Snitz Creek 4 Stream Restoration and Stormwater Retrofit Project
Cornwall Borough, Lebanon County, Pennsylvania

Pennsylvania Department of Environmental Protection
Growing Greener Plus Grants

December 2019

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Prepared for

Doc Fritchey Trout Unlimited

and

Quittapahilla Watershed Association

Prepared by

Clear Creeks Consulting

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Snitz Creek #4 Stream Restoration and Stormwater Retrofit Project
Detailed Project Description

I. Statement of Environmental Need

The Quittapahilla Creek Watershed is situated in the Ridge and Valley physiographic region in Lebanon County, Pennsylvania. Quittapahilla Creek is a tributary to Swatara Creek and is part of the Susquehanna River Basin. Its headwaters begin just southeast of Lebanon, Pennsylvania and it enters the Swatara Creek near North Annville, Pennsylvania.

The major land use in the watershed is agricultural. There are significant areas of urbanization along the Route 422 corridor in the City of Lebanon, West Lebanon, Cleona, and Annville. In addition, new development in the watershed is replacing farms with suburban communities. Past and current land use and land management practices in the rural areas, suburban communities, and urban centers have resulted in degraded water quality, stream bank and bed erosion, sedimentation, flooding, and the loss of riparian and in-stream habitat throughout the Quittapahilla Creek Watershed.

The Pennsylvania Department of Environmental Protection (PADEP) conducted studies in the 1980's and 1990's that indicate impairment of aquatic resources in the Quittapahilla Creek Watershed. In fact, the mainstem as well as all of the major tributaries to the Quittapahilla Creek are listed as impaired in the 303(d) listings. The 2000 305(b) Report prepared by DEP indicates that there are 88.9 miles of stream in the Quittapahilla Creek Watershed. Only 1.82 miles of stream (2%) were found to support designated aquatic life uses. The identified land use activities contributing to impairment include agriculture, crop related agriculture, urban/storm sewers, and bank modification. Sources of impairment include nutrients, siltation, suspended solids, organic enrichment/low dissolved oxygen concentrations, flow alteration, and other habitat alterations.

The Total Maximum Daily Loads (TMDLs) Report (PADEP, 2000) cites excessive sediment and nutrient levels as a major water quality problem in the Quittapahilla Creek Watershed. The report indicates that these pollutants are causing increased algae growth, large accumulations of fine sediments on the streambed, and degradation of in-stream habitat. Although the report attributes the excessive sediment and nutrient levels principally to agricultural activities, these pollutants are also associated with other upland sources (e.g., urban runoff) as well as in-stream sources (e.g., stream bed and bank erosion).

Since 1998, the Quittapahilla Watershed Association (QWA) has been working with a number of private organizations and public agencies to improve the water quality and aquatic habitat of Quittapahilla Creek. However, until 2001 there had been no comprehensive assessment, nor coordinated effort to identify and prioritize water quality, habitat and stream channel stability problems throughout the watershed. As a consequence, targeting of stream reaches for improvements had been on a project-by-project basis.

The QWA believed that their best chance for resolving the existing problems and avoiding future problems was to step back from the project-based approach and develop a comprehensive plan of action based on an assessment of the entire watershed. They believed that this approach would serve to focus funding and restoration and management efforts where they are most needed. They also believed that it is the approach that has the greatest chance for long-term success.

Accordingly, in 2000 the QWA contracted Clear Creeks Consulting to conduct an assessment of Quittapahilla Creek Watershed and develop a restoration and management plan focused on addressing the problems identified by the assessment. In cooperation with the QWA, Clear Creeks formed an interdisciplinary team that included; Skelly & Loy, Inc.; U.S. Fish & Wildlife Service, Chesapeake Bay Field Office; Penn State Institutes of the Environment, Pennsylvania State University; Department of Biology, Lebanon Valley College; and U.S. Geological Survey, New Cumberland Field Office. Supported by Growing Greener Grants received from PADEP in 2001 and 2003, the Assessment Phase of Quittapahilla Watershed Project was completed between 2001 and 2005 and the Planning Phase between 2005 and 2006.

The major components of the Assessment Phase included analysis of natural and man-made watershed characteristics and their influence on the hydrologic and sediment regime of the watershed; geomorphologic stream assessment; subwatershed reconnaissance and analysis; ecological assessment of habitat and biological communities; water quality modeling; water quality monitoring; and problem identification and prioritization. The Planning Phase of the project focused on identifying and prioritizing Best Management Practices (BMPs) to address the problems identified in the subwatersheds and along the main stem of Quittapahilla Creek. This included a comprehensive evaluation and prioritization of general, as well as site specific BMPs for controlling agricultural and urban runoff; and a comprehensive evaluation of general, as well as site specific restoration measures to correct stream stability and habitat problems. In addition, county, city and township land use, land development, environmental, and resource protection policies and programs were evaluated. Recommendations were developed for policies and programs focused on stream, wetland and floodplain protection and management.

At the time the Restoration and Management Plan was prepared, deadlines for meeting MS4 requirements were still years away for the City of Lebanon and the other Townships in the watershed. Undeterred, the QWA resolved to move forward with implementation of the stream restoration projects identified in their Restoration and Management Plan. Utilizing Growing Greener and PA Fish and Boat Commission Grants the QWA proceeded with design, permitting and construction of restoration projects along the mainstem Quittapahilla Creek. The major obstacle slowing their restoration efforts has been a lack of funding. The QWA determined that they would seek other funding sources. In order to qualify for 319 funding they decided to prepare the USEPA required Watershed Implementation Plan (WIP).

Funded by a 2016 Growing Greener Grant, the first steps in developing the USEPA Approved WIP were initiated in March 2017 and involved bringing the QWA members and representatives of local municipalities up to speed on what was involved in the original Quittapahilla Creek Watershed Assessment, what had been accomplished since the completion of Quittapahilla Watershed Restoration and Management Plan, and what remained to be done to prepare a Watershed Implementation Plan. In addition, the QWA formed working committees for each WIP task.

Utilizing the original list of restoration projects from the Restoration and Management Plan, a preliminary projects list was prepared for the Prioritization Committee to review. The four major tributary subwatersheds and each project reach within a subwatershed were evaluated relative to its contribution to pollutant loadings based on water quality modeling, observations recorded during the field reconnaissance survey and subsequent assessments. Projects that fell outside of the QWA's ability to control the outcome, such as those involving removal of concrete flumes, bank stabilization in quarries and on golf courses were dropped from the list.

The Prioritization Committee prioritized the four tributary subwatersheds in descending order, with Snitz Creek being the highest priority, Killinger Creek second, Beck Creek third and Bachman Run fourth. It was agreed that projects would be completed by priority subwatershed starting at the top of the watershed and working in a downstream direction. Projects representing severe conditions and contributing high sediment loadings would warrant moving out of order.

The final WIP document includes pollutant loading reduction estimates by subwatershed and pollutant loading reduction estimates by projects within subwatersheds. Cost estimates for design and permitting, cost estimates for construction, and total project costs were developed for all of the prioritized projects. Specific funding sources were identified for each prioritized project. An implementation schedule was prepared that shows completion of all prioritized projects by 2030. This includes 69 projects in the subwatersheds and 19 projects along the mainstem Quittapahilla Creek.

The WIP also includes a detailed monitoring plan to evaluate the success of the projects in meeting the water quality and habitat objectives of the WIP. QWA and DFTU will assume responsibility for maintenance of individual restoration projects. The WIP also outlines how the QWA will continue their current public outreach and education efforts to enlist support for and promote public participation in the restoration of the Quittapahilla Watershed. The WIP document was submitted for USEPA and PADEP review and approval on September 7, 2018.

In preparing this grant proposal request for Pennsylvania Department of Environmental Protection Growing Greener Grant Plus funds for Fiscal Year 2020, the QWA and DFTU evaluated the list of priority projects identified in our WIP document relative to their goals for 2020. Snitz Creek watershed ranks first among the four subwatersheds covered by our WIP. Snitz Creek, Project #2 was submitted for Water Quality Improvement Projects along the Sunoco Mariner East 2 Pipeline Corridor Grant Program in 2018. That grant application was approved in March, 2019. Design plan development and permitting are currently underway. Snitz Creek, Project #3 is the third on the priority projects list for Snitz Creek watershed and was submitted for Section 319 Nonpoint Source Management funding in July 2019. Project #4 is the fourth on the priority projects list for Snitz Creek watershed and is covered by this application.

Justification for Funding

Pennsylvania Department of Environmental Protection Growing Greener Grant Plus funds are provided to implement Design and Construction Projects that will:

- Directly address causes and sources of impairment as listed in DEP's 2018 Integrated Water Quality Report.
- Reduce nitrogen, phosphorus and sediment pollutants loads from agricultural and urban runoff, by implementing and maintaining Best Management Practices (BMPs).
- Implement stream restoration, bank stabilization and/or stormwater management projects to reduce runoff volumes, increase infiltration, improve water quality and assist in future flood prevention.

As noted, the Total Maximum Daily Loads (TMDLs) Report (PADEP, 2000) cites excessive sediment and nutrient levels as a major water quality problem in the Quittapahilla Creek Watershed. The report indicates that these pollutants are causing increased algae growth, large accumulations of fine sediments on the streambed, and degradation of in-stream habitat. The excessive sediment and nutrient levels are attributed to agricultural activities, urban runoff and stream bed and bank erosion.

The 2018 Integrated Water Quality Report lists this reach of Snitz Creek as impaired with the source of impairment being crop related agriculture and the cause of impairment being siltation.
The Quittapahilla Creek Watershed Implementation Plan identified projects focused on stream bed and bank erosion and impacts associated with agricultural operations. The WIP includes nitrogen, phosphorus and sediment loading reduction estimates by subwatershed and loading reduction estimates by projects within subwatersheds. An implementation schedule was prepared that shows completion of all prioritized projects by 2030. This includes 69 projects in the subwatersheds and 19 projects along the mainstem Quittapahilla Creek.

Snitz Creek watershed ranks first among the four subwatersheds covered by our WIP. Snitz Creek, Project 4 is fourth on the priority projects list for Snitz Creek watershed. It represents an important next step in our continuing effort to implement those projects identified in our WIP for the Snitz Creek subwatershed. It will significantly reduce nutrient and sediment loadings to the Snitz Creek and Quittapahilla Watershed and will ultimately help us meet the TMDL goals for both watersheds.

Proposed Scope of Work

Existing Conditions

The reaches along this part of Snitz Creek were historically straightened. The results of a rapid geomorphic assessment conducted during the summer of 2019 indicated that the stream reaches through this project area are laterally and vertically unstable. Stability problems include bed incision, a high degree of entrenchment, bank erosion, and heavy sedimentation and aggradation (mid-channel and lateral bars). The increased sedimentation has significantly degraded in-stream habitat resulting in shallow pools and riffles that are highly embedded with fine sediments.

Reach 1, immediately downstream of Cornwall Road is highly confined by rip-rap and an old stone wall along the left bank and rubble, rip-rap and a short section of bedrock along the right bank. The wall is in disrepair and failing. Along Reaches 2 and 3, the rear yards of homes on Hillside Street back up to the stream. For some of these residences the dwellings and/or out buildings are situated near or literally at the top of the stream bank. Historically, stonewalls were installed to protect some of these properties. Unfortunately, significant lengths of the walls are in disrepair and failing. Where walls were not installed the high banks are eroding and threaten to undermine structures. Along Reach 4 conditions are somewhat better with lower banks and less erosion. However, the channel is overwide, impacted by heavy sedimentation, there a very few trees and shrubs and the stream banks are overgrown with invasive and exotic weeds and vines. At the downstream end of the reach the channel turns sharply to the right. The channel narrows and high banks along both sides present a significant constriction that creates an upstream backwater under storm flow conditions. The high left bank has large trees that are being undercut by erosion. Along Reach 5 the stream characteristics change again, with high eroding banks, an over-wide channel and heavy sedimentation. The stream banks are overgrown with invasive and exotic weeds and vines and totally lack trees and shrubs. Contributions of runoff from cultivated fields and the lack of shade along this reach is contributing to the growth of thick filamentous algal mats. Although there are trees and shrubs along the streambanks of Reach 6, the height of the banks and confined nature of the channel are contributing to erosion and undercutting of the trees. The following photographs documenting the existing conditions were taken along the project area in July and November 2019.

Looking downstream from Cornwall Road at upstream end of Reach 1

Looking upstream at Cornwall Road Bridge

Rubble along right bank at edge of parking lot

Old stone wall along left bank

Channel confined by stone wall along left bank and rip-rap along right bank

Rip-Rap failing along right bank

Stone wall failing along left bank

Channel confined by stone walls along both banks. Note rip-rap washed in from upstream

Channel confined by stone wall along left bank and rip-rap along right bank

Channel confined by stone wall along left bank and bedrock outcrop along right bank

Failing stone wall

Rubble along left bank

Bank erosion and undercut trees along left bank

Bedrock bottom at upstream end of Reach 2

Broken concrete and tires along toe of right bank

Broken concrete along toe of left bank

Yard waste placed along steep eroding left bank

Eroding left bank with minimal woody vegetation

Bank erosion and failing concrete wall along left bank

Failing concrete toe and stone wall along left bank

Failing stone wall along left bank

Steep eroding left bank with no woody vegetation

Outfall of stormwater management pond along right bank

Bank at upstream end of Reach 3 with all vegetation removed and replaced with scattered loose rock

Erosion and undercut trees along left bank

Failing concrete slabs and rock along left bank

Rubble revetment along left bank

Mid-channel bar, summer (photo above), fall (photo below)

Eroding left bank with some rubble revetment

Erosion along toe of left bank where all vegetation has been removed by landowner

Erosion along left bank where all vegetation has been removed by landowner

Streambanks overgrown with exotic and invasive weeds and vines at upstream end of Reach 4

Overwide section

Short, relatively stable section with woody vegetation

Streambanks overgrown with exotic and invasive weeds and vines

Low terrace with bankfull bench along inside of bend

Overwide section with lateral bar and developing mid-channel bar

Erosion and undercut trees along left bank downstream end of Reach 4

Erosion and undercut trees along left bank downstream end of Reach 4

Lateral and mid-channel bars along upstream end of Reach 5

Erosion along right bank

Vegetated mid-channel bar

Erosion along right bank

Remnants of landowners attempt to stabilize eroding bank

Streambanks over grown with exotic and invasive weeds and vines throughout entire reach

Thick mats of filamentous algae and floating scum

Thick mats of filamentous algae and floating scum

Farm equipment ford crossing

Confined upper section of Reach 6 (top of banks red arrows)

Steep, vertical right bank (top of bank red arrow)

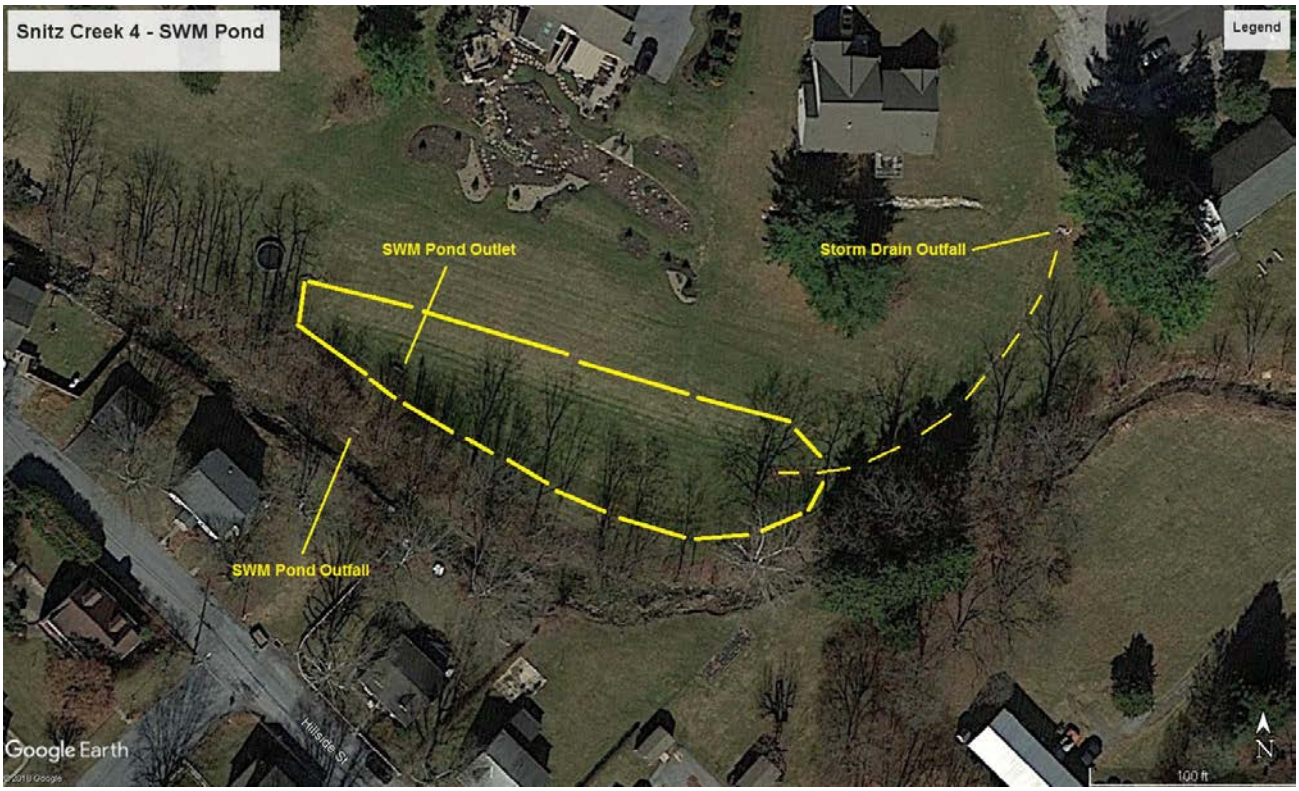
Erosion along left bank

Debris jam and erosion along both banks

Erosion and undercut trees along right bank

Tree roots exposed along entire left bank

Erosion and undercut trees along right bank



Aerial photograph shows existing Cornwall Hills SWM pond with discharge into Reach 2

SD Outfall below Cornwall Hills Drive

Rip-rapped stormwater conveyance swale

View across upper section of SWM pond

SWM pond outlet structure (red arrow)

SWM pond outlet structure

SWM pond outfall structure along Reach 2

Restoration Objectives and Expected Environmental Benefits

The Snitz Creek 4 Project proposes to restore approximately 2,989 linear feet of Snitz Creek from Cornwall Road to the confluence with the Middle Fork of Snitz Creek. In addition, an existing dry detention pond serving Cornwall Hills Subdivision will be retrofitted to provide water quality management of runoff from subdivision that discharges into the project reaches.

The restoration design objectives are to create a stable B4c/C4 stream channel along the project reaches. Concepts of the proposed restoration are included below.

The restoration approach for Reach 1 will involve:

- Removing existing debris jams and junk from the channel;
- Replacing the failing stone wall from the left bank along the upper section with an imbricated rock wall.
- Removing the rip-rap and rubble from the right bank along the upper section and grading a bankfull bench to alleviate the confinement and provide flood relief.
- Removing the failing stone wall from the left bank along the middle section and grading a bankfull bench to alleviate the confinement and provide flood relief.
- The existing rock outcrop along the right bank along the middle section will be left undisturbed.
- Replacing the failing stone wall and rubble from the left bank along the lower section with an imbricated rock wall.
- Grading a floodprone area along the right bank to alleviate the confinement and provide flood relief.
- The newly constructed streambanks and floodprone areas will be stabilized by seeding with native grasses and planting with native trees and shrubs.

The restoration approach for Reach 2 will involve:

- Installing an imbricated rock wall along the eroding left banks.
- Grading a bankfull bench along the right bank to alleviate the confinement and provide flood relief.
- The newly constructed streambanks and floodprone areas will be stabilized by seeding with native grasses and planting with native trees and shrubs.

The restoration approach for Reach 3 will involve:

- Removing existing debris jams and junk from the channel;
- Installing an imbricated rock wall along the eroding left bank along the upper section.
- Grading a bankfull bench along the right bank along the upper section to alleviate the confinement and provide flood relief.
- Replacing the failing stone wall and rubble from the left bank along the middle section with an imbricated rock wall.
- Remove exotic and invasive vegetation along the right bank along the middle and lower section and planting with native trees and shrubs.
- Grading a floodprone area along the right bank to alleviate the confinement and provide flood relief.
- Narrow overwide sections by installing toe benches along channel margin.

The restoration approach for Reach 4 will involve:

- Remove exotic and invasive vegetation along the right bank along the upper and middle section
- Grading a floodprone area along the right bank to alleviate the confinement and provide flood relief.
- Grading a floodprone area along the left bank to alleviate the confinement and provide flood relief.
- Narrow overwide section by installing toe benches along channel margin.
- Along the tight, confined bend at the downstream end of the reach, installing an imbricated rock wall along the eroding left bank, removing trees along right bank and grading a floodprone area to alleviate the confinement and provide flood relief.
- The newly constructed streambanks and floodprone areas will be stabilized by seeding with native grasses and planting with native trees and shrubs.

The restoration approach for Reach 5 will involve:

- Removing exotic and invasive vegetation along both banks along the entire reach.
- Grading a floodprone area along both banks along the entire reach to alleviate the confinement and provide flood relief.
- Narrow overwide sections by installing toe benches along channel margin.
- The newly constructed streambanks and floodprone areas will be stabilized by seeding with native grasses and planting with native trees and shrubs.

The restoration approach for Reach 6 will involve:

- Grading a bankfull bench and floodprone area along both banks along the entire reach to alleviate the confinement and provide flood relief.
- Narrow overwide sections by installing toe benches along channel margin.
- The newly constructed streambanks and floodprone areas will be stabilized by seeding with native grasses and planting with native trees and shrubs.

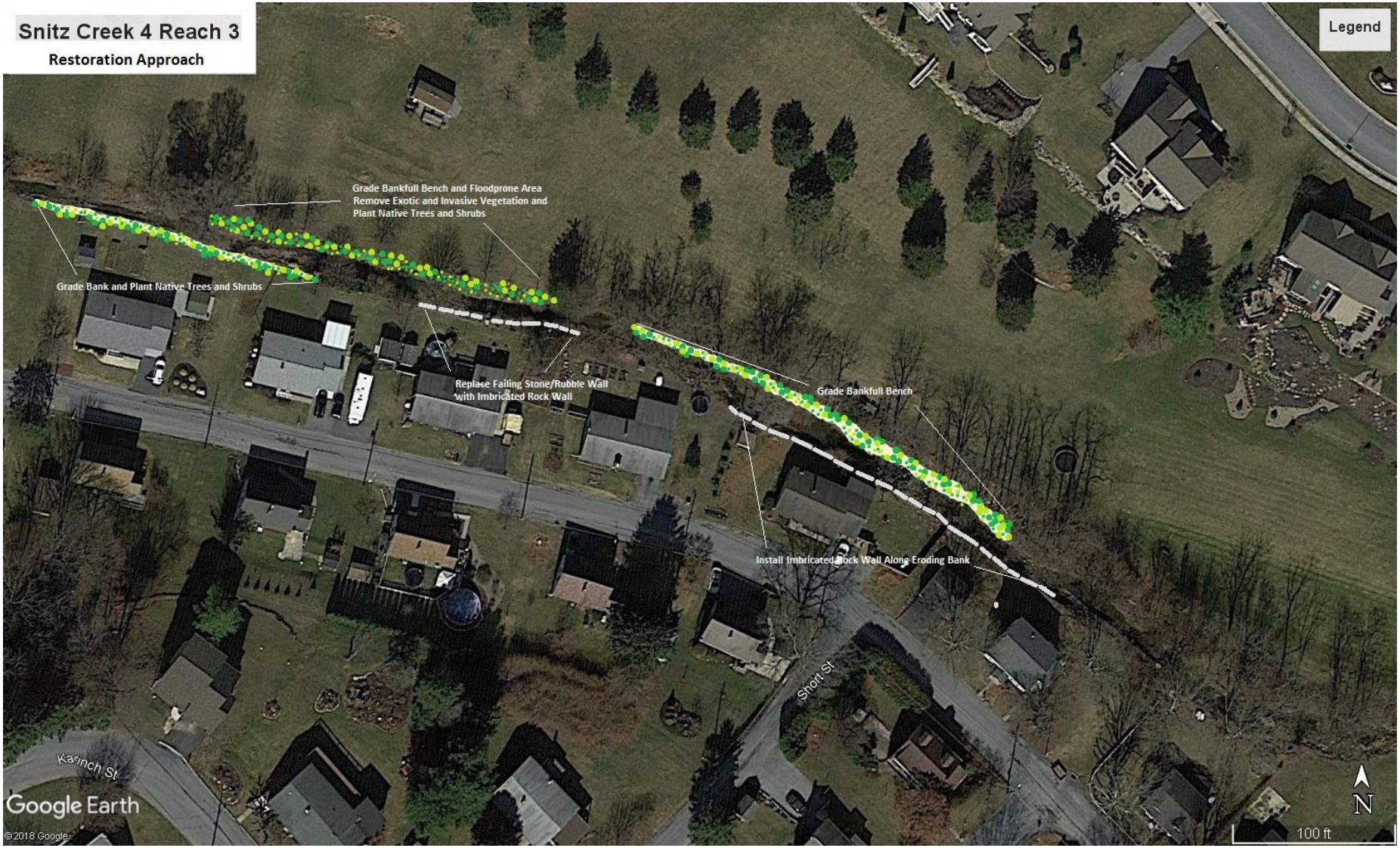
Cornwall Hills Stormwater Pond Retrofit will involve:

- Modify existing dry detention pond serving Cornwall Hills Subdivision along Reach 2 to create extended detention pond and/or bioretention to provide water quality management of runoff from subdivision.
- Existing storm drain outfall below Cornwall Hills Drive and rip-rapped stormwater conveyance swale into pond will not be disturbed.

This project will reduce nitrogen, phosphorus and sediment loadings to Snitz Creek from streambank erosion by 224.2 lbs./yr., 203.3 lbs./yr. and 134,146.3 lbs./yr., respectively. Retrofitting the Cornwall Hills Stormwater Pond will provide additional reductions in nutrients.


Snitz Creek 4 Reach 1
Restoration Approach
Legend
Cornwall Hills Dr
Existing Bedrock Outcrop
Grade Bankfull Bench
Grade Floodprone Area
Remove Failing Stone Wall and
Grade Bankfull Bench
Replace Failing Stone Wall and Rip-Rap
with Imbricated Rock Wall
Replace Failing Stone Wall
with Imbricated Rock Wall
Google Earth
©2018 Google
N
100 ft


Snitz Creek 4 Reach 2
Restoration Approach
Legend
Grade Bankfull Bench
Replace Failing Stone Wall
with Imbricated Rock Wall
Install Imbricated Rock Wall Along Eroding Banks
Short St
Hillside St
Steel St
Google Earth
© 2018 Google
N
100 ft


Snitz Creek 4 Reach 3
Restoration Approach
Legend
Grade Bankfull Bench and Floodprone Area
Remove Exotic and Invasive Vegetation and
Plant Native Trees and Shrubs
Grade Bank and Plant Native Trees and Shrubs
Replace Failing Stone/Rubble Wall
with Imbricated Rock Wall
Grade Bankfull Bench
Install Imbricated Rock Wall Along Eroding Bank
Short St
Karinch St
Google Earth
©2018 Google
N
100 ft


Snitz Creek 4 Reach 4
Restoration Approach
Legend
Grade Floodprone Area
Remove Exotic and Invasive Vegetation, Grade Floodprone Area
Grade Floodprone Area
Install Imbricated Rock Wall Along Eroding Bank
Grade Bank and Plant Native Trees and Shrubs
Hillside St
Google Earth
©2018 Google
N
100 ft


Snitz Creek 4 Reach 5
Restoration Approach
Legend
Remove Exotic and Invasive Vegetation, Grade Bankfull Bench and Floodprone Area
Remove Exotic and Invasive Vegetaion, Grade Bankfull Bench and Floodprone Area
Google Earth
©2018 Google
N
100 ft


Snitz Creek 4 Reach 6
Restoration Approach
Legend
Grade Bankfull Bench and Floodprone Area
Grade Bankfull Bench and Floodprone Area
Lackawanna Dr
Google Earth
©2018 Google
N
100 ft


Snitz Creek 4 - SWM Pond
Legend
Hillside St
Google Earth
©2018 Google
N
100 ft

Partnerships and Synergy with Other Projects in the Watershed

Over the years, the QWA has formed a close working relationship with the Lebanon Valley Conservancy and the Doc Fritchey Chapter of Trout Unlimited (DFTU). The QWA and its partners have provided many hours of in-kind services. For this project, the Doc Fritchey Chapter of Trout Unlimited will provide administrative and contract management services. QWA and DFTU will coordinate with the landowners to obtain the necessary Letters of Commitment, Access Authorization Letters and Landowner-Grantee Letters of Agreements.

The Lebanon County Stormwater Consortium was formed by the City of Lebanon, Annville Township, Cleona Borough Authority, North Cornwall Township, North Lebanon Township and South Lebanon Township. The Joint Pollutant Reduction Plan they developed to meet MS4 requirements includes proposed retrofits to existing urban BMPS, proposed new urban BMPs, as well as fourteen stream restoration projects along the mainstem Quittapahilla Creek. In addition, USDA-NRCS and the Lebanon County Conservation District, have committed to work with the QWA and DFTU to implement stream restoration projects that were identified on farms in the Quittapahilla Watershed Restoration and Management Plan. They propose to utilize EQUIP funds supplemented by matching funds from other sources to design, permit and implement thirty two restoration projects over the next 5 – 10 years.

Contractor Provisions

After evaluating other consultants, the Quittapahilla Watershed Association and Doc Fritchey Chapter of Trout Unlimited selected the consulting team of Clear Creeks Consulting and Environmental Planning and Restoration (EPR) to prepare the restoration design plans and to obtain local, state and federal permits for this project.

Staffs with these two firms were key members of the multidisciplinary team that conducted the original detailed assessment of the Quittapahilla Creek watershed. Clear Creeks prepared the Restoration and Management Plan (2006). Clear Creeks and EPR have teamed to provide design and permitting services for the QWA and LVC to complete two restoration projects along Snitz Creek and Beck Creek utilizing the grant funds obtained from the Water Quality Improvement Projects along the Sunoco Mariner East 2 Pipeline Corridor Grant Program in Spring 2019. Most recently Clear Creeks completed the Quittapahilla Creek Watershed Implementation Plan (2018) for QWA.

Given their outstanding work on the assessment, management plans and restoration projects, and the fact that they have been working closely with the QWA since 2000, the members feel they are the most qualified and best prepared consultants to help implement their stream restoration projects. The following scope of work outlines the services and deliverables they will provide under the grant funds we are requesting.

Detailed Scope of Work

Phase 1 - Design and Permitting

➢ Existing Conditions Topographic Survey and Base Map Preparation

- Set up a GPS ground control network.
- Field-run survey will be conducted to provide detailed channel topography and floodplain topography along 2,989 feet of Snitz Creek from upstream of the bridge at Cornwall Road and downstream to the confluence with the Middle Fork of Snitz Creek. This will include:
    - The floodplain survey will extend 25 – 30 feet from the top of bank on the left side of stream and 50 feet from the top of bank on the right side of the stream along the three upper reaches.
    - The floodplain survey will extend 100 feet from the top of bank on the left and 50 feet from the top of bank on the right side of the stream along the three lower reaches.
    - In addition, the survey will cover the interior of the Cornwall Hills SWM Pond including the storm drain outfall below Cornwall Hills Drive, rip-rapped stormwater conveyance swale into pond, pond outlet structure, pond bottom and side slopes.
    - The longitudinal profile will be surveyed along the project reach. The profile survey will follow the thalweg and include channel bed, water surface, and top of bank profiles at key points (e.g., top and bottom of riffles, bottom of run, Dmax of pools, and top of glide, etc.);
    - A baseline will be established along the right floodplain/terrace for the entire length of the project reach.
    - Cross-sections shall be established off the baseline, extending 25 feet on either side of the channel, and surveyed at 100 foot intervals and at key points along the channel (Apex of bends, mid-riffle, max depth of pools). Minimum points along a cross-section shall include start and end of cross-section, top of bank, toe of bank/edge of water, thalweg, centerline, and several points either side of center line).
    - Significant in channel features (e.g. bedrock outcrops) will be identified.
    - Identification and survey of any public or private utilities, such as sanitary sewer manholes, storm drain outfalls, phone and power poles, stormwater management pond embankment, and petroleum pipeline ID poles, etc.
    - Survey upstream, downstream and through the stream sections at the bridge at Cornwall Road with sufficient detail to allow hydraulic analysis of this structure.
    - Vertical and horizontal controls will be set.
- Develop the following base maps of the project area from field run survey for use in developing restoration designs.
    - The plan view will be prepared at 1 in. = 20 ft. Cross-sections will be prepared at 1 in. = 5 ft. vertical and 1 in. = 5 ft. horizontal. Longitudinal Profile will be prepared at 1 in. = 5 ft. vertical and 1 in. = 20 ft. horizontal.
    - The plan view will include topography at one-foot contour intervals in the channel and across the floodplain/terraces and adjacent hill slopes to either side of the channel. It will show existing structures, such as buildings, retaining walls, fences, roads, drainage pipes, and bridge; major stream features (e.g., point bars, depositional areas, rock outcrops, etc.) will be shown.

➢ Hydrologic and Hydraulics Analysis

- Utilizing standard hydrologic modeling methods (TR-20) develop the peak discharge rate for the 1-, 2-, 10-, 50- and 100-year 24-hour storms under existing conditions for the project reach. The model will be calibrated to regional regressions and/or the FEMA 100-year published flow data so as to serve as the basis for analyzing in the following flood plain modeling effort.
- Utilizing the 1-, 2-, 10-, 50 and 100-year flows developed from the hydrologic analysis and regional regressions, conduct existing and proposed hydraulic analyses for the project reach. Traditional

methods including HEC-RAS will be used to approximate and model existing and proposed water surfaces and hydraulic parameters associated with these flow events.

- The HEC-RAS model will also import the HEC-2 data from the detailed FEMA modeling used for the Flood Insurance Rate Mapping of the project area. This cost estimate assumes that we will be able to develop a model that reflects less than 0.01 foot flood water surface elevation change to remain consistent with PADEP regulations.
- If, however this cannot be achieved, it will become necessary to proceed through the process to obtain a Conditional Letter of Map Revision (CLOMR) and Letter of Map Revision (LOMR) process with FEMA. This effort is estimated to require an additional $0.00 of effort to complete this procedure.

➢ Field Studies and Design Criteria

- Conduct Level II and Level III Geomorphic Assessment
- Collect and analyze bulk sediment to verify sediment transport capacity
- Determine design bankfull channel dimensions.
- Geotechnical evaluations of the Cornwall Hills SWM Pond

➢ Preliminary Design Plans

- Utilizing the field-run topography and base maps, preliminary design plans will be prepared for the channel restoration and stormwater pond retrofit. The plans will include: plan view sheets, representative cross-section sheets, structure typical details, and preliminary landscape plans for the Snitz Creek corridor and SWM pond interior.

➢ Final Design Plans and Construction Documents

- Final restoration design plans will be prepare. The plans package will include: grading plans, cross-section sheets, profile sheets, and grading typical details, and final landscape plans for the Snitz Creek corridor and SWM pond interior.
- Prepare a Design Report that summarizes the results of the field studies, existing/proposed conditions hydrologic and hydraulic analysis, sediment transport analysis, geotechnical evaluations, and supporting engineering computations for the restoration/stabilization of Snitz Creek project reach and Cornwall Hills SWM Pond Retrofit.
- Prepare Erosion and Sediment Control Plans including sequence of construction; stockpile and staging areas, clean water diversion, sediment and erosion control measures,
- Prepare quantity estimates for materials, and final engineer's cost estimates for materials and construction.
- A Professional Engineer licensed in the state of Pennsylvania will review, sign and seal the final design plans.

➢ Local State and Federal Permit Applications

- Conduct environmental assessments required for permitting including wetland delineation, archeological, historical, RET, etc.

- Conduct a pre-application field meeting with the local, state and federal permitting agencies to present the concept design plans, discuss overall project goals and objectives and site specific constraints.
- Prepare Erosion and Sediment Control Submittal Package.
- Prepare Joint Permit Application packages for submission to the Quittapahilla Watershed Association. The authorized representative for the QWA will sign and forward the permit application package to the permitting agencies.
- Prepare written responses (with accompanying plan revisions) to agency comments and or questions..

➢ Bid Assistance

- After the design plans are completed but prior to permits being issued Clear Creeks will prepare Bid Documents and conduct a Site Showing for perspective contractors. LVC and QWA will solicit bid proposals from a list of qualified construction contractors.
- The Construction Contractor selected for the Project will assist Clear Creeks, LVC and QWA in preparing grant applications for funding of the Construction Phase of the Project.

➢ OM&R Plan

- Clear Creeks will prepare a Preliminary OM&R Plan for the Project Area that defines allowed and prohibited activities along the project area. Identify monitoring, maintenance and repair activities to be performed, outline a schedule for those activities and the parties responsible for conducting those activities.

➢ Project Management, Coordination, Meetings and Site Visits

- Assist QWA and LVC in obtaining funding.
- Manage project scheduling, prepare and submit invoices for payment, prepare status reports for Lebanon Valley Conservancy and prepare final project report.
- Conduct Intra-Team office/field meetings to discuss hydrologic and hydraulic analysis, the findings of the field studies and subsequent recommendations, drafting of preliminary and final design drawings, and other project related issues.
- Attend up to three (3) office/field meetings with the Quittapahilla Creek Watershed Association and property owners to discuss project scheduling, the findings of the field studies and subsequent recommendations, discuss landscaping issues, present preliminary and final design drawings, and other project related issues.

<u>Deliverables</u>

- Final Design Plans
- Construction Specification Documents
- Permit Application Package
- OM&R Plan
- Bid Assistance

Project Schedule

Task	Start and Completion Dates
Phase 1 – Design and Permitting	
Existing Conditions Topographic Survey and Base Maps	NTP – Day 45
Hydrologic and Hydraulic Analysis	NTP – Day 45
Field Studies and Design Criteria	NTP – Day 45
Preliminary Design	Day 45 – Day 90
Final Design and Construction Documents	Day 90 – Day 120
Local, State and Federal Permitting	Day 120 – Day 270

The QWA and Doc Fritchey Trout Unlimited intend to utilize the funds requested under this grant application to develop the restoration design plans and obtain permits. After the design plans are completed but prior to permits being issued QWA and Trout Unlimited will solicit bid proposals from a list of qualified construction contractors. The Construction Contractor selected for the Project will assist Clear Creeks, QWA and Trout Unlimited in preparing grant applications for funding of the Construction Phase of the Project.

Commonwealth Investment Criteria

Consulting firms, construction contractors, nurseries, and landscape companies depend primarily on private development and publicly funded projects for business opportunities. Publicly funded projects are critical for sustaining these businesses. An evaluation of the economic impact this project will have on the consulting firms, construction contractor, nursery and landscape company directly involved, as well as the quarries; heavy equipment leasing, parts and maintenance; fuel suppliers; and erosion control products materials and equipment suppliers indicates that a minimum of 20 permanent fulltime jobs would be retained. An additional 51 temporary fulltime jobs would result from this project.