June 2017 Version 1.0

Approved: July 6, 2017

TINKER'S CREEK 04110002 05 02 Headwaters Tinker's Creek (HUC 12)

Nine-Element Nonpoint Source Implementation Strategic Plan (NPS-IS Plan)

Developed by:

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Acknowledgements

Tinker's Creek Watershed Partners (TCWP) would like to thank the Central Lake Erie Basin (CLEB) Collaborative, West Creek Conservancy and Chagrin Valley Engineering Ltd. for helping coordinate the stakeholder meetings, reviewing the plan, and for providing mapping assistance. TCWP is also grateful to CLEB Collaborative for the online survey that was used to gather more information from community leaders and project partners living and working in the watershed. Some introductory portions of the plan were adapted from the initial *Tinker's Creek Watershed Action Plan* which was developed by Cuyahoga County Board of Health (CCBH) and Tinker's Creek Watershed Partners and endorsed by the Ohio EPA in 2008. The *Nine-Element Nonpoint Source Implementation Strategic Plan (NPS-IS Plan) Ottawa River-Frontal Lake Erie: Tenmile Creek HUC-12 (04100001 03 06)* also served as a template for this plan.

The following Tinker's Creek Watershed Partners team and staff are acknowledged for their contribution to this report: Babette Gowda and Jennie Brancho.

The Chagrin Valley Engineering Ltd. (CVE) team for GIS data acquisition and maintenance, the creation of the Stream Resource Database, the Urban Sub-watershed Initiative, impervious surface, canopy and other natural resource datasets.

The Northeast Ohio Regional Sewer District (NEORSD) for sharing their biological data and potential stormwater projects with the development team. Then last but not least the West Creek Conservancy, for being the fiscal agent for the project and grant applicant. Without their guidance leadership this project would not have been possible.

This publication was financed in part or totally through a grant from the Ohio Environmental Protection Agency and the United States Environmental Protection Agency, under the provisions of Section 319(h) of the Clean Water Act of 1972.

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Chapter1: Introduction

This document addresses the **Headwaters Tinker's Creek HUC-12 (04110002 05 02)**. Tinker's Creek is the largest tributary to the Cuyahoga River with a watershed drainage area of 96.4 square miles. The main stem of Tinker's Creek is approximately 30-miles long and its watershed traverses four (4) counties in northeast Ohio (Portage, Geauga, Summit and Cuyahoga).

Headwaters Tinker's Creek has a watershed drainage area of 25.25 square miles and drains areas within Portage and Summit counties. Sub-watersheds included in this HUC-12 are Hudson Springs, Tinker's Creek State Park, Bell Run and Tinker's Creek Headwater.

As State and Federal nonpoint source funding now relies upon the development of an NPS-IS plan, this NPS-IS plan must be accepted by both the USEPA and Ohio EPA as meeting the 9-minimum element requirements as outlined in the USEPA's *Handbook for Developing Watershed Plans to Restore and Protect our Waters*. Tinker's Creek Watershed Partners and its collaborators including watershed members and communities, local agencies and other conservation organizations recognize the importance of strategic project implementation as we seek to address the impairments within Tinker's Creek watershed.

1.1 Background

This NPS-IS is an update to the fully endorsed *Tinker's Creek Watershed Action Plan June 2010* which incorporates all 3 HUC-12 watersheds. This document has provided a starting point for initial project implementation to improve and protect the waters of Tinker's Creek with an emphasis on critical areas within each HUC-12.

1.2 Watershed Profile & History

Tinker's Creek headwaters (Headwaters Tinker's Creek 04110002 05 02) begins in Franklin Township, Portage County meandering north to its confluence with the Cuyahoga River (Town of Twinsburg – Tinker's Creek 04110002 05 04) in the Village of Valley View. As it flows north the main stem of Tinker's Creek is fed by several tributary streams. One tributary, Pond Brook (HUC 12 - 04110002 05 01) begins in the City of Aurora at Pond Brook Lake flowing through Reminderville and heading south to its confluence with the main stem at the municipal boundary between the City of Twinsburg and Twinsburg Township.



Figure 1: Tinker's Creek Watershed Location Map



Figure 2: Headwaters Tinker's Creek HUC-12 Watershed Location Map



Figure 3: Photograph of Tinker's Creek, view looking upstream from Seasons Road; Streetsboro, Portage County

Prior to 1786, Ottawa Indians inhabited the watershed, specifically along the ridges adjacent to Tinker's Creek Road in Walton Hills and Valley View. However, as settler encroachment and westward expansion ensued, those Ottawa settlements disappeared. Shortly thereafter, a Moravian mission established itself. The pilgrims called it Pilgerruh or "Pilgrims Rest." In 1797, the Connecticut Western Reserve Land Company began to survey the land. A gentleman named Moses Cleveland lead the survey crew along with a Principal Boatman named Joseph Tinker. Because no convenient communication technology existed then, all documents and recordings were meant to be hand delivered. On a journey back to Connecticut, Joseph Tinker drowned in a boating accident. Out of homage to him and his dedicated work, Pilgerruh was renamed Tinker's Creek.

In 1987, the Great Lakes Water Quality Agreement formed to reverse the devastation from industrial pollution, dedicating 43 Areas of Concern (AoC) across the Great Lakes. In 1988, the Cuyahoga Remedial Action Plan Coordinating Committee determined the boundaries of the Cuyahoga AoC, which included the Tinker's Creek watershed. The Great Lakes Water Quality Agreement calls for Remedial Action Plans (RAPs) to restore and protect 10 beneficial uses in the Cuyahoga AoC. An impaired beneficial use means a change in the chemical, physical, or biological integrity of the Great Lakes system to which the Cuyahoga River flows too. Therefore, the Tinker's Creek watershed is an integral part of the process to "delist" the Cuyahoga River as an AoC.

Four (4) park districts have conserved land within the watershed, including the Ohio Department of Natural Resources Tinker's Creek State Park. In addition Cuyahoga Valley National Park and Cleveland Metroparks Bedford Reservation meet at the confluence of the Cuyahoga River and Tinker's Creek. Bedford Reservation is the largest protected area within the watershed and contains a National Natural Landmark named Tinker's Creek Gorge, which includes a Scenic Overlook, Bridal Veil Falls, and the Great Falls of Tinker's Creek.

All 24 communities within the Tinker's Creek watershed are considered Phase 2 communities. This requires those communities to submit and perform requirements for stormwater management under the National Pollution Discharge Elimination System program (NPDES). Tinker's Creek Watershed Partners are working with many of those communities to assist them with Public Involvement Public Education (PIPE) to help satisfy those requirements set forth in the permit.

1.3 Public Participation and Involvement

The original watershed action plan was finalized by TCWP and endorsed by the state in 2010. Extensive input from community representatives, consultants, and agencies was utilized to identify water quality issues throughout the watershed. The WAP has been the organization's guiding document to implement planned projects and to help identify new projects. As projects were completed, TCWP remained in contact with communities to address arising concerns. At least once each year, TCWP met with each community to inquire about issues and followed up with them throughout the year. To further address needs within the watershed, TCWP has been communicating with agencies such as Ohio EPA, ODNR, and several park districts on water quality, protected lands, and potential projects.

In 2014, TCWP worked with community partners to solicit and identity new projects. These efforts included meeting with community leaders and consultants to identify problem areas in communities and possible solutions. Seven new projects were identified and conceptual plans were added to the WAP.

In order to ascertain the key challenges going forward and update the WAP to a Nine-Element Plan, TCWP utilized a survey that went out to community representatives and project partners throughout the watershed. The survey was sent to 154 individuals that ranged from municipal employees, project consultants, park districts, and local government agencies that work within the watershed. Along with the survey, TCWP requested potential project ideas from community members. Phase II updates were sent to the community watershed representatives each month from September 2016 to March 2017 with important information about the NPS-IS update process.

TCWP held our annual Mayors' Breakfast in March of 2017 where we solicited additional input from the attendees on issues in their communities. In attendance included mayors, city managers, stormwater representatives, and engineers from the watershed communities. Information on critical areas, issues in the watershed, and potential projects were confirmed and/or provided at this meeting.

All this input from watershed partners has helped us to establish critical areas and projects that will help bring these areas into attainment. As the Nine-Element Plan is intended to be a working document, we will continue to work with our partners in the watershed to update the document and add additional projects that will help us reach our attainment goals and objectives.

Chapter 2: Watershed Characterization and Assessment Summary

2.1 Watershed Characterization

2.1.1 Physical and Natural Features

Tinker's Creek is the largest tributary to the Cuyahoga River with a watershed drainage area of 96.4 square miles. The main stem of Tinker's Creek is approximately 30-miles long and the watershed traverses across four (4) counties in northeast Ohio (Portage, Geauga, Summit and Cuyahoga). Elevations in the watershed vary, with the highest elevation point being 1,200 feet above mean sea level and the lowest point lying at 620 feet above mean sea levels where Tinker's Creek flows into the Cuyahoga River.

The physiographic features of the watershed are those characteristics related to both the topography and geology of the basin. Tinker's Creek is located within the Glaciated Appalachian Plateau physiographic region, which consists predominately of silty loam and clayey loam soils. Portions of the stream are on bedrock, which forms waterfalls that act as a natural barrier to the passage of fish. Lower stream portions have carved the Tinker's Creek Gorge, which is listed as a National Natural Landmark within the National Park Service's program(Source: Ohio EPA, Division of Surface Water), (Source: *Kerr + Boron (Tinker's Creek Watershed Conservation Priority Plan*). Carved by glaciers and ancient streams, this region is less hilly and lacks the rugged quality of the unglaciated landscape.

Slopes vary greatly within the Tinker's Creek watershed, ranging from steep gorge areas where the river has cut its way down through bedrock to gentle slopes, flat areas, marshes, and wetlands. Rock outcroppings exist in several areas. The pattern of slopes within the watershed is gentle, with the steepest gradients found along the stream banks and where Tinker's Creek flows into the Cuyahoga River. Deeply incised and steep slopes define the valley and gorges nearer this confluence point, partially as a result of increased downstream erosion due to higher water flows and dredging of the 6.5 mile Cuyahoga Shipping Channel. Steep slopes generally have the highest erosion potential from runoff or from channel undercutting of the stream banks. Identifying the steepest slope areas that either would contribute to higher erosion potential or offer the most value for sensitive and unique habitats is a focus. For example, many portions of the middle Tinker's have steep slopes that create waterfalls and other unique topographic areas.

Other physical characteristics notable within the Tinker's Creek watershed are Class 2 & 3 impoundments and dams, most of which are privately maintained, three (3) of which are within Headwaters Tinker's Creek HUC-12.

Soils are also assigned to hydrologic soil groups. Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration soils. Only the soils that is in their natural condition and are in Group D are assigned to dual classes. The predominant soil series in the Headwaters Tinker's Creek HUC-12 is as follows:

Ellsworth series – deep soils that are moderately well drained and slowly or very slowly permeable; slopes 2 to 70%.

Mahoning series – deep soils that are somewhat poorly drained and slowly or very slowly permeable; slope ranges from 0 to 6%.



Figure 4: Headwaters Tinker's Creek HUC-12 Underlying Soil Series Map

Tinker's Creek has a greater number and acreage of wetlands when compared to any other tributary in the lower Cuyahoga River area. Tinker's Creek contains approximately 951 wetlands or 3,917 acres of wetlands throughout the three (3) HUC 12 sub-watersheds in Tinker's Creek watershed. Like most other impacted watersheds, the range of wetland quality depends on the location within the watershed.

The more urbanized locations in Tinker's Creek contain lower quality wetlands than areas that are currently developing or have not been developed yet. ORAM scores were deduced from previous field investigations performed by the Cuyahoga RAP, Davey Resource, and Enviroscience Inc. Clearly, a significant amount of moderate to high quality wetlands exists in the watershed; according to acres and number. Tinker's Creek has a relatively rich wetlands inventory, and consequently, a need to protect these important water resources. In addition, the Tinker's Creek Wetland Prioritization Plan 2007/2008, shows all 951 wetlands have been identified.

Of those wetlands, 421 are thought to be non-forested. Of the non-forested wetlands in the watershed, the total acreage for those identified is 2,224 acres.

The U.S. Fish and Wildlife Service is the principal federal agency tasked with providing information to the public on the status and trends of wetlands within the United States. This data is shared via the National Wetlands Inventory (NWI). The following Figure indicate wetlands areas within the Headwaters Tinker's Creek HUC-12 sub-watershed as identified by the NWI.



Figure 5: Headwaters Tinker's Creek HUC-12 National Wetland Inventory Map

The Ohio Department of Natural Resources (ODNR), Division of Wildlife (DOW) maintains the Natural Heritage Database. A review of this database indicates there are 14 animals and 57 plants listed within the Tinker's Creek watershed (see Tables 1 and 2.).

Scientific Name	Common Name	State Status
Catocala gracilis	Graceful Underwing	Endangered
Childonias niger	Black Tern	Endangered
Myotis sodalis	Indiana Bat	Endangered
Opheodrys vernalis	Smooth Green snake	Endangered
Clemmys guttata	Spotted Turtle	Threatened
Gomphaeschna furcillata	Harlequen Darner	Threatened
Condylura cristata	Star-nosed Mole	Species of Concern
Etheostorna exile	Iowa Darter	Species of Concern
Hemidactylium scutatum	Four-toed Salamander	Species of Concern
Porzana carolina	Sora Rail	Species of Concern
Rallus limicola	Virginia Rail	Species of Concern
Gallinago gallinago (delicata)	(Wilson's) Common Snipe	Special Interest
Troglodytes troglodytes	Winter Wren	Special Interest

Table 1: State Listed Animal Species in Tinker's Creek watershed

Scientific Name	Common Name	State Status	Scientific Name	Common Name	State Status
Carex arctata	Drooping Wood Sedge	Endangered	Carex lasiocarpa	Slender Sedge	Potentially Threatened
Cornus canadensis	Bunchberry	Endangered	Carex pallescens	Pale Sedge	Potentially Threatened
Cypripedium parviflorum var. parviflorum	Small Yellow Lady's- slipper	Endangered	Carex straminea	Straw Sedge	Potentially Threatened
Galium labradoricum	Bog Bedstraw	Endangered	Castanea dentata	American Chestnut	Potentially Threatened
Hypnum pretense	Wrinkled-leaved Marsh Hypnum	Endangered	Chamaedaphne calyculata	Leather-leaf	Potentially Threatened
Juniperus communis	Ground Juniper	Endangered	Corallorhiza maculate	Spotted Coral-root	Potentially Threatened
Melampyrum lineare	Cow-wheat	Endangered	Cornus rugosa	Round-leaved Dogwood	Potentially Threatened
Myrica pensylvanica	Bayberry	Endangered	Deschampsia flexuosa	Crinkled Hair Grass	Potentially Threatened
Tomentypnum nitens	Fuzzy Hypnum Moss	Endangered	Equisetum sylvaticum	Woodland Horsetail	Potentially Threatened
Carex bushii	Bush's Sedge	Threatened	Eriophorum viridicarinatum	Green Cotton Grass	Potentially Threatened
Carex diandra	Lesser Panicled Sedge	Threatened	Gentianopsis crinite	Fringed Gentian	Potentially Threatened
Calopogon tuberosus	Grass-pink	Threatened	Gentianopsis procera	Small Fringed Gentian	Potentially Threatened
Corydalis sempevirens	Rock-harlequin	Threatened	Geum rivale	Water Avens	Potentially Threatened
Cypripedium reginea	Showy Lady's-slipper	Threatened	Larix larcina	Tamarack	Potentially Threatened
Elymus trachycaulus	Bearded Wheat Grass	Threatened	Persicaria robustior	Coarse Smartweed	Potentially Threatened
Epilobium strictum	Simple Willow-herb	Threatened	Phegopteris connectilis	Long Beech Fern	Potentially Threatened
Melanthium virginium	Bunchflower	Threatened	Platanthera flava	Tubercled Rein Orchid	Potentially Threatened
Potentilla palustris	Marsh Five-finger	Threatened	Poa paludigena	Marsh Spear Grass	Potentially Threatened
Rhododendron periclymenoides	Northern Rose Azalea	Threatened	Potamogeton natans	Floating Pondweed	Potentially Threatened
Salix candida	Hoary Willow	Threatened	Prenanthes racemosa	Prairie Rattlesnake Root	Potentially Threatened
Sisyrinchium mucronatum	Narrow-leaved Blue- eyed Grass	Threatened	Rhynchospora alba	White Beak-rush	Potentially Threatened
Solidago squarrosa	Leafy Goldenrod	Threatened	Salix myricoides	Blue-leaved Willow	Potentially Threatened
Sparganium androcladum	Keeled Bur-reed	Threatened	Salix serissima	Autumn Willow	Potentially Threatened
Viburnum alnifolium	Hobblebush	Threatened	Shepherdia canadensis	Canada Buffalo-berry	Potentially Threatened
Viburnum opulus var. americanum	Highbush Cranberry	Threatened	Sphenopholis pensylvanica	Swamp-oats	Potentially Threatened
Calla palustris	Wild Calla	Potentially Threatened	Triantha glutinosa	False Asphodel	Potentially Threatened
Carex alata	Broad-winged Sedge	Potentially Threatened	Triglochin palustris	Marsh Arrow Grass	Potentially Threatened
Carex bebbii	Bebb's Sedge	Potentially Threatened	Zigadenus elegans	White Wand-lily	Potentially Threatened
Carex flava	Yellow Sedge	Potentially Threatened			

Table 2: State Listed Plant Species within Tinker's Creek watershed

The U.S. Fish and Wildlife Service (USFWS) maintains a database of federally listed species that can occur within Ohio by County. For the four (4) Counties (Cuyahoga, Summit, Geauga and Portage) that Tinker's Creek watershed is present in. The USFWS indicates as follows: federally endangered - Piping Plover (*Charadrius melodus*), Kirtland's Warbler (*Dendroica kirtlandii*), Indiana Bat (*Myotis sodalis*), Mitchell's Satyr Butterfly (*Neonympha mitchellii mitchellii*); federally threatened - Northern Monkshood (*Acotinum noveboracense*), Rufa Red Knot (*Calidris canutus rufa*), Northern Long-eared Bat (*Myotis septentrionalis*) and Eastern Massasauga (*Sistrurus catenatus*).

Although the Bald Eagle (*Haliaeetus leucocephalus*) has been de-listed as an endangered species, it is still protected under the Migratory Bird Act, the Bald and Golden Eagle Act, as well as the Lacey Act. USFWS includes the Bald Eagle for all counties in Ohio as a Species of Concern.

Inventories of invasive species have not been conducted for the Tinker's Creek watershed in its entirety. The Ohio EPA has identified the two most common invasive fish species in collections from 2000-2008 as gizzard shad and carp. To date, there have been no reports of any of the Eurasian goby species in the watershed. Other potentially harmful invasive aquatic animal species include zebra mussels, not yet noted in the watershed, and the rusty crayfish (*Orconectes rusticus*), most likely in the watershed. Negative impacts on the watershed associated with the rusty crayfish are not known at this time.

In addition, a number of plant species have invaded the aquatic/semi aquatic habitat which may have negative impacts on the watershed and its associated wetlands. In general invasive plant species out-compete native plants, resulting in decreased plant diversity, as well as choking off habitat niches, along with chemical impacts associated with decaying biomass. Plant species which fit this classification include reed canary grass (*Phalaris arundinacea*), narrow-leaved cattail (*Typha angustifolia*), buckthorn (*Frangula alnus*), common reed (*Phragmites australis*), garlic mustard (*Alliaria petiolata*), Japanese honeysuckle (*Lonicera japonica*), Japanese knotweed (*Polygonum cuspidatum*), purple loosestrife (*Lythrum salicaria*), multiflora rose (*Rosa multiflora*) and Eurasian water milfoil. While present in the watershed, large scale impacts attributable to these species have not yet been investigated.

Name	Permit #	Class	Owner/	Owner	Location	Receiving	Date	Purpose	Impoundment	Dam
			Туре			Stream	Built		Туре	Туре
Hudson	Exempt	3	Public,	Hudson	Hudson	Tributary	1948	Recreation,	Dam And	Earthfill
Springs			Local	Township		To Tinkers		Public	Spillway	
Lake Dam				Board Of Park		Creek				
				Comm.						
Trail Lake	Exempt	3	Private	William &	Streetsboro	Tributary	Unkno	Fish	Dam And	Earthfill
Dam				Margaret F.		То	wn	Hatchery	Spillway	
				Gressard		Tinker's				
						Creek				

Table 3: Tinker's Creek Watershed Dams

2.1.2 Land Use and Protection

Headwaters Tinker's Creek HUC-12 (04110002 05 02) has a watershed drainage area of 25.25 square miles and drains areas within the following communities found within Summit and Portage counties: Hudson (Summit County); Aurora, Streetsboro, Franklin Township, Village of Sugar Bush Knolls (Portage County).



Figure 6: Headwaters Tinker's Creek Community Map (04110002 05 02)

The late 1990s and 2000s saw significant residential development within the outlying suburbs of both Cleveland and Akron including the municipalities of Twinsburg and Aurora. This HUC-12 still maintains a rural feel. The Tinker's Creek watershed is fortunate in that it has protected lands at the federal, state, county, and local levels.

In 2014 Summit Metro Parks entered into an agreement with the Ohio State Parks to manage Tinker's Creek State Park and Tinker's Creek State Nature Preserve (355 acres) located within the Headwaters Tinker's Creek HUC-12. Land use within this HUC-12 is characterized as the following: 44.10% developed, 31.00% forest, 15.00% grass/pasture, 5.40% row crop and 4.50% other (water) (Ohio Environmental Protection Agency Integrated Report, 2016).



Figure 7: Headwaters Tinker's Creek Land Use Map (04110002 05 02)



Figure 8: Un-named tributary within industrial development (view looking upstream & Mondial Parkway.);

Streetsboro, Portage County.



Figure 9: Un-named tributary within residential development (view looking upstream at Highridge Dr.);

Streetsboro, Portage County.

2.2 Summary of Biological Trends

The Ohio EPA completed a TMDL for the Lower Cuyahoga River basin and it was approved by the US EPA in September 2003. Within the Tinker's Creek Watershed portion of the TMDL, several water quality issues were identified. Sedimentation, organic enrichment, low in-stream dissolved oxygen, nutrient enrichment, toxicity, habitat alteration, as well as yet to be determined impairments, were considered the main water quality issues facing Tinker's Creek. These unknown impairments could be contributed to the Streetsboro waste water treatment plant's (WWTP) which discharge into this watershed. Please see Figure 12: Tinker's Creek watershed Qualitative Habitat Evaluation Index Scores, Figure 13: Tinker's Creek watershed Invertebrate Index Scores and Figure 14: Tinker's Creek watershed Index of Biological Integrity Scores.

The Tinker's Creek headwaters originate in wetlands in Portage County. Habitat impairments reflect a historically dredged stream in various stages of recovery. Poor flow heterogeneity and a significant sediments load contribute to the known ecological impairments. Increased turbidity limits habitat for fish as well as diversity of species present. Nutrient levels have been shown to be elevated throughout the watershed. Rapid development and poor stormwater management are the two (2) key influencing factors. Lower habitat scores are found in the Twinsburg area where influences from upstream flow pattern changes continue. Channel destabilization and entrenchment are common in this section of the watershed on both the main stem and tributaries.

The Ohio EPA collected intensive biological community, chemical water quality, and physical habitat data in the assessment unit from 2006 to 2008. This undertaking was in support of ongoing efforts to determine effects of trace pharmaceuticals on biological communities and aquatic life use attainment status in the Tinker's Creek basin. Scores and attainment uses from the Ohio EPA's 2016 Integrated Water Quality Monitoring and Assessment Report can be found in the table below (Table 6).

Sample Station Name	River Mile	ALU Type	Sampling Year	IBI Score	QHEI Score
Tinker's Creek near		Non			
Hudson @ ST RT 82	24.50	WWH	2006	26	63
Tinker's Creek @		Non			
Hudson-Aurora Rd	25.05	WWH	2009	26	54.5
Tinker's Creek SE of					
Hudson @ Seasons		Non			
Rd	28.80	WWH	2006	34	47
Trib to Tinker's Creek					
(25.44/0.18/0.93)		Non			
Dst. I-80	0.6	WWH	2013	30	28.5

Table 4: Headwaters Tinker's Creek HUC-12, OEPA Aquatic Life Use Monitoring Sites



Figure 10: Headwaters HUC-12, In-stream habitat example with culverted stream section; Hudson, OH



Figure 11: Un-named tributary in Headwaters HUC-12, example of stream morphology showing loss of sinuosity



Figure 12: Tinker's Creek watershed Qualitative Habitat Evaluation Index Scores



Figure 13: Tinker's Creek watershed Invertebrate Index Scores



Figure 14: Tinker's Creek watershed Index of Biological Integrity Scores

2.3 Summary of Pollution Causes and Associated Sources

The Ohio EPA's 2016 Integrated Water Quality Monitoring and Assessment Report has determined the cause(s) of impairment within the Headwaters Tinker's Creek HUC-12 watersheds are as follows:

- Organic enrichment/Dissolved Oxygen
- Oil and grease
- Nutrients
- Natural limits (wetlands)
- Flow alternation
- Direct habitat alterations
- Cause unknown

The major nonpoint source impacts in the watershed are a result of suburbanization and urbanization. Impacts associated with these sources include an increased sediment load to the streams, which result in decreased substrate heterogeneity and overall habitat quality. This is observed in many smaller tributaries and the Tinker's Creek main stem from its headwaters into Twinsburg. Increases in impervious surface area also results in flashier stream flows which are partially responsible for channel incision and bank destabilization, both noted as occurring in the watershed.

Total Maximum Daily Load (TMDL) Pollutant Load Allocations – The following information provided is from the Lower Cuyahoga River TMDL, which was completed and finalized in September 2003. Flows in the lower section of Tinker's Creek are highly influenced by the discharge of treated wastewater from upstream WWTPs. In 1991, the combined effluent had a median discharge of 11.623 mgd or 17.9 cubic feet per second (cfs). The 1996 Tinker's Creek water chemistry data collected at RM 0.1 showed no exceedances of WQS criteria. However, nitrate concentrations continue to be markedly elevated with a mean 6.81 mg/l compared to the 1991 mean of 7.6 mg/l. In contrast to lower Tinker's Creek, the median nitrate concentration from similarly sized reference streams in the EOLP ecoregion is 0.425 mg/l (n=298) (Ohio EPA 1999c). The excessive nitrates reflect the effluent dominated nature of the creek and improved ammonia nitrification at the major municipal WWTPs in the basin. These levels could limit biological potential in Tinker's Creek. Other factors, such as barriers to fish migration (i.e. waterfalls located downstream at RM 5.6), excessive turbidity, or other unknown causes and sources of impairment may contribute to the non-attainment.

Eight (8) watershed stressors have been identified through the TMDL report: organic enrichment, nutrient enrichment, low in-stream dissolved oxygen, toxicity, sedimentation, habitat degradation, bacteria, and yet unknown impairments. Increased amounts of organic material in the system stem from loss of the riparian area, lawn clippings, and yard waste. Increased nutrients are speculated to be caused by loss of the riparian area, urbanization, use of lawn fertilizers, pet and wildfowl waste, and loss of a consistent tree canopy. Low levels of dissolved oxygen can cause a reduction in biological diversity. Decomposing organic material and high nutrient levels cause both algal blooms and corresponding decay when those plants die off, each of which depletes the water of oxygen – especially in the summer months. The input of non-point source pollution from the surrounding landscape coupled with the effluent discharges has created toxic conditions for biological species as well. The combination of several water quality degraders produces these toxic conditions.

In addition, Tinker's Creek experiences very high sediment loading caused from significant increases in storm water loading, which is correlated to the high amounts of impervious cover in the watershed (21%). Tinker's Creek watershed, like most urban watersheds, continues to experience a net loss of habitat both for terrestrial and aquatic species alike. Low QHEI scores throughout most of the watershed are caused by loss of riparian areas, poor water quality, loss of connectivity to green corridors, and urbanization. The high bacterial levels in the watershed are caused by failing septic systems, Combined Sewer Overflows (CSOs), and non-point source pollution from impervious land cover. The "yet unknown impairments" allude to a water quality degrader which is of unknown composition. Evidence of pharmaceutical compounds negatively influencing aquatic biology is being studied as a direct cause of the unknown impairments.

Tinker's Creek is an effluent dominated stream and can consist of over 75% effluent during low-flow periods in the summer. The WWTP are the largest contributors of flow to the stream; other dischargers exist in the basin but are not included in this evaluation. Between 1960 and 1970, the basin saw an 83% increase in median stream flows, most likely due to population increases in the suburban communities, which resulted in increased flows to the wastewater treatment plants. Over the years, many improvements have been made at the individual plants, which have resulted in the high level of treatment and excellent compliance records seen today. This has resulted in improved macroinvertebrate communities generally meeting goals of the Clean Water Act. Fish communities in the watershed, namely tributaries and Tinker's Creek upstream of the natural waterfall, continue to show signs of impairment. In this case, the discharges from the plants are one of several factors considered responsible for the impairment.

The Ohio EPA in conjunction with USGS and the local communities with discharging WWTP's to Tinker's Creek have partnered to study the impact of effluent outputs from the plants to Tinker's Creek. Because Tinker's Creek has seven WWTP's within its drainage basin, it makes the watershed a unique study area for the impact of pharmaceuticals on aquatic species and biological diversity. The data is currently being analyzed and may provide insight into a growing issue which many water bodies will ultimately face. The study focuses on why fish populations are showing no improvement in the upper main stem while QHEI scores remain relatively stable. The increase of pharmaceutical and personal care products usage, and a growing population makes this study and future studies even more important to water quality initiatives. Elevated nutrients and turbidity are also being evaluated as possible stressors to this system.



Figure 15: Headwaters HUC-12 outfall/outlet (view looking downstream at Blue Heron Ln) Hudson, Summit County.

2.4 Additional Information for Determining Critical Areas and Developing Implementation Strategies

Tinkers Creek Watershed Partners have used several studies and survey feedback in order to determine the critical areas within the HUC-12 watersheds. The groundwork for the critical areas was derived from the attainment and targeted delisting recommendation information from the Tinker's Creek Watershed Action Plan (2010) and the Lower Cuyahoga Total Daily Maximum Load (September. 2003) documents. Although the data in these documents is older, TCWP used them to help narrow down known issues in the watershed.

The Ohio EPA's Water Quality Summary 2016 Integrated Report also provided relevant data and helped TCWP identify attainment issues and associated areas that had similar attainment issues. This information was paired with local knowledge of problem areas gathered from community interactions and through a survey sent to watershed communities and partners that work in the watershed. This helped to identify causes of impairments and potential projects.

Ohio EPA's *Support for the Development of Management Actions in Cuyahoga Area of Concern*, January 2017 by Tetra Tech was also utilized to determine the critical areas. The objective of this study was to develop lists of prioritized proposed management actions for the Cuyahoga AOC. The lists of proposed management actions within this document are considered "living documents". Ohio EPA plans to make revisions as data gaps are filled, new data becomes available, and as additional management actions are identified and implemented.

Town of Twinsburg – Tinker's Creek HUC-12 does not meet the beneficial use impairment (BUI) for degradation of fish populations (#3a) and degradation of benthos (#6) but does meet for loss of fish habitat (#14a). Pond Brook HUC-12 meets the BUI for both degradation of fish populations and loss of fish habitat but does not meet

the BUI for degradation to benthos. Headwaters Tinker's Creek HUC-12 does not meet any of the BUI (3a, 6, 14a). The proposed management actions to remedy these impairments include removal of the barrier or impoundment, restore habitat (in-stream) and/or reconnect water resource and associated floodplain.

Chapter 3: Critical Area Conditions & Restoration Strategies

3.1 Overview of Critical Areas

The following Critical Areas has been identified based on local knowledge of issues, attainment status, geography, and impairments. Critical Area 1: **Headwaters Tinker's Creek HUC-12** (including main stem and other tributaries)

Critical Area 1 is located is the headwaters of Tinker's Creek and is less developed with more forested/grass lands. The range of QHEI scores is actually greater than those in the upper watershed. Lower habitat scores are found in the Twinsburg area where influences from upstream flow pattern changes continue. Channel destabilization and entrenchment are common in this section of the watershed on both the main stem and tributaries. This area of the watershed is still developing at a rapid rate. Many wetlands, fens, and marsh areas populate this part of the watershed while development is promoting additional pressure on the natural resources to function and perform in a manner that can accommodate the added water. A few small agricultural plots can be found in this area but they are not heavily farmed.



Figure 16: Critical Area 1, Headwaters HUC-12, including potential projects and OEPA attainment monitoring sites

3.2 Critical Area 1: Conditions, Goals & Objectives

3.2.1 Detailed Characterization

Critical Area 1 encompasses the HUC-10 Headwaters Tinker's Creek sub watershed. Within this critical area, the major causes of impairment are organic enrichment/dissolved oxygen, oil and grease, nutrients, natural limits (wetlands), flow alteration, direct habitat alterations and cause unknown. A TMDL has been developed for organic enrichment/dissolved oxygen, nutrients, siltation, habitat, and bacteria. Land use within this watershed is divided as follows: 44.10% developed, 31.00% forest, 15.00% grass/pasture, 5.40% row crops, and 4.50% other.

Headwaters Tinker's Creek: Detailed assessments of headwater streams within the watershed are limited. It is fair to assume that the number of primary headwater streams (>1 square mile in drainage) has decreased since pre-settlement. These small streams are often lost due to development. There are still high quality headwater streams influenced by groundwater remaining in the watershed in such areas as Twinsburg and Aurora.



Figure 17: Headwaters HUC-12, example 'typical' of Critical Area 1

3.2.2 Detailed Biological Conditions

The headwaters of Tinker's Creek are wetland influenced and support fair quality fish communities, fairly typical of swampy streams. Further downstream, fish communities drop to the poor range downstream from the Streetsboro WWTP. Changes to the watershed include increased stretches of channelized habitat and increased suburban development. Nutrient levels were elevated below the WWTP but other factors, such as barriers to

fish migration (i.e., waterfalls located downstream at RM 5.6), excessive turbidity, or other unknown causes and sources of impairment may contribute to the NON-attainment.

This watershed has been identified to have an impaired Aquatic Life WWH. Intensive biological community, chemical water quality, and physical habitat data were collected in the assessment unit from 2006 to 2008 in support of ongoing efforts to determine effects of trace pharmaceuticals on biological communities and aquatic life use attainment status in the Tinker's Creek basin. Several sources of this impairment have also been identified, including urban runoff/storm sewers (NPS), source unknown, onsite wastewater systems (septic tanks), natural, major municipal point source, and land development/suburbanization.

Sampling within the Tinker's Creek Headwaters provides insight into this impairment. In 2006, one site was sampled in Tinker's Creek State Park. This site scored an IBI of 26 (poor) and a QHEI of 63. Sampling of one site in the Tinker's Creek Headwaters sub-watershed in 2006 yielded an IBI of 34 (fair) and QHEI of 47.

One site sampled within the Tinker's Creek State Park in 2009 scored an IBI of 26 (poor) and a QHEI of 54.5. In 2013, one site was sampled in Hudson Springs. An IBI of 30 (fair) and a QHEI of 28.5 were assigned to this site. The invertebrate community here was also found to be in poor condition.

3.2.3 Detailed Causes and Associated Sources

Causes of Impairment:	Sources of Impairment:
organic enrichment/DO	urban runoff/storm sewers (NPS)
oil and grease	source unknown
nutrients	onsite wastewater systems (septic tanks)
natural limits (wetlands)	natural
flow alteration	major municipal point source
direct habitat alterations	land development/suburbanization
cause unknown	

The Tinker's Creek headwaters originate in wetlands in Portage County. Habitat impairments reflect a historically dredged stream in various stages of recovery. Poor flow heterogeneity and a significant sediment load contribute to ecological impairments. Increased turbidity helps to limit fish community structure. Nutrients are elevated throughout parts of the system. Influences of rapid development with fair to poor storm water management become evident.

Dominant habitat impairments in this critical area include no riffles, high/moderate riffle embeddedness, no fast current, fair/poor development, heavy/moderate silt, recovering channel, sparse/no cover, no sinuosity, silt/muck substrate, and channelized/no recovery.

3.2.4 Outline Goals and Objectives for Headwaters Tinker's Creek Critical Area 1

Headwaters Tinker's Creek HUC-12: Erie-Ontario Lake Plain (EOLP) Warmwater Habitat, 25.25 mi².

The overall nonpoint source restoration goals for any NPS-IS plan are to improve IBI and QHEI scores so that the partial or non-attainment sites can achieve full attainment of the WWH designated aquatic life use for the respective water body. Specific goals applicable to non-attainment sites are outlined below:

Goal 1: Achieve an IBI score of at least 34 at Tinker's Creek near Hudson @ St. Rt. 82 (RM 24.50).

NOT ACHIEVED: Site currently has an IBI score of 26.

Goal 2: Maintain a QHEI score of 63 at Tinker's Creek near Hudson @ St. Rt. 82 (RM 24.50).

ACHIEVED: Site currently has a QHEI score of 63.

Goal 2: Achieve an IBI score of at least 34 at Tinker's Creek @ Hudson-Aurora Rd. (RM 25.05).

NOT ACHIEVED: Site currently has an IBI score of 26.

Goal 3: Achieve QHEI score of at least 60 at Tinker's Creek @ Hudson-Aurora Rd. (RM 25.05).

NOT ACHIEVED: Site currently has a QHEI score of 54.5.

To achieve these goals for Critical Area 1, the following objectives need to be achieved:

Objective 1: Preserve and protect land along riparian areas and important natural features such as wetlands and fens from development through acquisition, revegetation, conservation easements, and LID or conservation development. Increase forest and understory cover protection along riparian areas through the adoption of riparian setbacks and enforcement by communities.

• Plant 50 acres of riparian area along Tinker's Creek and its tributaries.

Objective 2: Increase wetland protection through adoption of wetland setbacks and enforcement in watershed communities, especially in vulnerable headwater communities.

• Restore 50 acres of wetlands/floodplain wetlands in Tinker's Creek.

Objective 3: Restore in-stream habitat utilizing natural channel design to help create habitat and flood plain connectivity to support aquatic life.

• Restore and reconnect a minimum of 3,000 linear feet of stream.

Objective 4: Restore natural flow regimes in Tinker's Creek.

• Daylight 800 feet of stream through culvert removal.

As these objectives are implemented, water quality monitoring (both project related and regularly scheduled monitoring) will be conducted to determine progress toward meeting the identified goals (i.e., water quality standards). These objectives will be reevaluated and modified if determined to be necessary. For instance; many agricultural BMPs can be "stacked" (a systems approach) that will also incrementally improve the quality and quantity of runoff and drainage waters and in-stream water quality.

When reevaluating, the committee will reference the Ohio EPA Nonpoint Source Management Plan Update (Ohio EPA, 2013), which has a complete listing of all eligible NPS management strategies to consider including:

- Urban Sediment and Nutrient Reduction Strategies;
- Altered Stream and Habitat Restoration Strategies;
- Nonpoint Source Reduction Strategies; and
- High Quality Waters Protection Strategies

Chapter 4: Projects and Implementation Strategy

4.1 Projects and Implementation Strategy Overview Table(s) (Overview Table)

or <u>Headwaters Tinker's Creek (HUC-12)</u> (04110002 05 02) —Critical Area 1								
Applicable Critical	Goal	Objective	Project #	Project Title	Lead	Time Frame	Estimated Cost	Potential/Actual
Area					Organization			Funding Source
Altered Strea	m and	Habitat Res	toration St	rategies				
1	1,2,3, 4	1,2,3	1	Hudson Tenbroeck (TC-2)	TCWP, City of	1-3 years	\$191,500	Section 319, GLRI,
				Restoration Project	Hudson			USFWS grants
1	1,2,3,4	3,4	2	State Route 303 Culvert Project	TCWP, City of	1-3 years	\$1,668,919.02	Section 319, GLRI,
				(Stream Restoration)	Streetsboro			USFWS grants
1	1,2,3,4	2,3	3	State Route 14 Drainage Ditch	TCWP, City of	1-3 years	\$769, 664.69	Section 319, GLRI,
				Restoration	Streetsboro			USFWS grants

4.2 Project Summary Sheet(s)

These summary sheets provide the essential nine elements for short-term and/or next step projects that are in development and/or in need of funding. As projects are implemented and new projects developed, these sheets will be updated. Any new summary sheets created will be submitted to the state of Ohio for funding eligibility verification (i.e., all nine elements are included).

Project #1 Summary Sheet

Nine Element Criteria	Information needed	Explanation
n/a	Title	Hudson Tenbroeck (TC-2) Restoration Project – Project #1
criteria	Project Lead	Tinker's Creek Watershed Partners (TCWP)
d	Organization &	City of Hudson
	Partners	Davey Resource Group
criteria	HUC-12 and Critical	04110002 05 02
с	Area	Critical Area 1
criteria	Location of Project	3210 Hudson Aurora Road, Hudson, OH 44236
С		41.262119, -81.394334
n/a	Which strategy is being addressed by this project?	Altered Stream and Habitat Restoration Strategies
criteria f	Time Frame	Short-Term (Priority) (1-3 yr.)
criteria	Short Description	This 3,100 linear feet stretch of Tinker's Creek was channelized, impacting the potential habitat and functions of this stream. Reconnecting the floodplain, improving in-stream habitat, and replanting the area with woody vegetation will improve floodplain functionality and water quality.
criteria g	Project Narrative	A total of fourteen wetlands and four streams, one being Tinker's Creek, were found within the study area. The wetlands are moderate to high quality and include areas of emergent, scrub/shrub, and forested plant communities. All of the wetlands fall into the Ohio Rapid Assessment Method (ORAM) Category 2 or 3 ranges and are abutting or adjacent to streams and/or in the floodplain of Tinker's Creek. To evaluate the potential habitat in Tinker's Creek, the Qualitative Habitat

Evaluation Index (QHEI) was performed on three reaches along this	
stream. The upstream reach, Reach 1, is moderately embedded with	
mostly muck. The stream has been channelized, but there is only fair	
development. This stream reach has many negative habitat characteris	stics
diagnostic of the MWH habitat use. Based on the potential habitat, the	e
middle reach (Reach 2) of this stream is very likely to attain WWH. The	2
maximum pool depths are greater than 0.4 meter; the dominant subst	rate
types are gravel and sand and are moderately embedded; there is fast	
flow; there is moderate cover with four types present; and the	
channelization is not maintained. The substrate of the downstream re	ach,
Reach 3) is dominated by muck, heavily embedded, lacking fast flow, a	nd
lacking sinuosity with fair development. With the multitude of negativ	e
habitat characteristics, it is likely that this reach would not attain WWF	١.
The Index of Biotic Integrity (IBI) was also performed on this reach in 2	009.
The majority of the fish species identified are tolerant species. As this	
stream is in the Erie Ontario Lake Plains Ecoregion, this stream falls into	D
the poor range. The use designation of this segment of Tinker's Creek	is
WWH, per the Ohio Administrative Code, Chapter 3745-1-26 Water	
Quality Standards. According to the 2009 IBI, a portion of this stream i	S
not attaining WWH; and according to both the 2009 and current QHEI,	
portions of this stream are not likely to attain WWH.	
This site also serves as excellent habitat with good connectivity to othe	er
natural areas for two species of bats: the federally endangered Indiana	а
bat (<i>Mvotis Sodalis</i>) and the federally threatened northern long-eared	bat
(Myotis septentrionalis).	
This restoration project will use dredged materials to create a floodpla	in
bench and restore a hydrological connection to the adjacent wetlands	and
floodplain. The area is approximately 575 feet long by 17 feet wide an	d
will be excavated to a depth of approximately 4 to 5 feet. Four modifie	۶d
Newbury rock riffle grade control structures will be installed to improv	e
in-stream habitat and maintain channel elevation. Following construct	ion,
areas near and within the riparian area will be seeded with native plan	ts.
Erosion control matting will be placed along the edge of the streambar	ıks
and anchored with live stakes, including shrubby willows and dogwood	ls.
The excavated floodplain will be planted with larger native trees and	
native smaller trees and shrubs.	
criteria Estimated Total cost Sub-Contractual: The following are the cost estimates combining	
d materials, construction, and permitting as estimated by Davey Resource	e
Group: USACE/OEPA permitting costs an estimated \$5.000: SWPPP	
preparation and coordination \$2,600; engineering and modeling \$20.0	00;

		\$2,300; construction and oversight \$135,200; and plant and seed
		installation \$19,700. In total the project is expected to cost \$191,500.
criteria	Possible Funding	Section 319(h) grants, GLRI and USEWS.
d	Source	
criteria	Identified Causes and	Causes: direct habitat alterations, flow alterations
а	Sources	Sources: land development, suburbanization
		Sources, land development, subdi banization
criteria b & h	Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?	The goals are to achieve an IBI score of at least 34 at Tinker's Creek @ Hudson-Aurora Rd. (RM 25.05) at a site that currently has an IBI score of 26; achieve an IBI score of at least 34 at Tinker's Creek near Hudson @ St. Rt. 82 (RM 24.50) at a site that currently has an IBI score of 26; achieve a QHEI score of at least 60 at Tinker's Creek @ Hudson-Aurora Rd. (RM 25.05) at a site that currently has a QHEI score of 54.5; to maintain a QHEI score of 62 at Tinker's Creek near Hudson @ St. Rt. 82 (PM 24.50) at a site
		that has a score of 63.
		Reasonable objectives are:
		Objective 1: Preserve and protect land along riparian areas and important natural features such as wetlands and fens from development through acquisition, revegetation, conservation easements, and LID or conservation development. Increase forest and understory cover protection along riparian areas through the adoption of riparian setbacks and enforcement by communities.
		 Plant 50 acres of riparian area along Tinker's Creek and its tributaries.
		Objective 2 : Increase wetland protection through adoption of wetland setbacks and enforcement in watershed communities, especially in vulnerable headwater communities.
		 Restore 50 acres of wetlands/floodplain wetlands in Tinker's Creek.
		Objective 3 : Restore in-stream habitat utilizing natural channel design to help create habitat and flood plain connectivity to support aquatic life.
		• Restore and reconnect a minimum of 3,000 linear feet of stream.
	Part 2: How much of the needed improvement for the	 50 acres of the 50 acres of riparian area planted along Tinker's Creek and its tributaries of objective 1 will be met (100%)
	whole Critical Area is <i>estimated</i> to be accomplished by this	 25 acres of the 50 acres of wetlands/floodplain wetlands restored in Tinker's Creek of objective 2 will be met (50%)

	project?	 1000 linear feet of the 3000 linear feet of in-stream habitat restored and reconnected in Tinker's Creek of objective 3 will be met (33.3%)
		Goals: There is recognition that there is lag time associated with nonpoint source-related projects and measured stream response. With respect to the goals in critical area 1, QHEI will be the main driver as that will dictate the habitability of fish and macroinvertebrates. Current data shows that the QHEI at RM 25.05 is 54.5, which is 5.5 points below the attainment index score of 60. It is expected that the restoration project will substantially improve the QHEI such that it will be at a 60 or better within a year of restoration, and maintain or improve the QHEI score at RM 24.50, currently scoring 63, with incremental increases in the IBI scores for the next several years thereafter. Both RM 24.50 and 25.05 sites currently have an IBI score of 26, with goals to achieve at least an IBI score of 34.
	Part 3: Load Reduced	Estimated 150.6 pounds/year Nitrogen, 80.4 pounds/year Phosphorus, and 24.4 tons/year sediment will be removed as a result of this project.
criteria i	How will the effectiveness of this project in addressing the NPS impairment be measured?	If the project is funded the monitoring will be completed by the sub- contractor for the period as depicted by the required 401 and 404 permits. Thereafter we anticipate staff from the OEPA-DSW Ecological Assessment Unit will perform both pre- and post-project monitoring.
criteria e	Information and Education	At a minimum the project will be highlighted in the TCWP annual report and featured on the TCWP website and social media accounts. In addition information will be provided and education/outreach will comply with all grant and funding source requirements (e.g. 1 fact sheet, 1 press release and 2 web articles).

Project #2 Summary Sheet

Nine Element Criteria	Information needed	Explanation
n/a	Title	SR 303 Culvert Project (Stream Restoration) - Project #2
criteria	Project Lead	Tinker's Creek Watershed Partners (TCWP)
d	Organization &	City of Streetsboro
	Partners	EnviroScience
		AECOM

criteria	HUC-12 and Critical	04110002 05 02
С	Area	Critical Area 1
criteria	Location of Project	Between addresses 299 & 571 on State Route 303, Streetsboro, OH 44241
С		Project Coordinates: 41.239831, -81.378659
n/a	Which strategy is being	Altered Stream and Habitat Restoration Strategies
	addressed by this	
	project?	
criteria f	Time Frame	Short-Term (Priority) (1-3 yr.)
oritoria		The problem even in this stratch of Tinkey's Creek near CD 202 is a ninch
criteria	Short Description	noint associated with a culvert too small for the stream it is meant to carry
		This project will remove historic fill separating Tinker's Creek from its
		adjacent floodplain wetland and add sinuosity to the existing channel
criteria	Project Narrative	The main stem of Tinker's Creek flowing under SR 303 culvert was ditched
g		and channelized through the entire project reach for drainage and
		development. In the project area, Tinker's Creek is moderately incised with
		streambank neights approaching 5 it., causing erosion and channel
		community but is inaccessible during frequent storm events and exhibits
		signs of degradation by drainage ditches and invasive species on both sides.
		Pockets of native scrub/shrub vegetation are prevalent but any open areas
		are generally dominated by invasive species.
		Three metal corrugated culverts convey flow under SR 303, but all the
		outlets are submerged; two are partially blocked. Flooding is a concern. The
		low road elevation and limited capacity of the culverts are limiting factors in
		restoration concept designs. Assuming a bridge will eventually replace the
		ineffective culverts, a restoration approach for the reach upstream of SR 303
		will reverse known impairments of incision and channelization by restoring a
		meandering channel in a raise grade approach while still being cognizant of
		flooding issues.
		The project area spans an existing channel length of ~3,575ft. Area 1
		consists of 706 ft. of restoration with construction of a new channel to the
		west of an open field/wetland area. The new channel will be 30 ft. wide and
		2.15 ft. deep on average. Excavation from the new channel will fill in the
		existing channel. This area will establish a proper channel/floodplain
		channel will be impounded for a short time until the natural bodiese of the
		channel will be impounded for a short time until the natural bedioad of the

		stream can adjust. The channel will not be re-meandered downstream of Area 1 in effort to save the extensive woody vegetation here.
		Area 2 (2,414 ft.) will continue with the raise grade approach by constructing a new channel at the appropriate floodplain/channel relationship. The design increases slope to compensate for the 1.5-2.0 ft. of elevation associated with the raise grade reaches. Therefore, floodplain excavation (avg. width 150-175ft) will maintain an accessible floodplain with the changing gradient. Excavated material will be placed into the existing alignment to the appropriate floodplain elevation. However, the existing channel does not have the capacity to spoil the entire amount; thus, an estimated 2,000CY will be hauled off-site. The project crosses to a proposed riffle location ~130ft downstream to improve the hydraulic efficiency and capacity of the crossing. It is recommended that 1-2 grade control riffles be installed downstream of the crossing and to place dump rock scour
		The completed project area shall be planted with native species with woody species along the streambanks as well as woody vegetation to provide competition for invasive species and invasive treatment over 116 acres.
criteria d	Estimated Total cost	Sub-Contractual: The following estimates for sub-contractual costs were calculated by EnviroScience: final design and permitting (15% of construction) costs were estimated at approximately \$148,975.92; coordination (5% of design) \$7,448.80; construction \$993,172.82; site stabilization erosion and sediment control \$51,636.39; native plantings \$85,000.00; invasive species treatment (116 acres) \$75,000.00; environmental oversight \$65,000.00; monitoring for environmental permit (5 years) \$25,000.00; and project contingency (15% of subtotal) \$217,685.09. Total sub-contractual costs are estimated to be approximately \$1,668,919.02.
criteria d	Possible Funding Source	Section 319(h) grants, GLRI, USFWS
criteria a	Identified Causes and Sources	Causes: flow alteration, direct habitat alterations, natural limits (wetlands) Sources: land development/suburbanization

criteria b & h	Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?	 The goals are to achieve an IBI score of at least 34 at Tinker's Creek @ Hudson-Aurora Rd. (RM 25.05) at a site that currently has an IBI score of 26; achieve an IBI score of at least 34 at Tinker's Creek near Hudson @ St. Rt. 82 (RM 24.50) at a site currently has an IBI score of 26; achieve a QHEI score of at least 60 at Tinker's Creek @ Hudson-Aurora Rd. (RM 25.05) at a site that currently has a QHEI score of 54.5; to maintain a QHEI score of 63 at Tinker's Creek near Hudson @ St. Rt. 82 (RM 24.50) at a site that has a score of 63. Reasonable objectives are: Objective 3: Restore in-stream habitat utilizing natural channel design to help create habitat and flood plain connectivity to support aquatic life. Restore and reconnect a minimum of 3,000 linear feet of stream. Objective 4: Restore natural flow regimes in Tinker's Creek. Daylight 800 feet of stream through culvert removal.
	Part 2: How much of the needed improvement for the whole Critical Area is <i>estimated</i> to be accomplished by this project?	 1000 linear feet of the 3000 linear feet of in-stream habitat restored and reconnected in Tinker's Creek of objective 3 will be met (33.3%) 800 linear feet of 800 linear feet of stream daylighting in Tinker's Creek of objective 4 will be met (100%) Goals: There is recognition that there is lag time associated with nonpoint source-related projects and measured stream response. With respect to the goals in critical area 1, QHEI will be the main driver as that will dictate the habitability of fish and macroinvertebrates. Current data shows that the QHEI at RM 25.05 is 54.5, which is 5.5 points below the attainment index score of 60. It is expected that the restoration project will substantially improve the QHEI such that it will be at a 60 or better within a year of restoration, and maintain or improve the QHEI score at RM 24.50, currently scoring 63, with incremental increases in the IBI scores for the next several years thereafter. Both RM 24.50 and 25.05 sites currently have an IBI score of 26, with goals to achieve at least an IBI score of 34.
	Part 3: Load Reduced	69.0 pounds/year Nitrogen, 35.5 pounds/year Phosphorus, and 26.4 tons/year sediment will be removed as a result of this project.
criteria i	How will the effectiveness of this project in addressing the NPS impairment be measured?	If the project is funded the monitoring will be completed by the sub- contractor for the period as depicted by the required 401 and 404 permits. Thereafter we anticipate staff from the OEPA-DSW Ecological Assessment Unit will perform both pre- and post-project monitoring.
criteria e	Information and Education	At a minimum the project will be highlighted in the TCWP annual report and featured on the TCWP website and social media accounts. In addition

information will be provided and education/outreach will comply with all
grant and funding source requirements.

Project #3 Summary Sheet

Nine Element Criteria	Information needed	Explanation
n/a	Title	SR 14 Drainage Ditch Restoration – Project #3
criteria	Project Lead	Tinker's Creek Watershed Partners
d	Organization &	City of Streetsboro
	Partners	EnviroScience
criteria	HUC-12 and Critical	04110002 05 02
С	Area	Critical Area 1
criteria	Location of Project	Nearby Address: Home Depot, 9585 OH-14, Streetsboro, OH 44241
С		Project Coordinates: 41.252718, -81.366400
n/a	Which strategy is being addressed by this project?	Altered Stream and Habitat Restoration Strategies
criteria f	Time Frame	Short-Term (Priority) (1-3 yr.)
criteria	Short Description	This area has impaired two tributaries located on south of Route 14 behind a Home Depot that enter into a man-made retention pond before becoming over-wide ditches. The project will remove berms separating streams from their floodplains, add curves/meanders, and control invasive species.
criteria g	Project Narrative	This area has two impaired, poor quality headwater tributaries located on the south side of Route 14 behind a Home Depot. Stream 1 flows under SR 14 from north to south for approximately 1,500ft before its confluence with Stream 2 which flows from the east. Both streams then enter into a man-made retention pond. Stream 1 exhibits bank erosion and down cutting. The immediate riparian zone is relatively intact, providing a 50- 100ft buffer. Stream substrates are primarily cobble and gravel in the

		upper reaches. As the stream transitions into the lower valley, the constructed pond causes sediments to drop out of the water column and
		aquatic life.
		Downstream of the pond outlet, the streams become over-wide ditches. The low quality wetland communities on either side of them are dominated by invasive species. An additional significant impairment is the hydrologic separation between the wetland communities and the ditch through elevation changes and earthen berms. Several large berms supporting access roads cross the property. Drainage ditches continue to
		flow to the west through a berm and culvert before turning south. The site has numerous impairments affecting water quality and habitat, namely the routing of streams through an impoundment and the hydrologic separation. Sediment transport of the system is interrupted by the impoundment, and an alternative should be evaluated to continue this necessary function downstream.
		The project will restore stream and wetland function while still satisfying the original design intentions. The western berm separating the existing stream from the northern wetland cell will be removed to an appropriate elevation. Riffles will be installed in the existing channel alignment. The stream will then be diverted back into the general alignment of the ditch traveling to the west. An earthen plug will be installed at the entrance to the open water cell at the appropriate elevation. A meandering channel will be constructed along the ditch alignment. Flow will then continue west through an opening in the existing berm. If desired, this location could be suitable for a water control structure that constricts storm flow without preventing fish passage. Once through the berm, the conceptual
		channel alignment is shifted south through firmer ground to help constructability in this reach. The final design will be designed in a manner to use the existing wetlands and ground elevations as the bankfull/active floodplain elevation to the maximum extent possible. The final grade control structure should be re-installed or significantly modified to ensure both base flow and storm flow is conveyed through the intended design inverts. To compensate for the significant drop in gradient, a series of raise grade riffles will transition the grade down to the existing.
criteria d	Estimated Total cost	<u>Sub-Contractual:</u> EnviroScience provided the following design-build cost estimates: final design and permitting (17% of construction) is estimated to cost \$66,368.02; coordination (5% of design) \$3,318.40; construction \$390,400.14; site stabilization erosion and sediment control \$28,187.08; native plantings \$80,000; invasive species treatment \$40,000;

criteria d criteria a	Possible Funding Source Identified Causes and Sources	environmental oversight \$36,000; monitoring for environmental permit (5 years) \$25,000.00; and project contingency (15%) \$100,391.05. Overall, sub-contractual costs are estimated to be approximately \$769,664.69. Section 319(h) grants, GLRI Causes: direct habitat alterations, flow alterations Sources: land development/suburbanization
criteria b & h	Part 1: How much improvement is needed to remove the NPS impairment for the whole Critical Area?	 The goals are to achieve an IBI score of at least 34 at Tinker's Creek @ Hudson-Aurora Rd. (RM 25.05) at a site that currently has an IBI score of 26; achieve IBI score of at least 34 at Tinker's Creek near Hudson @ St. Rt. 82 (RM 24.50) at a site currently has an IBI score of 26; achieve a QHEI score of at least 60 at Tinker's Creek @ Hudson-Aurora Rd. (RM 25.05) at a site that currently has a QHEI score of 54.5; maintain a QHEI score of 63 at Tinker's Creek near Hudson @ St. Rt. 82 (RM 24.50) at a site that has a score of 63. Reasonable objectives are: Objective 2: Increase wetland protection through adoption of wetland setbacks and enforcement in watershed communities, especially in vulnerable headwater communities. Restore 50 acres of wetlands/floodplain wetlands in Tinker's Creek. Objective 3: Restore in-stream habitat utilizing natural channel design to help create habitat and flood plain connectivity to support aquatic life. Restore and reconnect a minimum of 3,000 linear feet of stream.
	Part 2: How much of the needed improvement for the whole Critical Area is <i>estimated</i> to be accomplished by this project?	 25 acres of the 50 acres of wetlands/floodplain wetlands restored in Tinker's Creek of objective 2 will be met (50%) 1000 linear feet of the 3000 linear feet of in-stream habitat restored and reconnected in Tinker's Creek of objective 3 will be met (33.3%) Goals: There is recognition that there is lag time associated with nonpoint source-related projects and measured stream response. With respect to the goals in critical area 1, QHEI will be the main driver as that will dictate the habitability of fish and macroinvertebrates. Current data shows that the QHEI at RM 25.05 is 54.5, which is 5.5 points below the attainment index score of 60. It is expected that the restoration project will substantially improve the QHEI such that it will be at a 60 or better within a year of restoration, and maintain or improve the QHEI score at RM

		24.50, currently scoring 63, with incremental increases in the IBI scores for
		the next several years thereafter. Both RM 24.50 and 25.05 sites currently
		have an IBI score of 26, with goals to achieve at least an IBI score of 34.
	Part 3: Load Reduced	115.0 pounds/year Nitrogen, 57.4 pounds/year Phosphorus, and 35.4
		tons/year sediment will be removed as a result of this project.
criteria i	How will the	If the project is funded the monitoring will be completed by the sub-
	effectiveness of this	contractor for the period as depicted by the required 401 and 404
	project in addressing	permits. There after we anticipate staff from the OEPA-DSW Ecological
	the NPS impairment	Assessment Unit will perform both pre- and post-project monitoring.
	be measured?	
criteria	Information and	At a minimum the project will be highlighted in the TCWP annual report
е	Education	and featured on the TCWP website and social media accounts. In addition
		information will be provided and education/outreach will comply with all
		grant and funding source requirements (e.g. 1 fact sheet, 1 press release).

Works Cited

Homer, C.G., Dewitz, J.A., Yang, L., Jin, S., Danielson, P., Xian, G., Coulston, J., Herold, N.D., Wickham, J.D., and Megown, K., 2015, <u>Completion of the 2011 National Land Cover Database for the conterminous United</u> <u>States-Representing a decade of land cover change information</u>. *Photogrammetric Engineering and Remote Sensing*, v. 81, no. 5, p. 345-354

Appendix A: Acronyms and Abbreviations

A ALU AoC	Aquatic Life Use Area of Concern
<u>B</u> BEHI	Bank Erosion Hazard Index
D DSW E	Division of Surface Water
EOLP EPA	Erie-Ontario Lake Plains Environmental Protection Agency
<u>G</u> GPM GLRI	Gallons Per Minute Great Lakes Restoration Initiative
H HSTS HUC	Home Sewage Treatment Systems Hydrologic Unit Codes
l IBI ICI	Index of Biotic Integrity Invertebrate Community Index
M Mwb	Modified Index of Well-being
N NLCD NWI NPS NPS-IS	National Land Cover Data National Wetlands Inventory Non-Point Source Nonpoint Source Implementation Strategic Plan
ODNR OEPA ORAM	Ohio Department of Natural Resources Ohio Environmental Protection Agency Ohio Rapid Assessment Method
<u>Q</u> QHEI	Qualitative Habitat Evaluation Index
<u>R</u> RM	River Mile

<u>S</u> SWCD SR	Soil and Water Conservation District State Route
T TMDL TSD TCWP	Total Maximum Daily Load Technical Support Document Tinker's Creek Watershed Partner. Inc.
U USDA USGS USFWS	United States Department of Agriculture United States Geological Survey United States Fish and Wildlife Services
W WAP	Watershed Action Plan