that occupies the majority of the western portion of the restoration project in the North zone. This wetland has multiple inlets where floodwaters can access the area. Observations throughout the year suggest that approximately 0.5 inches of rainfall begins to supply water from Haley's Run. A large part of this wetland has remained inundated throughout the year. The average depth in the wetland is approximately 1 ft with a maximum depth just over 2 ft.

4.0 Native Plant Restoration

A significant planting effort of native trees, shrubs, live cuttings and herbaceous species was undertaken to replace the lost vegetation and create a foundation for ecological recovery. Proposed native species and seed mixes varied depending on whether they were planted in a restored floodplain, upland or wetland area (Table 3). The original design plan established the quantity and diversity of the different species. However, the actual placement of the trees and shrubs were determined in the field by visual placement. The plant installation focused not only on complete coverage of the restoration area but also utilizing groups and clusters of vegetation to increase success of similar species. A total of 1077 woody plants, 42% (452) trees and 58%(625) shrubs ranging in size from 2 gallon pots to 4-5 inch caliper trees were installed on the site. Planted trees consisted of 17% (77) native white pine while the remaining 83% (375) were deciduous species.

During 2011, approximately 10 trees had exhibited mortality. A maintenance event was completed on October 18, 2011 and approximately 20 trees were planted to replace those that had not survived and to further augment the plant community of the project area. In 2012, several of these 20 trees also exhibited mortality, but most survived. Over seeding of native grass species was again conducted in some upland areas to discourage spread of invasive species from adjacent properties, most notably Japanese Knotweed. Spray treatment of the invasives was also performed during late summer/early fall. Additionally, approximately 324 wetland plugs were planted in the wetland areas on April 28, 2012. Most planting effort was spent in the large north wetland to encourage vegetative dispersal and establishment within the open water portion of the wetland.

Table 3. Native Species List

Floodplain / Riparian	
Herbs	
Genus/Species	***Common Name***
Agrimoniaparviflora	Small-flowered agrimony
Bidenscernua	Nodding Bur Marigold
Bromusaltissimus	Wild Brome Grass
Carexcrinita	Fringed sedge
Carexintumescens	Bladder sedge
Carexlurida	Lurid sedge
Carexvulpinoidea	Fox sedge
Elymusriparius	Riverbank wild rye
Elymus virginicus	Virginia Wild Rye
Eupatorium fistulosum	Joe Pye Weed
Eupatorium maculatum	Spotted Joe Pye Weed
Impatiens capensis	Jewelweed
Juncus effusus	Soft rush
Leersiaoryzoides	Rice cutgrass
Monardafistulosa	Wild bergamot
Poapalustris	Fowl bluegrass
Panicumclandestinum	Deertongue
Penstemon digitalis	Tall White Beard tongue
Rudbeckiahirta	Black Eyed Susan
Verbesinaalternifolia	Wingstem
Shrubs/Trees	
Genus/Species	***Common Name***
Acer rubrum	Red maple
Betula nigra	River birch
Cornus sericea	Red osier dogwood
Liquidambar styraciflua	Sweetgum
Platanus occidentalis	American sycamore
Salix interior	Sandbar willow
Ulmus americana	American elm
Viburnum dentatum	Arrow wood
Viburnum lentago	Nannyberry

Wetlands	
Herbs	
Genus/Species	***Common Name***
Alismasubcordatum	Water plantain
Asclepiasincarnata	Swamp milkweed
Bidensfrondosa	Beggar Ticks
Carexcrinita	Fringed sedge
Carexlupulina	Hop sedge
Carexlurida	Lurid sedge
Carexscoparia	Broom sedge
Carextribuloides	Blunt broom sedge
Carexvulpinoidea	Fox sedge
Carexfrankii	Frank's sedge
Eleocharispalustris	Creeping Spike Rush
Eupatorium fistulosum	Joe Pye Weed
Eupatorium maculatum	Spotted Joe Pye Weed
Eupatorium perfoliatum	Boneset
Glyceria striata	Fowl manna grass
Hibiscus moscheutus	Rose mallow
Iris versicolor	Blue flag
Juncus canadensis	Canada rush
Juncus effusus	Soft rush
Leersiaoryzoides	Rice cutgrass
Lobelia cardinalis	Cardinal flower
Lycopus americanus	Water horehound
Mimulus ringens	Monkey flower
Onocleasensibilis	Sensitive fern
Polygonumarifolium	Halberdleaftearthumb
Scirpuscyperinus	Woolgrass
Sisyrinchiumangustifolium	Blue-eyed grass
Spiraeabetulifolia	CorymbedSpiraea
Verbena hastata	
Shrubs/Trees	
Genus/Species	***Common Name***
Cephalanthus occidentalis	Buttonbush
Cornus amomum	Silky Dogwood
Cornus sericea	Red osier dogwood
Quercus bicolor	Swamp White Oak
Sambucus canadensis	Common elderberry

Upland	
Herbs	
Genus/Species	***Common Name***
Agrostis alba	Redtop
Aster macrophyllus	Bigleaf aster
Aster laevis	Smooth blue aster
Aster novae-angliae	New England aster
Echinacea purpurea	Purple Coneflower
Elymuscanadensis	Canada Wild Rye
Elymus virginicus	Virginia Wild Rye
Schizachyriumscoparium	Little Bluestem
Solidagorigida	Stiff goldenrod
Rudbeckiahirta	Black Eyed Susan
Sorghastrumnutans	Indian grass
Shrubs/Trees	
Genus/Species	***Common Name***
Acer saccharinum	Silver maple
Acer saccharum	Sugar maple
Amelanchier sp.	Serviceberry
Carpinuscaroliniana	American hornbeam
Cornus racemosa	Gray dogwood
Liquidambar styraciflua	Sweetgum
Liriodendron tulipifera	Tulip poplar
Nyssa sylvatica	Sour gum
Pinusstrobus	White pine
Quercus rubra	Red oak
Rhusaromatica	Fragrant sumac
Rhusglabra	Smooth sumac
Rhustyphina	Staghorn sumac

4.1 Tree Installation

A majority of the trees were installed with the assistance of a machine powered 3 ft auger. Holes were drilled to a depth approximately 0.5-1.0ft greater than root ball depth. Width of the hole drilled was expanded to at least 2X root ball width. Prior to drilling the hole the topsoil was preserved to one side of the hole to allow for use as backfill around the rootball. The hole was backfilled to the appropriate depth such that the top of the rootball was either flush or slightly lower than the surrounding finish grade. Excess material was used to create a water retention ring around the tree. Trees were watered to remove air spaces in the newly backfilled dirt (Figure 19).

Figure 19. Installed Tree

4.2 Shrub Installation

Shrubs were installed into hand dug holes. Topsoil was first preserved to one side of the hole. The hole was expanded to at least 2 times the container size and 0.25 to 0.5 ft greater in depth. Shrubs were carefully loosened from the pot and roots massaged from the root bound condition and placed into the hole flush or slightly below the surround finish grade. Shrubs were watered to remove air spaces in the newly backfilled dirt (Figure 20).

Figure 20. Installed Shrub

4.3 Live Stake Installation

Fast growing species such as willow and silky dogwood were focused along the stream banks in the form of live cuttings for bank stability and habitat (Figure 21). A total of 1,300 live cuttings were harvested (1,000) from northeast Ohio and purchased (300) from Ernst Seeds in Meadville PA. Live cuttings must be installed during the dormant season or early spring, therefore cuttings were installed in March and April. Cuttings were installed on approximately 3-5 ft centers along both banks of 1,200 ft of channel of the South and Middle zone completed in the Fall of 2009. A limited number of live stakes were installed in the North zone along the first meander bend downstream of Landon Street corner (~Station 11+00).

Figure 21.Live Stake Installed

A live cutting was typically installed using a 3 ft length of rebar ¾ inch diameter to create a pilot hole approximately ¾ of the length of the live cutting to be installed. The hole was created at a slight angle downstream in the direction of stream flow. Live cuttings were hammered into place with a rubber mallet. Damaged material resulting from installation was trimmed.

4.4 Native Seed Installation

Following topsoil placement to finish grade, a combination of temporary quick-grow annual ryegrass and the appropriate native seed mix were installed. The annual ryegrass was installed with a broadcast drop spreader at a rate of approximately 50lbs/acre. The annual rye grass provided quick germination and soil stabilization. Germination was observed as short as 5-7 days following seeding. All native seed was hand spread at a rate of approximately 15lbs/acre. Native seed was hand spread due to the varying seed sizes and weight of the different species that is not conducive to broadcast spreaders.

Overall, the stand of grass that has developed throughout the site has been excellent. Native species are maturing in all three work zones, while some remnants of the annual ryegrass still exist throughout the site. Overseeding with native species continues during monitoring events and site visits to discourage spread of exotic and invasive species.

5.0 Habitat Restoration

Habitat restoration was a key component of the restoration project. The basis for a majority of the improvement came from the large amount of trees and understory that the remediation was required to remove. By request, a large portion of this material was stockpiled for re-use. A total of 100 trees were marked between the three zones for stockpiling that ranged in size from 8-20 inch caliper. Stockpiled material also aimed at keeping branches, trunks and as much of the existing condition of the tree as possible. Prior to placement, trees were cut to length when necessary.

5.1 In-stream Woody Habitat

Woody material is an important component of headwater stream ecosystems and therefore woody debris was installed to form several different types of habitat that can be described as log-vanes, brush layering and log revetments (Figures 22-24). Thirteen woody habitat structures were installed throughout the project length. Specific woody debris locations, alignment, type and size was designed in the field at the discretion of the restoration biologist due to the variability of each location and source of wood. Installation of these structures generally occurred before finish grade. This approach allows logs to be buried into the bank, anchored with boulders and/or held into place with wooden "pins" that are essentially 3-5 inch diameter branches cut to a point. The length and diameter of the woody material comprising the habitat structure generally ranged from 10-20 feet in length and a diameter of 6-12 inches. All structures were installed at low angles, shallow slopes 2-5% and minimal protrusion heights to minimize risk with the structure relating to scour and flow affects. One structure at the beginning of the straight section in the North zone (just upstream of the Seiberling culvert) was a concaved log placed across the stream to maintain a scour pool, but also functions to capture debris before washing downstream to block the culvert.


Figure 22. Log Vane


Figure 23. Log revetment / brush layering


Figure 24. Brush Layering

5.2 Woody Debris Deadfall


Figure 25. Deadfall Placement

Following topsoil placement, woody debris and logs were placed at locations in the floodplain and wetlands. The deadfall was generally placed at an angle with the flow of water. The deadfall provides additional habitat for wildlife and mimics the natural conditions of a wooded corridor and floodplain. Figure 25 provides an example of the amount and appearance of the deadfall prior to mature grass growth.

5.3 Qualitative Habitat Evaluation Index (QHEI)

Existing in-stream habitat was evaluated with the QHEI which is a standard subjective evaluation performed by the Ohio EPA (Table 4). Prior to restoration, Haley's Ditch scored a 55.25 out of 100 possible points. Typically, scores greater than 60 have sufficient habitat to support a WWH fish community. The results from Haley's Ditch suggest that the existing habitat has a marginal capability to meet WWH standards. Major limiting factors to the site related primarily to channel morphology (Metric 3), diversity of in-stream habitat (Metric 2) and riffle-pool quality (Metric 5). Riffle quality was generally poor with shallow depths consisting of moderately embedded substrates. Pool depth was considered average, but the number of quality pools was limiting.

Table 4. Existing Conditions QHEI Summary

Haley's Ditch	Metric Score
Metric 1. Substrate 20pts max	12
Metric 2. In-Stream Cover 20 pts max	12
Metric 3. Channel Morphology 20 pts max	10
Metric 4. Riparian 10 pts max	4.75
Metric 5. Riffle Pool Quality 20 pts max	8.25
Metric 6. Gradient 10 pts max	8
Total Score	55.25

The restoration project focused on improving the limiting habitat conditions described above. A second post-restoration evaluation was performed in July 2012 on a reach in the South zone. The results indicate a score of 76, which is an improvement of 7 points over the as-built score, and an improvement of 20.75 compared to the pre-construction QHEI score of 55.25 (Table 5).

Table 5. Post-Restoration, Year 1 and Year 2 QHEI Summaries

Haley's Run As-Built	Metric Score
Metric 1. Substrate 20 pts max	17.5
Metric 2. In-Stream Cover 20 pts max	11
Metric 3. Channel Morphology 20 pts max	14.5
Metric 4. Riparian 10 pts max	6
Metric 5. Riffle Pool Quality 20 pts max	12
Metric 6. Gradient 10 pts max	8
Total Score	69

Haley's Run Year 2	Metric Score
Metric 1. Substrate 20 pts max	17.5
Metric 2. In-Stream Cover 20 pts max	15
Metric 3. Channel Morphology 20 pts max	17
Metric 4. Riparian 10 pts max	6
Metric 5. Riffle Pool Quality 20 pts max	13.5
Metric 6. Gradient 10 pts max	8
Total Score	77

Haley's Run Year 3	Metric Score
Metric 1. Substrate 20 pts max	18
Metric 2. In-Stream Cover 20 pts max	14
Metric 3. Channel Morphology 20 pts max	16.5
Metric 4. Riparian 10 pts max	6
Metric 5. Riffle Pool Quality 20 pts max	11.5
Metric 6. Gradient 10 pts max	8
Total Score	74

Comparison of the pre- and post-restoration habitat indicates improvement in most metrics with the most substantial improvement in substrate (Metric 1). Channel morphology and development was also improved due to the new pattern and riffle-pool creation. In-stream cover increased substantially this year contributing markedly to stream function and habitat for fish and wildlife. This resulted in the most notable metric increase.

6.0 Summary

The restoration is demonstrating an outstanding basis for recovery through its focus of reversing the historical impairments and the impacts to habitat and morphology caused by remediation, and continues to improve ecological function. The project created a meandering stream with riffles and pools of varying slopes, depths and lengths that provide a strong foundation for habitat and stream function. The imported stream substrates placed and compacted to finish grades provide stream bed stability and habitat for fish and macroinvertebrates. Strategic placement of woody debris added quality habitat, bank stability, and erosion protection in numerous areas throughout the corridor. The restored floodplain elevations provide the benefit of energy dissipation, stormwater management and fine sediment storage.

A fair amount of wildlife has been observed within the project area in 2011. Mammals observed include muskrat, white-tailed deer, and grey squirrel, among others. Although an electrofishing sampling event has not been conducted, several species have been observed and netted, including creek chub, blacknose dace, and central stoneroller. A variety of bird species have also been observed. Mallards, Canada geese, kingfisher and great blue heron are among the waterfowl utilizing the larger wetland areas. A variety of songbirds as well as at least one warbler species have been observed using the floodplain and wetland areas. Amphibian species observed during 2012 included American toad, pickerel frog, and tadpoles of various species. No reptile species have yet been observed during monitoring activities.

The photos from 2012 are added to the before and after comparison from established photo locations to visually appreciate the scope of change from post-remediation to years 1–3 post-restoration.

Representative Project Zone Photos Before and After

Post-Remediation

Photo 1. South Zone

Photo 2. Middle Zone

Photo 3. North Zone facing south

Post-Restoration