TENNESSEE DEPARTMENT OF AGRICULTURE
NONPOINT SOURCE PROGRAM
REQUEST FOR PROPOSALS FY 2017

ATTACHMENT A

Watershed Based Plan

Name of Project: Restoring Turkey Creek to improve the Middle-Fork Forked Deer River

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Watershed Identification (name, location, 12-digit HUC, etc.)**:** Turkey Creek is within HUC: 080102040104 (Fig 1.). The entire Turkey Creek watershed is listed on Tennessee Department of Environment and Conservation's 303(d) list as a result of reduce biological integrity from siltation and physical substrate and habitat alterations. The listed causes of degradation are from stream channelization, crop production, and development.

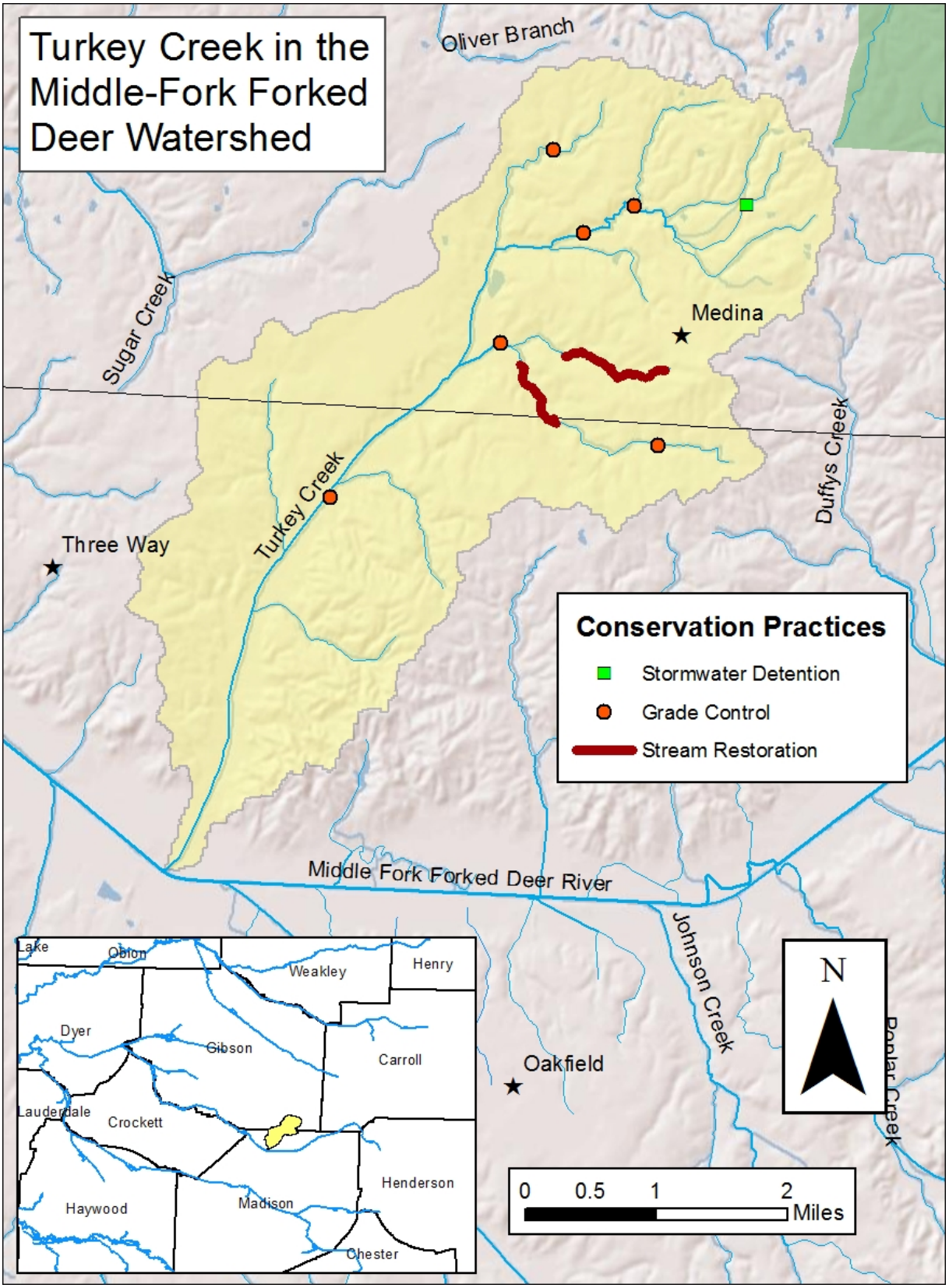

Figure 1. Map of Middle-Fork Forked Deer River system depicting Turkey watershed (in yellow).

Causes and Sources of Nonpoint Source Pollution in the Watershed

Increased development and a deficiency in controlling urban strormwater runoff is causing pollution of the Turkey Creek watershed. Land use in Turkey Creek is 2% wetland, 18% developed (urban), 22% forested, and 58% agricultural. Turkey Creek is impaired due to physical substrate and habitat alteration and has experienced a loss of biological diversity (Tennessee Department of Environment and Conservation 2011). We expect the major source of these impairments is from increased watershed development in recent years. To our knowledge, the entire watershed has been channelized which has directly altered all physical stream habitats and initiated channel incision throughout the watershed. The severe channel incision is currently arrested at many road crossings but is threatening transportation infrastructure and a waste water treatment facility. We expect as development in this region increases, that there will be an additional phase of channel adjustment that will include further channel incision and eventual channel over-widening.

These channel adjustments and resultant sediment pollution will further impair or prevent recovery of biological integrity and will exacerbate flooding issues in the watershed. Increased stormwater runoff from rapid urban expansion is currently causing large channel adjustments such as channel degradation and over-widening. The excessive sedimentation caused by these processes is likely to further degrade biota in the Turkey Creek watershed and will likely impact the Middle-Fork Forked Deer River (MFFDR). Of particular concern, is that the excessive sedimentation will cause a valley-plug in the MFFDR. Valley-plugs often result in significant ponding that causes large timber kills of bottomland forests and typically result in anoxic conditions that degrade biological integrity.

In addition to impairing biota, the current and expected channel adjustments are threatening private landowners, agricultural producers, and infrastructure. Private landowners are currently experiencing rapid land loss in areas where Turkey Creek is over-widening. We expect this problem to continue because urban development is expanding in the watershed and it is likely that channel adjustments will become greater and more rapid. These changes will continue to release large sediment loads to Turkey Creek and the MFFDR and will likely form valley-plugs. Valley-plug formation will lead to increase flood damages to infrastructure and agricultural crops as Turkey Creek and the MFFDR lose their ability to transport excessive flood waters.

Estimate of Load Reductions

Sediment Load Reduction: Down-cutting presents a risk of approximately **140-200k** tons of additional sediment supply above normal supply rate. The existing risk is due to historic channelization that resulted in a degradation which is still active but is being restrained in several areas such as roadway crossings where grade control is in place. The protection of these locations is not sufficient for large (>10yr) storm events and each failure allows propagation of the down cut and triggers channel adjustment through erosion and mass wasting.

Reductions by Individual Measures:

Grade control: Halts active erosion and prevents further mass wasting within a zone of influence upstream of installed structures. **8,000 Tons of sediment storage behind an individual structure.**

Levee Setback: Provides flood water and sediment storage as well as floodplain area that can be accessed for nutrient uptake. **1 Ton per linear foot per inch of sediment**

Detention/infiltration Basin: Reduces storm water peak flows which helps prevent erosion from rapidly rising flood waters and attenuates flood peaks downstream. These basins also serve as sediment storage, reducing the sediment loading downstream. **Effective removal of coarse sands equal to the storage capacity of the detention structure below normal pool elevation.**

Floodplain Restoration/Reconnection: Provides flood water and sediment storage across the floodplain. This reduces shear stresses to help prevent erosion of stream banks. The typically wide floodplains in this area allow for large areas of nutrient uptake and sediment removal. **2 Tons per linear foot per inch of accumulated sediment.**

Bankfull Bench – The bankfull bench provides floodplain relief within an over-widened canal. This approach allows for larger flood flows while maintaining natural stream characteristics such as debris and sediment processing and flood peak attenuation. **1 Ton per linear foot per inch of sediment**

BMP List and Budget

Multiple BMPs are needed in Turkey Creek watershed to address the urban development threats and resulting channel adjustment that pollute and degrade to the Forked Deer River system. West TN River Basin Authority and The Nature Conservancy will work together to determine BMPs that will best reduce non-point source pollution while balancing the needs of landowners, infrastructure, and biota. Below are several BMPs that will be implemented in Madison County to improve hydrologic function and reduce sedimentation.

- **Grade-control Structures:** Headcutting is a common problem in urbanizing streams as they are adjusting to accommodate increased flood magnitudes. Channel incision increases bank failures and transports large amounts of sediment to downstream waterways. Grade-control structures will be installed to arrest the headcuts to prevent further bank degradation and sedimentation of downstream waterways.
- **Bankfull Bench:** Many stream banks are actively eroding and contributing large amounts of sediment due to loss of riparian zones and altered hydrology in urban settings. Bank stabilization will be accomplished by grading banks to stable slopes, installing armoring as needed, and replanting riparian zones to provide the root structure needed to prevent erosion.
- **Stormwater detention/infiltration basin:** Increased runoff from urban areas is generally considered the largest contributor to stream degradation due to subsequent changes in stream channel morphology (e.g., incision). Stormwater detention ponds will be installed where practical to reduce flood peaks, thus mimicking a more natural hydrology and preventing further channel adjustments and sedimentation.
- **Levee set-backs:** Streams that have been channelized and leveed rarely connect with their floodplain and when they do often cause greater flood damage than would normally be expected for a given rain event. Channelization and leveeing also prevents floodplain deposition of sediments and results in greater sediment loads to downstream waterways. Levee set-backs involve moving a stream's levees away from the banks to re-create its floodplain. This allows for more frequent floodplain inundation and results in decreased flood damage, reduced sedimentation (due to deposition in the floodplain), and creates habitat for wildlife.
- **Stream/floodplain restoration:** Channelization of streams reduces physical habitat complexity and is associated with increased sedimentation due to channel incision, relative to more 'natural' meandering streams. Where practical, meanders will be restored in channelized systems as a means to improve physical habitats.

Proposed Conservation Plan Budget			
BMP Name	**Quantity**	**Cost/Unit**	**Budget Estimate**
Grade-control structures	6	$50K/each	$300,000
Stormwater Detention Structures	2	$50K/each	$100,000
Stream Restoration/Levee Setback/ Bankfull Benchcut	5000 lf	$125/lf	$625,000
Total Budget for Watershed Plan:			**$1,025,000**

Timeline, Tasks, and Assessment of Progress

This conservation plan will be implemented in three major phases as described below. Each bullet below represents a chronological sequence of tasks to be completed for this plan.

Phase 1 – Due to the current and impending stream degradation and bank failures, the first phase will involve remediating all acute threats that are contributing large amount of sediment to the watershed. The major tasks involve installing grade-control structures to arrest and prevent further headcut expansion. Additionally, reducing areas of active channel-widening will be necessary to protect property and infrastructure and to reduce sediment loading. These measures will not directly restore channelized habitats but are necessary for the success of future channel restoration work.

Phase 2 – After the major acute sedimentation threats are mitigated and reduced our conservation focus will be on restoring floodplains and channelized streams. During this phase, there will be a focus on detaining excessive stormwater runoff from urbanized areas. We will work with private landowners interested in restoring stream channels and reestablishing bottomland forest floodplains as a means to improve instream habitats and biota. Additionally, these projects will increase flood and sediment storage in an effort to reduce downstream flooding and prevent valley-plug formation.

Phase 3 – Floodplain and channel restoration of the Middle-Fork Forked Deer River will be completed after the threats from Turkey Creek are adequately reduced. This phase will allow for increased floodwater and sediment storage that will more closely mimic natural flooding regimes, thus improving physical habitats and biological integrity.

Criteria to Assess Achievement of Load Reduction Goals

The major criterion to assess load reduction goals will be from detecting measurable improvements in biological integrity (see monitoring section below). Additionally, completion of the above phases and BMPs will determine whether our sediment load reduction goals are met.

Monitoring and Documenting Success

The expected outcome of our watershed plan is to reduce sediment loading and improve the biological integrity of the Turkey Creek watershed and the Middle-Fork Forked Deer River. Therefore, successful completion of this plan is contingent on impacted waterways being removed by TDEC from the 303(d) list. The Nature Conservancy and WTRBA will work with TDEC personnel to adjust the timeline of our watershed plan or the sampling events in the TDEC watershed assessment so that the impacts of our conservation efforts can be documented. Interim progress will be evaluated primarily through monitoring biological indicators downstream of our project

sites. Macroinvertebrate taxa intolerant to disturbance and those sensitive to sedimentation will be used as biological indicators. An increase in indicator abundance will provide a measure of reductions in sedimentation and overall success of our conservation work (Berkman et al. 1986).