AN APPROACH TO STREAM MAINTENANCE IN BRADFORD COUNTY

A PILOT PROPOSAL

March 2012 DRAFT

BRADFORD COUNTY STREAM MAINTENANCE PILOT

Executive Summary

Bradford County and other Counties in the glaciated northern tier of Pennsylvania have, and continue to experience, excessive stream channel aggregation in the form of gravel deposition and excess debris as a result of stream bank failures. The causes of this excess material are both natural and anthropogenic in nature and include: geology and soils; topography, weather; alteration of riparian/stream areas; debris jams; transitional areas; historic anthropogenic channel alterations; past land use. For a more detailed explanation see appendices "C". In Bradford County, over 1.5 million feet of stream banks are excessively eroding as a result of unstable channels, resulting in an average of 1 million tons of excessive gravel which fall out in depositional areas in the channel. The resulting environmental impacts consist of: disruption of natural stream order and flow; damage to fish species through direct abrasion to body and gills; loss of fish spawning areas due to the filling in of gaps in streambeds; a breakdown in the aquatic food chain as sediment suffocates small organisms living in the streambed; accelerated filling in of dams and reservoirs; and a change in the water composition in the Chesapeake Bay and other estuaries. Additionally, through the disruption of stream channel stability, both economic and social impacts can be considerable. These would include: increase in out of bank flooding in areas of severe deposition; loss of property through excessive channel meander; failure of culvert and bridge structures; additional maintenance costs; threats to homes and businesses; potential threat to human safety.

The lack of sufficient funding at the Federal, State and County levels to address the watershed and channel issues, both in the near and long range future, necessitate the consideration of a maintenance program that would both meet the needs of the communities bordering these streams as well as working within environmental sensitivities, and aid in returning streams in the region to a more stable form. Two specially convened task forces to address northern tier stream issues were called in 1994-5 and again in 2005-2007 by PA Senator Roger Madigan and PA DER/DEP (see Appendices A & B). These task forces consisted of Federal, State, Regional, County and Local authorities and assigned the identification of potential strategies to address stream issues. These reports include the following recommendations:

- …*DEP should continue to review and revise regulations and proceedures, where necessary, to simplify and speed up the permitting process, including a permit to authorize perpetual gravel excavation from critical locations (1995)*
- *…The means to stabilize streams and the need to routinely excavate gravel and debris remain unresolved general issues. Best management practices specifically developed for the glaciated northern tier area should be developed to provide guidance for landowners and municipalities… (1995)*
- *An effective outreach and educational effort needs to be focused on the development of an awareness of the nature and response of streams in the region to decisions and actions of landowners and municipal officials. This would include such elements as stream morphology; the importance and roles of floodplains, stormwater management, and riparian areas. (2007)*

- *Municipal, Agency and other personnel involved in stream maintenance need to understand how to conduct such activities in an environmentally sensitive manner so as to minimize adverse impacts of such activities. (2007)*
- *An incentive program for the training of individuals that work with stream maintenance is recommended. This could be in the form of a pilot project in the region that could include such incentives as financial assistance similar to the State's Dirt and Gravel Roads Program, or expedited permit processing for those entities trained. (2007)*

This pilot proposal includes the development of an approach first utilized in the NY City Reservoir watersheds in Delaware County, NY. It includes the creation of working "regional curves" that can be utilized to identify the stream channel elements of width, depth, cross sectional area and flood plain dimensions at a given stream reach location in the watershed. This tool, coupled with an extensive training component for municipal officials and contractors, an expedited permit process, and over seen locally can achieve the following goals:

- ***Provide a tool and mechanism that will enable those conducting stream maintenance activities to do so in a timely and environmentally sensitive manner***
- ***Provide a tool that will aid landowners and regulatory authorities in identifying the scope maintenance needs and remedial actions***
- ***Provide watershed specific criteria for regulators and emergency response agencies to identify the scope of work needed to restore channel dimensions in emergency and post flood conditions***
- ***Begin restoration of channel stability through reconnection of channels to a stable form and to their floodplains as part of any channel maintenance activities***

This pilot also proposes the consideration of the issuance of a joint DEP/COE permit that would cover Bradford County under agreed upon criteria so that the goal of timely, efficient regulatory requirements are met.

Project Overview

Glaciated streams of the northern tier of Pennsylvania are impacted by a number of interrelated human and natural elements as described in appendix "C". These impacts have created a system of unstable channels that experience accelerated and aggravated maintenance needs. These needs can, and often do create conditions that threaten environmental qualities, property, structures and even human well being in times of flooding. The regular maintenance of these channels is both challenging for the landowner as well as the regulatory agencies that oversee this work. Specifically, these challenges include:

- *Lack of specific criteria that triggers the need for maintenance*
- *A regulatory and permitting process that can be administratively burdensome to both the permitee and regulating agency*
- *Lack of specific criteria for regulators to apply to restoration activities after a flood or similar emergencies*

In Delaware County, NY, in the NY City water reservoir area, the Soil and Water Conservation District, in conjunction with the NY DEC, NYC DEP and Army COE, has developed a tool and corresponding training program that allows an environmentally sensitive approach to stream maintenance that increases the awareness of those active in stream maintenance, expedites the permitting process and aids in the restoration of channel stability. This project proposes to duplicate this approach.

The anchor for a more efficient and environmentally sensitive approach to stream maintenance is the creation of "regional curves" for the watershed in Bradford County. Stream channel characteristics are formed as a result of watershed specific conditions such as geology and soils, climate, hydrology and hydraulics, human impacts, etc. A regional curve is a tool developed and utilized to assist in identifying channel dimensions such as width, depth, cross sectional area, slope and flood plain elevations and width. While regional curves are estimating tools that need to be validated for extensive stream channel design, they do serve as a good approximating tool for emergency and maintenance work. This is especially true in that no similar tool is currently utilized under emergency permit conditions.

The pilot would involve developing regional curves for Bradford County. It is assumed that 2 sets of curves would be developed, both containing a rural and developed watershed condition. Tables from the data collected would be developed to assist any individual or regulator to locate the watershed position of a proposed project location and be able to determine estimations of the finished channel dimensions.

To best utilize the regional curves, a training program would be developed and held which would offer participants a "certification/accreditation" that would enable them to conduct channel maintenance work under an expedited permit. The training would include an overview of stream processes, an explanation of regional curves and how to utilize them, a field exercise in laying out a project, and a field exercise in the completion of a project. Training materials utilized by the Delaware SWCD were based on the ESM for Streams developed by the Bradford Conservation District and modified to the regional curve approach. These same materials would be used and upgraded for the Bradford County pilot.

An additional benefit of the development of the regional curves is that it would allow regulatory agency personnel to identify specific criteria for any work permitted under emergency conditions, regardless of the expertise or experience of the individual issuing the permit.

With the development of the regional curves, a locally administered program could be implemented to assure quality use of the approach. The Conservation District currently has 4 to 5 qualified individuals that could serve as the administrators. In instances where a landowner was concerned about channel capacity to carry flood waters, a cross sectional survey compared with the regional curve, would determine the percentage of loss of capacity. A maintenance activity could then be performed to restore that capacity if it is revealed that over a specified percentage has been lost. Landowners would have to engage an equipment operator that was certified through the training to utilize any type of expedited permitting.

In the case of permitting, a pilot permit would be submitted and considered for approval for the whole County. The permit application would specify the utilization and oversight of the use of the regional curve approach to maintenance. Typical permit conditions would be applicable such as work in trout streams, PNDI searches, EV or HQ watersheds, and erosion and sedimentation controls. Once the permit is finalized and issued to the County, work for individual sites could be authorized locally under the regional curve conditions, with local oversight and responsibility for following the criteria, and final inspection. The DEP and COE would conduct followup reviews as necessary to determine effectiveness and compliance with the permit.

An additional benefit of this approach is that any maintenance activity would be tied to the regional curves which will incorporate the dimensions of a modeled “stable” stream reach with associated floodplain access. This would begin to address some of the historic abuse of streams through maintenance and can result in improved hydrology through improved floodplain access.

WORK PLAN

Objective I – Identify / Confirm Stream Regions

Stream Morphology is influenced by variables such as weather patterns (precipitation and characteristics), topography (slope characteristics), geology (soils, infiltration rates, stream bedload characteristics), land cover and others. The Conservation District will work with previous efforts to confirm their applicability as well as review GIS data through various databases to establish appropriate regions with similar characteristics.

Costs:

- Review existing work, meet with County data
  - ✓ BCCD Stream Team + 1 GIS @ 8hrs X $40/hr = **$640**

Objective II – Identify Representative Watershed(s) in County

The Conservation District will identify a relatively stable, representative watershed in each of the identified regions. Two watersheds (developed and rural) will be selected for each Region. District will visit representative watersheds to confirm appropriateness of selections.

Costs:

- Identify representative watershed
- Site visit by CD Stream Team to each watershed (2)
  - ✓ 2 watersheds X 2 staff @ 8hrs X $40/hr = **$1,280**
  - ✓ Mileage – 300 miles @.50/mile = **$ 150**

Subtotal $1,430

Objective III – Field Data Collection (4 Watersheds)

In order to develop the Regional curves, the two representative watersheds in each identified Region (developed and rural – assuming 2 regions), extensive cross sectional and other geomorphic information will need to be collected. Conservation District will be utilized to collect data. It is estimated that 40 hours will be needed for each identified watershed.

Costs:

- Watershed Data Collection
  - ✓ 2 CD staff X 40 hrs X 4 watersheds = 320 hrs X $40/hr = **$12,800**
  - ✓ Mileage – 1,000 @ .50/mile = **$ 500**

Subtotal $13,300

Objective IV – Data Development & Regional Curve Development

Data from the selected watersheds, USGS Gauging Stations in the identified Regions, Stream Stats and other sources will be compiled and utilized to develop the Regional Curves. The draft curves will be distributed and review comments incorporated into a final document. It should be stated that the Regional Curves developed will be of the quality to be utilized for emergency and maintenance uses and will form the basis, with continued monitoring and data collection for future design purposes.

Costs:

- Data Compilation and Curve Development
    - ✓ 2 CD Stream staff X 40 hrs X 4 watersheds = 320 hrs @$40/hr = **$12,800**
  - Data Review & Edit
    - ✓ 1 CD Stream staff X 8 hrs X 4 watersheds = 32 hrs @$40/hr = **$ 1,280**

Subtotal $14,080

Objective V – Municipal and Contractor Trainings

2 - three day trainings will be developed and organized and held, targeting municipal officials and contractors in the County. Those completing the training will receive certification that they are qualified in the use of the procedure.

Costs:

- Develop Training Materials = **$1,500**
- 2 County Trainings
  - ✓ 2 Trainings X 3 days X 3 Trainers X 10hrs = 180 hrs @$40/hr = **$7,200**
  - ✓ Hall, food X 3 days X 2 trainings X 30 attendees @ $1,000 = **$2,000**
  - ✓ Materials, Books X 30 attendees X 2 trainings = **$1,000**
  - ✓ Mileage – 500 miles @ .50/mile = **$ 250**
  - ✓ Training set up & coordination – 2 X $250 = **$ 500**

Subtotal $12,550

Administration & Oversight

Costs:

- Administration, Accounting, Project Management **$ 2,000**
- Misc. Mileage, Meetings, etc. **$ 500**
- Copies, Postage, etc. **$ 500**

Total Project Cost $32,930

- ***Note – Ongoing technical support for landowners, municipalities, etc. estimated at 50% of a personnel year + additional trainings, etc. = approximate annual costs of $25-30,000.00***

APPENDIX A

Flooding and Stream Erosion Roundtable Final Report – December 1995

FLOODING AND STREAM BANK EROSION ROUNDTABLE

FINAL REPORT

I. SUMMARY AND RECOMMENDATIONS

Several intense rainstorms and damaging floods occurred throughout the Bradford and Tioga County area during the summer of 1994. Roads and bridges were washed out, homes and businesses flooded, agricultural fields were eroded and some fields were buried in stream-deposited gravel, and stream channels were filled with gravel and debris. County and local governments, Pennsylvania Department of Transportation (PennDOT), Pennsylvania Department of Environmental Protection (DEP) and other state and federal agencies devoted large amounts of staff time and funds to provide emergency assistance and flood recovery help and guidance. Following the flood of August 18, 1994, the Governor issued a state declaration of disaster.

Stream bank erosion and deposition of gravel was a major problem. Large gravel deposits obstructed stream channels and bridges causing damage to roads and bridges and adjacent property. In the opinion of many local residents, the lack of prior routine "stream cleaning" to remove the gravel was the obvious cause of the flooding, and therefore, the means to prevent future flooding. Because the streambed material is so highly erodible and mobile, excavation of streambed material is considered a temporary solution at best. Nevertheless, there may be localized problem areas where routine removal of gravel and debris would contribute to lower flood damage.

A special committee (Committee) was established in October 1994 to review the flood recovery efforts and develop long-range or permanent solutions. The Committee met seven times between October 1994 and July 1995 to review rainfall and stream flow records, geology, PEMA and FEMA emergency response systems, state and federal permit programs, and various state and federal flood protection and planning programs. A list of participants is shown in Appendix IV.

The Committee concluded that the flood damages resulted from intense rainfall aggravated by highly mobile streambeds. It was also concluded that there is a continuing need to remove large gravel deposit and debris (such as trees) from critical locations as soon as possible after they are deposited. However, it is believed that extensive channel cleaning and straightening would be temporary, excessively expensive, and would not effectively reduce flood damage.

State and federal flood restoration projects were undertaken at 35 locations in the two county area. A review of state and federal flood protection programs indicates that additional projects are not likely to be feasible due primarily to high construction cost compared to relatively low, non-permanent benefits. Nevertheless, individual municipalities may still apply directly to the individual programs for a more site specific study.

The following actions, responsibilities and concepts are recommended:

1. Since all municipalities are participating in the Federal Flood Insurance Program, all residents should be encouraged to purchase flood insurance, and municipalities should review the content and administration of their floodplain management ordinances and initiate improvements where necessary. Municipalities should take appropriate enforcement action against persons who violate floodplain ordinances.

2. County Commissioners should participate in the Act 167 Storm Water Management Program in order to obtain the benefits of the detailed watershed plan which is the foundation of that program.

3. Local, county, and state agencies should hold regular training exercises and information conferences so that each agency will know their role and services expected during and following flood events. Clear lines of communications should be established and maintained during emergencies.

4. DEP will continue to respond to individual municipal requests for stream improvement and flood protection studies, and will propose projects which are eligible for construction under program criteria. DEP should continue to review and revise regulations and procedures, where necessary, to simplify and speed up the permitting process, including a permit to authorize perpetual gravel excavation from critical locations.

5. PennDOT, county and local governments should inventory culverts, bridges and stream channels and other locations where deposits of stream bed gravel and debris would pose a threat during future floods and develop plans to clear these areas before damage occurs. Routine stream cleaning may require new sources of funding dedicated to this purpose.

6. PennDOT should consider the adoption of different criteria for bridge openings to reduce the threat related to bed load and debris. The owners of all bridges and culverts where significant problems have occurred should consider replacing with larger waterway openings.

7. PennDOT and DEP should investigate the feasibility of constructing debris dams upstream of vulnerable bridges, and authorize and encourage interested parties to remove the gravel from these facilities at regular intervals. At the time ofthis report, a pilot project is being developed.

8. Individuals should be encouraged to remove trees and other floating debris from the stream channel. No permits are required for this activity provided there is no earth work within the stream channel.

9. A disaster assistance loan program and other emergency financial assistance should be established by the General Assembly.

10. Watershed associations should be established to monitor conditions and pertinent activities, provide focus and leadership, and coordinate communications between residents, local government, and state and federal agencies.

11 . A PL-566 study of Bentley Creek by the NRCS should be initiated to develop a model management plan for the glaciated northern tier watersheds. At the time of writing this report, a feasibility review has been initiated by NRCS.

12. The means to stabilize streams and the need to routinely excavate gravel and debris remain unresolved general issues. Best management practices specifically developed for the glaciated northern tier area should be developed to provide guidance for landowners and municipalities. At the present time, no agency has this explicit responsibility as part of their mission, although the PL-566 for Bentley Creek is expected to provide some direction.

APPENDIX B

Executive Summary – Streambank Erosion Roundtable

June 2007

This roundtable consisted of representatives of various federal and state resource agencies, local government officials, local and state emergency management personnel, representatives of the PA Department of Transportation, PA Department of Environmental Protection, and Community and Economic Development. Additionally, representatives of County Conservation Districts, Planning Commissions, and Watershed Associations participated.

There were five sub-committees looking at various issues that were identified by the entire group. The sub-committees are Stormwater Management, Stream Clean Up and Stabilization, Fluvial Geomorphology Projects (FGM), Floodplain Mapping, and Emergency Management Services.

Stormwater Management

The final Pennsylvania Stormwater Best Management Practices Manual, and the Pennsylvania Stormwater Model Ordinance are now official. The Pennsylvania Department of Environmental Protection (DEP) will be offering training throughout the Northcentral Regional service area. This will be the best format to promote and incorporate stormwater management into site land use planning and for meeting Act 167 NPDES permitting requirements and ensure protection of public health, property, and future health of our streams.

The DEP planned Act 167 outreach will be to go to each county, one by one, over a period of 6 to 8 months, starting in the spring of 2007. The Department will ask the counties to invite municipal officials as well. At each meeting, DEP staff will do a quick overview of the Act 167 program, and review where the county and its municipalities now stand with regard to Act 167. The Department will look at the age of any previous planning done, and how well any current ordinances stand up to the new model ordinance. A determination will be made on how well the municipalities have complied by passing the required ordinance and implementing it, and then start the counties on a reasonable new planning effort, to rectify any problems from past Act 167 planning and begin the process of any new planning needed.

DEP will involve the County Conservation Districts, DEP Watershed Managers, DEP Engineers from the Soils and Waterways program, and Central Office's Stormwater Management program, which of course has the purse strings. The

Department intends to create an “Act 167 mini-team” for each county from the above personnel. DEP will emphasize and “push” the new model ordinance and its benefits, and attempt to get the counties into a more “dynamic” planning process for Act 167, as opposed to a “once and done” and then forgotten-about thing.

Every community’s land use plan should have an ordinance that protects stream buffers, mature trees, and natural features. Low Impact Site Design (LID) practices, as described in the PA Stormwater Best Management Practices Manual, should become the norm, and not the exception. These practices, often referred to collectively as Low Impact Development, preserve natural areas, reduce the creation of stormwater runoff, and use state-of-the-art stormwater management techniques. LID should be promoted as an alternative to traditional stormwater management. It seeks to reduce or eliminate stormwater and its associated pollution by trying to mimic natural hydrology by promoting infiltration into the soil, rather than runoff. LID can protect streams, recharge groundwater and reduce pollution.

Stream Channel Maintenance

The issues related to stream channel maintenance and stabilization continue to be a primary concern for landowners, municipal officials, and resource managers in the region. The long history of how streams have been managed or not managed, the geology, soils and hydrology, and weather patterns have all worked to create unstable stream systems. As a result, many of the landowners and municipal officials view streams as maintenance liabilities as opposed to valuable resources. Current weather patterns, lack of sound local stormwater and floodplain management, and land use decisions that impact on hydrology and hydraulics across the landscape of the region’s watersheds have negatively compounded stream stability issues.

The conclusions of the previously convened Flooding and Stream Bank Erosion Roundtable (May 1998) are still valid in that it called for the development of an innovative approach to regional stream stabilization and maintenance. Additional important goals identified for the purpose of this report include:

- An effective outreach and educational effort needs to be focused on the development of an awareness of the nature and response of streams in the region to decisions and actions of landowners and municipal officials. This would include such elements as stream morphology; the importance and roles of floodplains, stormwater management, and riparian areas.

- Municipal, Agency and other personnel involved in stream maintenance need to understand how to conduct such activities in an environmentally sensitive manner so as to minimize adverse impacts of such activities.
- An incentive program for the training of individuals that work with stream maintenance is recommended. This could be in the form of a pilot project in the region that could include such incentives as financial assistance similar to the State's Dirt and Gravel Roads Program, or expedited permit processing for those entities trained.
- Stormwater and Floodplain management programs and regulations need to be better understood and enforced in the region.

Emergency Management

The emergency services management sub-committee consisted of individuals who were directly involved in the process and are able to provide meaningful input into allowing local and state officials a better opportunity of responding to future events in a more logical and orderly manner.

Of all the problems that were identified in the area of local, county, state, and federal interface in response to flooding, the most glaring issues and the ones the committee most likely believe that inroads can be made in are as follows:

Flooding events are handled differently each time. Below are several scenarios that have been experienced in the past events.

- A declaration is issued and the Federal Emergency Management Agency (FEMA) is on site before preliminary damage assessments are completed.
- A declaration is issued and the local, county and state reports are completed, and then FEMA shows up and doesn't look at any local, county, and little state documentation.
- A disaster is declared and the PA Emergency Management Agency (PEMA) holds training and briefings on the impending interface with FEMA, and then FEMA changes the way they do things so the briefings, etc., seem invalid.
- Sometimes PEMA and FEMA inspectors will come into the county offices without advance notice and get maps, information of each municipality and public assistance requests, and then ask DEP, PennDOT representatives or others to accompany them to the local sites.

- There are times when DEP, PennDOT and County EMA Coordinators don't even know the survey teams are in the area until they leave or upset someone and they call us to complain.
- PEMA (in Harrisburg 24-hours) activates whoever is needed.
- Effective use of multi agencies in Harrisburg to facilitate agency collaboration.

In best-case scenarios, DEP, PennDOT, Local, County, PEMA and FEMA personnel went to the field together as a Disaster Survey Team. The interface brought out the best information in all agencies and made the process smoother for all involved.

The following recommendations selected from a list were embraced by this committee:

1. Develop Standard Operating Procedures (SOP). These should contain clear work assignments so that team members know what will be expected of them during an event.
2. Clarify the lead agency for which type of activity before the event.
3. Assign as many tasks as possible to each agency before the event with direction and activities outlined.
4. Identify a person, before the event, to be the Regional Emergency Response Point of Contact in each office, with authority to assign duties to other staff members.
5. Create a list of retired employees who may be willing to assist during event.

Additionally, FEMA/PEMA should train a team of DEP/PennDOT and County personnel before a flood to fill out computer reports and not begin training as a response to the flood.

Generally speaking, people and municipalities have not felt that the overall response to their problems have been done quickly and efficiently, especially when several agencies arrive at different times, with different missions and no one knows what the other did or what the other has to offer.

The committee realizes that no response is going to return everything to its original state or better shape than before, as some affected individuals and municipalities would like, but if agencies work together with surveys, inspections, permit issuances and documentations consistently, the public and the agency personnel will begin to believe we really are working toward getting back to "normal."

Fluvial Geomorphology

The overarching issue is, that due to the geology of the region, history of how we have been dealing with stormwater, mismanaging floodplains and development throughout the watershed, there is a need to emphasize an effective way of dealing with streams in the northern tier. The morphology of streams is constantly evolving and makes it difficult to reach dynamic equilibrium until some stability to the hydrology can be attained which makes restoration efforts a challenge to plan, design and install, and still expect long-term success of projects. Despite this situation there has been and continues to be a desire by watershed groups to promote good stewardship and complete restoration projects on streams in the region. The problems described below actually apply to various methods of stream restoration, but the approach driving the need for resolution is the use of fluvial geomorphology and natural stream channel design.

The use of fluvial geomorphology (FGM) and natural stream channel design (NSCD) to restore streams was first introduced in Pennsylvania in 1998. Of course that first project was Bentley Creek in Bradford County. Bentley Creek, along with many other projects constructed over the last nine years, has served as a living laboratory or demonstration on the use of FGM and NSCD. These projects have all experienced varying degrees of "success" and "failure," particularly those in the northcentral and northeast regions of PA. Many lessons have been learned by these projects, but we still have a long way to go to ensure these and future projects are designed and constructed with greater confidence for holding up in the long-term.

The overarching problem with FGM projects implemented in the northcentral region of PA is that these projects aren't as successful as they could or should be compared to those projects in other parts of PA. This is due to a variety of reasons, some known, some predicted, and others unknown. A few of the usual suspects are listed below:

- **Problem** - Many projects are not planned out to the rigor that is required to ensure a more successful project such as location selection, lack of detailed planning and restoration strategies, considerations of the river flow hydraulics in the design strategy, considerations of impacts of glacial geology in the northern tier and impacts of social issues.

- **Problem** - There is a great deal of confusion over which permits are applicable for certain situations, what the requirements will be and what the deliverables are for FGM projects. Terms such as success/failure and assessment need to be defined, types of permits required for specific situations need to be defined and the requirements for each permit need to be consistent and clear, requirements of as-built and monitoring need to be clarified, sequencing of projects needs to become a priority, inappropriate expectations and myths of what FGM and NSCD is and isn't need to be explained.

- **Problem** - There are many technical areas that still need further research and information shared when using this approach to restore streams which often is too expensive to develop for individual projects, however knowing little and using minimal information in its place is a huge contributor to the lack of success of projects that are implemented. Again the glacial geology of the northern tier compounds these issues. DEP doesn't necessarily have the resources to do all of this work on their own, so how do we enable others to do the research?

A few specific needs have been identified through the Sediment Roundtables which, if addressed, should help to bridge the gap to finding long-term successes with these projects.

- Need for specific guidance for grant applicants in relation to an FGM project and what is expected or required for getting a project funded. This guidance should be clear and concise, consistent from region to region, and written so it is easily understood by all partners. This guidance needs to be distributed and education needs to be provided to watershed organizations, watershed specialists, consultants, and DEP staff, specifically the Watershed Managers and Soils and Waterways Sections, so there is consistency across the state, and the expense can be identified up front, budgeted, and/or considered for in-kind matching opportunities.

- Need to identify the stream conditions and restoration design levels that make a project eligible for each specific type of permit (General Permit 1 and 3, Emergency Permit, Nationwide 27 with 401 Certification, Waiver 16 and Joint Permit), need to define core permit requirements appropriate for each permit and identify conditions that would require extra data to be provided for each permit. DEP needs to define the areas previously listed and there needs to be consistency from region to region, project to project. Once all of these are defined, it needs to be distributed to everyone and be accompanied by training for DEP staff (Watershed Managers and Soils and Waterways), watershed organizations, consultants, and conservation districts.

- Need for DEP to look more holistically at how to improve FGM designs/projects and develop partnerships to address these issues if they can't get it done themselves.

Flood Plain Management

Flood Plain Mapping isn't always accurate.

Map Modernization (MapMod) is a project to improve the accuracy. FEMA is continuing their mandated work to develop digital versions of the Flood Insurance Rate Maps (FIRMS) throughout the Commonwealth. The Pennsylvania Department of Community and Economic Development (DCED), the designated state-coordinating agency for the National Flood Insurance Program (NFIP), is fully engaged in the MapMod process.

Project Scoping meetings were held in Bradford, Sullivan, Susquehanna, and Wyoming counties to gain local input regarding the nature of the areas flooding, and to inform local officials of FEMA's process and DCED's role in the process.

2006 disaster recovery funds will be used to help develop/update the maps. It is unknown at this time to what extent new Hydraulics & Hydrology studies will be done. DCED is partnering with PAMAGIC to form a MapMod Committee comprised of local, county, state, and federal agency officials and key stakeholders to develop short and long-term MapMod related goals.

DCED held several Disaster Recovery workshops in Wyoming and Susquehanna counties last October, and follow-up discussions are being held with the code enforcement personnel in Susquehanna Council of Governments (COG) regarding uniform floodplain management ordinances and their enforcement.

Currently, three Flood Summits will be held by Endless Mountains Resource Conservation and Development Council for Susquehanna and Wyoming, Tioga and Lycoming, and Bradford and Sullivan counties beginning in June 2007.

The DCED has scheduled a number of workshops around the Commonwealth during May, 2007 titled "Safeguarding Floodplain Resources: Empowering Our Municipalities." The workshops are designed for municipal secretaries, building permit officers, zoning officers, code enforcement administrators, etc.

Some other projects currently underway at DCED include:

- Coordinating the editing and re-recording process with Commonwealth Media Services of Floodplain Management video from VCR to DVD.

- Sixteen County Conservation Districts including Bradford County are partnering with DCED to perform community assistance contacts and community assistance visits. The CAC/CAV program is designed to review local floodplain management programs and to provide technical assistance to the municipality and;

- DCED is currently revising their "Suggested Provisions of Floodplain Ordinances" to include optional regulations such as riparian buffers, ASFPM's No Adverse Impact Guidance, etc.

It was determined by the full task force to continue meeting in the future, regardless of the flooding events, and continue moving forward with the recommendations brought forth in this report.

Web Site Address: http://www.depweb.state.pa.us

Northcentral / Community Involvement / Stream Bank Erosion

APPENDIX C

Bradford County Conservation District CBP Strategic Plan 2005

POTENTIAL POLLUTION SOURCE:

Stream Bank Erosion

SOURCE BACKGROUND:

Pennsylvania's streams are often one of the largest unmeasured source of non-point source pollution. There are hundreds of thousands of miles of streams in Pennsylvania. Pennsylvania has the largest network of rivers and streams in the United States with the exception of Alaska. Unfortunately, due to the extent of this network, we (people) have altered these systems to 'fit' our ideal vision of lifestyle. Such actions that continue to act upon our precious resource include: land cover alterations, riparian vegetation removal, gravel removal, channel alterations, etc. This traditional thinking has led to degraded stream eco-systems and increased bank erosion/channel migration. The results are thousands of tons of sediment, not to mention what is being carried with it, being transported downstream to the Chesapeake Bay.

The presence of sediment is a natural and necessary part of a healthy stream. The addition of excess sediment, however, can cause great harm to the aquatic ecosystem. Here are some of the effects of excess sediment:

- Disruption of natural stream order and flow
- Damage to fish species through direct abrasion to body and gills
- Loss of fish spawning areas due to the filling in of gaps in streambeds
- A breakdown in the aquatic food chain as sediment suffocates small organisms living in the streambed
- Accelerated filling in of dams and reservoirs
- A change in the water composition in the Chesapeake Bay and other estuaries

Additionally, through the disruption of stream channel stability, both economic and social impacts can be considerable. These would include:

- Increase in out of bank flooding in areas of severe deposition
- Loss of property through excessive channel meander
- Failure of culvert and bridge structures
- Additional maintenance costs
- Threats to homes and businesses
- Potential threat to human safety

POLLUTION SPECIFIC CAUSES:

1. Alteration and Removal of Vegetative Cover

Riparian vegetation is critical to the maintenance of stable stream banks. Removal of this vegetative buffer leads to destabilized stream conditions due to a number of negative impacts. Riparian vegetation works to intercept a large percentage of rainfall, allowing for evaporation back into the atmosphere. Additionally, the root complexes of riparian trees, shrubs and grasses work to bind the soil together, increasing its erosion resistance. This soil loss is not just important from the standpoint of sedimentation. The ability of soils to absorb rainfall, known as infiltration capacity, is critical in the mitigation of excessive runoff to a stream during a precipitation event. As more soils are forever lost to erosion, the overall infiltration capacity in the watershed decreases. This allows for increases in the volume and rate of water entering a stream as surface runoff as the result of a particular precipitation event. The surface roughness created by a healthy riparian buffer slows the surface flow of water as it reaches the stream, thereby lengthening the time required by the water to reach the stream. This allows for higher infiltration rates, minimizing the amount of water reaching the stream as surface runoff. Lowering the velocity of surface runoff also helps to reduce its erosion potential. When riparian vegetation is altered or removed, all of these buffering benefits are lost. In fact, removal of streamside vegetation leads to a substantial increase in the volume of water reaching the stream as the result of a particular precipitation event. This water also reaches the stream more quickly than if a healthy vegetative buffer were in place.

Conversion of indigenous forest cover to agricultural land also affects watershed hydrology in similar ways. Historically, large portions of the County's watersheds have been cleared first for timber and then for farmland. Today, agriculture (cropland and pastureland) is the dominant land use in the stream valleys, accounting for nearly 66% of the entire land area. Widespread alteration of the dominant vegetative cover types in the watershed has undoubtedly had long-reaching adverse effects throughout the watershed, especially to the stream system therein.

Changes in hydrology as a result of alteration and/or removal of vegetation both along the riparian corridor as well as across the watershed are well documented. Removal of native forest cover in an experimental New Hampshire forest resulted in a 40% annual increase in surface runoff (water reaching the adjacent stream during and just after a particular precipitation event). This increase in surface runoff was even higher during the summer months, with runoff amounts increasing by 400 percent (Likens, 1984). Removal of riparian vegetation along a stream reach is devastating to that reach, and its direct effects are evidenced downstream. When native vegetation is altered on a watershed-wide scale, such as in the conversion of forests to agricultural or residential land, the impacts of that alteration are devastating to the entire watershed. The large-scale changes in hydrology resulting from this watershed-wide change in vegetative cover are well-reflected in the frequency and scope of instability issues evident in a watershed where such changes have taken place. Increased runoff rates and volumes lead to a well-documented increase in the frequency and intensity of bankfull discharges. These more frequent and intense flood events have an egregious effect on the stability of morphological features and processes along a stream or stream reach.

It is critical, wherever possible and practicable, to attempt to re-establish native vegetation as an integral part of any stream restoration, remediation, or stabilization project undertaken in the watershed. The benefits of establishing a healthy native riparian buffer are numerous. Streamside buffers stabilize local hydrology; increase roughness; allow more water to enter the soil (percolation); allow for the establishment of substantial root masses along the banks, provide structural stability to the banks; and increase the amount of quality habitat used by a myriad of birds, amphibians, insects, and mammals. Additionally, woody and leaf material originating from the riparian corridor establishes the very basis of the food chain within the stream. This coarse particulate organic matter (CPOM) provides food for microbes and some benthic macroinvertebrates which then become food for larger stream organisms (Sweeney, 1992; Allan, 1995). All in all, the establishment of a healthy native riparian vegetative stream buffer is extremely beneficial to the physical and ecological integrity of the stream and the stream corridor. Every effort should be made to establish and protect these critical areas as part of any watershed-wide stabilization effort.

2. Channel Encroachment / Floodplain Restriction

Floodplains are areas adjacent to streams which become inundated due to an increase in water surface elevation, namely as a result of precipitation events. Floodplains are critical in the dissipation of flow energy during high water events. As flowing water begins to inundate the floodplain, energy is lost as a result of increased roughness and alteration of the width/depth regime. This in turn reduces velocity and lowers the potential erosive effect of the high water event. Floodplain areas also increase the storage capacity of the basin, helping to maintain channel stability. As with wetlands, vegetated floodplain areas promote storage within the drainage basin, thereby increasing the retention of a greater volume of floodwater. Retention of floodwaters within the floodplain reduces peak discharges by lengthening the time to peak runoff. This helps to reduce flood energy, mitigating stream erosion and runoff hazards. Removal or alteration of floodplain vegetation decreases the storage potential of these floodplain areas, which in turn decreases time to peak discharge and increases runoff volume, thereby increasing the likelihood of downstream flooding (See 'Alteration and Removal of Vegetation').

Floodplain effectiveness is compromised by longitudinal or transverse encroachment. Longitudinal encroachment occurs when roadway fill, buildings, or other structures encroach upon the floodplain parallel to the stream channel. In Bradford County encroachment of roadways upon stream channels is fairly common, and is a significant source of impairment to a number of streams as documented in all watershed assessments conducted in the County. The construction of roadways along streams is common, as many of these roads follow old trails or travel routes, or at least follow the moderate grades that usually parallel streams. Encroachment of roadways upon stream corridors has serious impacts to the channel, however. The proximity of the road usually requires the removal of roadside vegetation as a road maintenance concern. Unfortunately, in situations where the stream and road are adjacent or nearly so, this roadside vegetation is also the streamside vegetation. Typically, streams which are laterally encroached by roads have very poorly vegetated banks, especially on the bank adjacent to the road. Since roads are intended to be permanent, immovable structures, streams which parallel them are unable to laterally migrate along road corridors. Streams which do so are usually straightened and deepened as a road maintenance measure. The banks are hardened with rip-rap or other bank protection structures. Since streams paralleling roads are unable to meander, they tend to down-cut. This causes incision and entrenchment of the stream channel. As this condition worsens, oftentimes being assisted by human road maintenance practices, the channel becomes further disconnected or restricted from the floodplain. This leads to accelerated erosion of the channel bed and banks during high flows, as the inherent energy-dissipation capabilities of the floodplain are non-existent. This excessive scouring of sediment generates extra material, which eventually is deposited somewhere downstream, often creating impaired morphology in those depositional areas and hence translating the impact of the road encroachment some distance downstream.

Transverse encroachment occurs when fill or structures encroach or span the floodplain perpendicular to the stream channel, such as debris jams, beaver dams, bridges or culverts. This type of encroachment eliminates floodplain access during high flow events, and increases scour and degrading of the streambed (in the case of bridges and culverts) by forcing the increased volume of water through a smaller opening, increasing its velocity. This increased velocity leads to a higher erosive potential at the outlet of the obstruction opening. Transverse encroachment may also increase upstream flooding due to backwater effects caused by the channel obstruction. Transverse obstructions also cause excessive deposition of sediment, ultimately leading to lateral migration of the channel (see ‘Debris Jams’).

3. Debris Jams

Debris jams are often serious contributors to the overall instability of a stream reach, particularly in those channel types with flatter slopes. Debris jams primarily work to degrade stream channels in two ways. First, the channel obstruction created by a debris jam can act as a deflector, diverting flow away from the existing channel, and forcing it to create a new channel where one previously did not exist. This scouring of a new channel generates excessive sediment, destabilizing the new banks as well as altering the proper dimension, pattern, and profile of the channel in the area of the debris jam. This additional sediment load generated as the stream creates a new channel is usually deposited somewhere downstream, altering channel morphology in that area. This change then causes new channel adjustments, for instance if this deposited material creates a transverse bar, or a mid-channel bar. These alter existing morphology by diverting flows away from their traditional path, ultimately leading to the generation of more sediment, which will be deposited further downstream. In this method, the process continues to repeat itself, leading to the translation of channel impairment quite a distance downstream of the original impact site. Also, this diversion of water from the old channel into a new channel usually involves the excessive erosion of the receiving bank. If this bank is located in a forested area, the result is often an undermining of streamside trees, which eventually fall into the stream and become the next debris jam.

A second manner in which debris jams affect the morphology of stream channels is through the obstruction of flood waters during high flow events. As discharge increases as a result of a precipitation event, water velocities and energy of the flow both increase. This increasing energy allows for the transport of sediment material through the stream system, with the transport ability of the stream increasing as discharge and energy increase. Simply put, the more energy the flow of water has, the more material, and larger material, it can move. Obstructions in the channel, such as debris jams, slow the flow of water down. As the water slows, it begins to lose energy. When it slows sufficiently to the point where it no longer has the energy required to move the sediment load it was able to carry before reaching the obstruction, it begins to deposit this excess sediment that it can no longer move. This causes an accumulation of excessive sediment just upstream of the obstruction. As this sediment accumulates here over time, the distance from the obstruction at which the deposition of sediment begins to occur migrates upstream.

The ultimate effect of this deposition of sediment is a flattening of the channel slope. As the slope of a stream channel increases, it typically becomes less sinuous, taking on a straightened form. Conversely, as the slope of a stream channel lessens, or flattens, that channel begins to become more sinuous, that is to say it begins to meander more. Taking into account the fact that stable stream reaches develop, over time, a fairly consistent slope, these slopes can be altered in a short period of time by a debris jam and by the processes outlined above. The result is lateral migration of the stream channel. As the slope of a stream reach is flattened by the excessive deposition of sediment, it becomes more sinuous, and begins to meander more significantly. This meandering behavior leads to erosion of the streambanks, which once maintained the straighter channel which previously existed. This accelerated erosion of the streambanks supplies more sediment to the stream system through this quickly degrading reach, accelerating the rate at which the channel slope flattens. As the channel slope decreases more and more, this prompts the channel to become more and more sinuous, further eroding the streambanks. In this manner, the process intensifies, and the impacts become more drastic.

In many instances where debris jams have existed for a long enough period of time as to create significant changes to channel morphology and/or bank stability, the removal of these obstructions may not be sufficient enough to restore channel or bank stability, either at the location of the debris jam or through the stream reach immediately downstream. Careful examination of the site must first assess the immediate and long-term impacts of debris removal before it is attempted.

4. Anthropogenic Channel Alteration

There is considerable documentation of the historic effect that man has had on Bradford County through deliberate alterations. Streams, over geologic time, without man's influence tend to reach a form that is adapted to the geology, slope and climate of an area. Clear-cutting at the turn of the 19th century and the related skidding of logs through the creek channels, changes in hydrology due to growth of the County have all resulted in the instability of our stream channels. With the lack of restoration, local officials and landowners have adopted an approach of stream "maintenance" to address the resultant overwhelming sediment supply. Streams are viewed in many instances as "maintenance liabilities".

Deliberate alteration of stream channels and corridors is widely evident throughout the County. Most common is the straightening of the wetted channel, usually as part of an effort to mitigate flood impacts, or to preserve established property (usually in the form of crop or pastureland). Many of these efforts consisted of digging a straight, deep trench through the channel, oftentimes using the displaced substrate material to construct berms on one or both sides of the creek. The impacts of straightening and berming the channel are devastating to the morphology of the stream, both locally as well as further downstream. As the channel is straightened, its velocities increase due to the loss of sinuosity, which functions as an energy-dissipation mechanism in low slope channels. (These increased velocities lead to excessive scour of the stream bed and banks. As this material is eroded, the channel deepens, and it becomes further detached form the floodplain. The straightening of a stream channel affects not only the straightened segment, but also has lasting impacts downstream. In many instances, the first meander downstream of a straightened reach of stream is accompanied by a severely eroding outside meander bank. Water passing through this straightened reach has a higher velocity than normal, and therefore has a more intense impact on the outside meander bank (higher near bank stress). The accelerated erosion of this outside meander bank generates excess sediment to the stream system, which eventually is deposited somewhere downstream. This sediment deposition usually leads to impaired morphology at these downstream sites.

Anthropogenic channel alteration still occurs frequently throughout the County. Activities such as removal of gravel bars, straightening of stream channels and construction of levees and berms are quite common, especially as part of damage relief as a result of recent flood events in the watershed (autumn of 2004). Unfortunately, execution of these activities without consideration of long-term channel stability impacts, or a lack of understanding as to the cumulative downstream impacts of these localized activities, often leads to a condition where makeshift stabilization efforts are short-lived, and lead to increased impairment of localized as well as downstream channel morphology. Many times, these impairments over time become the very causes of the excessive flood damage these efforts were originally implemented to avert. This issue is indeed a sensitive one, aggravated by existing beliefs in the community, and the personal impact to peoples lives caused by flood damage and other stream-related issues.

5. Transitional Areas

Erosion or impairment of stream banks and stable channel morphology is often evident in areas of stream corridor transition. These impacts are seen in areas where the stream corridor passes from a wooded to a pasture area, or vice versa. Transitional impairment can also occur along stream reaches which undergo a significant change in material size, channel type, or valley type.

Streams flowing through forested areas, or other areas where significant vegetative cover allows for ample stabilization of bank integrity and stable hydrologic parameters, tend to be broad, flat, and somewhat straight compared to streams flowing through pastures or other open areas. Streams flowing through these areas tend to be narrow, incised and/or entrenched, and meander quite significantly. These two generically differentiated stream types usually have different sediment transport regimes. That is to say, these stream types appear to be able to move varying sizes and amounts of sediment at different rates because of their differing channel configurations. In areas where the stream corridor or channel transitions from one type to the other, the capability of the channel to transport material changes, often abruptly. This change is linked directly to the change in channel dimension, pattern, and profile, which in turn affects the amount of energy high flows can potentially achieve. For instance, a stream channel of particular pattern, dimension, and profile carries water with a distinct amount of energy. The energy possessed by this flow is dictated by discharge, and by the dimension, pattern, and profile inherent to the stream channel type. This flow is capable of moving a particular amount of sediment, the amount of which is directly linked to the energy of the flow. This transporting of sediment material acts as a mechanism for energy dissipation. When this stream corridor enters an area where it transitions from one type to another, leading to a transition from one channel type to another (that is to say, a change from a channel of a particular pattern, dimension, and profile to that of another pattern, dimension, and profile), this transition translates to a change in flow energy, which in turn means a change in the amount of sediment able to be moved. In areas where the channel transitions to a type through which the flow can attain more energy, say from a highly sinuous, fairly flat C-type to a straighter and steeper B-type, this can result in disproportionately high flow energy if no excess sediment is present to be moved. This system is then said to be *sediment-starved*. These systems often generate excessive sediment by eroding bank material at an accelerated rate.

In areas where a steep channel transitions into an area with a flatter slope, sediment can be deposited as flow energy decreases. This excessive deposition can lead to alterations in channel morphology by forming detrimental features such as transverse bars or mid-channel bars, sometimes resulting in impairment of the channel.

Throughout the County, the most obvious and widespread type of transitional erosion occurs in areas where streams flow from woodland to pasture areas. This transition is usually accompanied by a transition from a broad, somewhat straight channel to a narrow, deep, sinuous channel. Near bank stress is very high at the point where the somewhat straight channel begins to meander through the beginning of the pasture reach, exerting highly erosive forces on the outside meander banks. This generally leads to accelerated erosion of these banks, as well as the accompanying generation of excessive sediment and the problems associated with it.

Although this type of erosion is directly due to natural hydraulic processes, the conditions in which these transitions occur are typically a result of human activity. The abundance of pastures and open agricultural fields in the water, often interspersed by small woodlots, account for the frequency of these stream corridor transitions. Additionally, channel alteration (straightening, etc…) changes stream slopes and channel types, creating transitions between altered and unaltered reaches. Taking into account the minimal buffering capacity of our existing geology and soils in the watershed (see 'Geology and Soils'), These anthropogenic alterations to land use cover types, as well as alterations to channel dimension, pattern, and profile, have been devastating to the overall stability of the stream system within the Sugar Creek watershed.

6. Geology and Soils

The geology and soil types present in the County do not lend well to the stabilization of stream channels and banks, especially when exposed to the stressors which exist in the drainage basin. Typically, soils are loose and are largely unconsolidated. Streambanks comprised of these soils, once left unprotected by the removal of vegetative root cover, are very easily eroded. These highly erodible materials do not offer a substantial buffer against the impacts which destabilize stream channels in this watershed. That is to say, these same stream impacts and causes of impairments, located on streams which exist in a watershed comprised of more erosion resistant soils, would cause less channel and bank impairment than is evident in the County's watersheds. This idea of a low 'resistance threshold' does much to explain the frequency and degree to which we see these impacts lead to channel and bank impairment.

A second aspect of watershed soils and geology influencing stream function is the shape of the larger sediment material, of which much of the substrate material in local stream channels is comprised. Most of the gravel- and cobble-sized material is flat and plate-shaped. Sediment material so shaped is highly mobile, and so is less resistant to high flow energy. The high mobility of the material means that, generally speaking, the bed characteristics of stream channels in the watershed are more susceptible to change, and most likely are changing more frequently and drastically than would bed features in a channel where sediment materials are more rounded, with higher densities per unit surface area, and therefore less mobile, all other watershed conditions remaining equal. What this means is that local geologic and soil conditions dictate that streams in the County are more susceptible to change, and are less resistant to negative impacts to channel and/or bank stability.

Much of the surface soil in the watershed is underlain by a fairly shallow (typically @ 12" to 24" below the surface) fragipan. This poorly permeable, lens-like layer often prevents substantial recharge of the underground aquifer. This condition lends a flashy nature to local streams in the watershed. In regions where no fragipan is present, adequate infiltration of rainwater leads to percolation into the ground aquifer. This removes much of the water which would enter the stream immediately as surface runoff (see 'Removal and Alteration of Vegetative Cover'). Instead, this water is slowly injected into the stream through the ground aquifer. The result is a more consistent streamflow regime over time. Stream discharge increases moderately during a normal rain event, and then falls gradually, but not drastically due to the constant influence of water from the ground aquifer. In this fashion, streamflows fluctuate less during periods of high and low precipitation.

This is not the case where a shallow fragipan affects percolation into the ground aquifer. Much of the water which might usually percolate into the ground aquifer, slowly recharging streamflow over an extended period of time, is instead intercepted by this fragipan, and after rapidly saturating the shallow soil layer above is discharged directly to the stream as runoff. Therefore, more water reaches the stream directly as runoff. At the same time, there is significantly less recharge of the groundwater aquifer, meaning that the less water is available for long-term injection to the stream from the aquifer. The end result is a more drastic increase in stream discharge during a rain event, followed by a substantial lowering of discharge after the initial runoff passes through. In this manner, streams in the County are flashy by nature, rising quickly during precipitation events and then lowering drastically shortly after the event has ended. This flashy nature translate into more frequent bankfull flow events, more frequent floods, and lower base flows during periods of low precipitation. The combination of this naturally occurring fragipan effect and the low resistance threshold of local soils, on top of all of the anthropogenic impacts to the streams in the watershed, culminate in the impaired conditions evident throughout the County.

The presence of this impervious subterranean layer also affects streambank stability. In areas where bank slopes have been substantially increased due to accelerated erosion, the fragipan layer is often exposed. When the sandy or silty bank material above the fragipan becomes saturated during a precipitation event or from offsite drainage, this already highly erodible material becomes even more easily moved as it slides across the slick surface of the fragipan layer, which is often comprised mostly of clay.

AMBIENT CONTRIBUTING CONDITIONS:

Local Soils, Geology, Topography, Waterways Network, Weather, and People

QUANTIFICATION OF POTENTIAL SOURCES:

See Attached Supporting Documentation (Excel Spreadsheet)

4346.4 Miles of Total Stream Bank Miles in Bradford County between the Major Sub-Watersheds of Bentley, Laning, Satterlee, Seeley, South, Sugar, Towanda, Wappessening, Wyalusing, and Wysox Creek and the Susquehanna and Chemung Rivers.

It has been estimated that 13.6% of stream banks are eroding. (Data from Sugar Creek Watershed Assessment)

Therefore, 4346.4 miles X 13.6% = ***295.9 Miles of Eroding Banks in Bradford County or 1,562,352 feet.***

Soil loss estimated through the evaluation of site specific data from the Sugar Creek Watershed Assessment and collaborated by data from the Bentley Creek Tributary Assessment indicates an average amount of .623 tons per foot per year. According to a published study by Lloyd A. Reed of the U.S. Geological Survey presented to the American Geophysical Union, Geochemical Society, and Mineralogical Society of America at their 1995 spring meeting, sediments characteristic of those in Bradford County remain in suspension much longer then previously anticipated. In fact, as much as 50% of the fine sediments could reach the Chesapeake Bay or be trapped by the dams on the Susquehanna, from Bradford County. It is also a safe assumption that 50% of the typical soils in the County can be classified as fines.

Therefore the following calculations can be assumed as accurate:

1,562,352 feet of eroding stream bank X .623 tons = 973,345 tons annually are lost directly into Bradford County streams through bank erosion. 50% or 486,672 tons are fines, and of that number, 50% or 243,336 tons potentially reach the Chesapeake Bay.

Additionally, based on average contributions of 2.5 pounds of nitrogen and1 pound of phosphorous (USDA NRCS *Bentley Creek Preliminary Report)* for each ton of sediment of stream bank soil, ***608,340 pounds of nitrogen and 243,336 pounds of phosphorous are delivered to the Bay.***

In summary:

- ⇨ 1,562,352 feet or 295.9 miles of streambanks are eroding in Bradford County
- ⇨ 973,345 tons of sediment are entering Bradford County Streams from streambanks annually.
- ⇨ 243,336 tons of sediment are reaching the Chesapeake Bay from Bradford County streambanks annually.
- ⇨ 243,336 pounds of phosphorous are reaching the Chesapeake Bay from Bradford County streambanks annually.
- ⇨ 608,340 pounds of nitrogen are reaching the Chesapeake Bay from Bradford County streambanks annually.

DEP Tributary Strategy Plan goals target Bradford County to install

8.82 miles of Non-Urban Stream Restoration by 2010

Potential Best Management Practices to Address Sediment Source Stabilization Related to Streams:

Natural Stream Channel Design
Riparian Plantings
Riparian Easements
Stormwater Management Planning
Creation of Floodplain Access
Flood Water Detention/Retention
Land Purchasing
Riparian Management Planning
Streambank Stabilization - Structure
Streambank Stabilization - Bioengineering
Stream Channel Stabilization
Landowner Education
Municipal Official Education
Watershed Association Development and Education
Watershed Planning
Contractor Education

Proposed Needs to Address All Above Identified Sources by 2010:

STAFFING NEEDS

- ***EDUCATION – MUNICIPALITIES, WATERSHED GROUPS, LANDOWNERS, AGENCIES***
  - ***1/2 MAN YEAR @ $30,000/YEAR X ½ = $15,000/YEAR X 5 YEARS =*** *$75,000*
- ***ASSESSMENT, DESIGN, CONSTRUCTION OVERSIGHT AND ADMINISTRATION***
  - ***2 FULL-TIME @ $30,000/YEAR X 2 = $60,000/YEAR X 5 YEARS =*** *$300,000*
- ***PROJECT ENGINEER***
  - ***¼ MAN YEAR @ $64,000/YEAR X ¼ = $16,000/YEAR X 5 YEARS =*** *$80,000*
- ***ADMINISTRATIVE SUPPORT***
  - ***¼ MAN YEAR @ $30,000/YEAR X ¼ = $7,500/YEAR X 5 YEARS =*** *$37,500*

BEST MANAGEMENT PRACTICES INSTALLATION

$132,000 - $528,000 PER MILE X 8.82 MILES = *$1,164,240 – $4,656,960*

TOTAL REQUIRED MONETARY NEEDS:
$1,656,740 - $5,149,460

DATA SOURCES:

- ***SUGAR CREEK TRIAGE REPORT***
- ***BENTLEY CREEK TRIBUTARY ASSESSMENT***
- ***TOWANDA CREEK WATERSHED ASSESSMENT***
- ***LLOYD A. REED, U.S. GEOLOGICAL SURVEY PRESENTED TO THE AMERICAN GEOPHYSICAL UNION, GEOCHEMICAL SOCIETY, AND MINERALOGICAL SOCIETY OF AMERICA AT THEIR 1995 SPRING MEETING***

Watershed Name	1st Order Streams (miles)	2nd Order Streams (miles)	3rd Order Streams (miles)	4th Order Streams (miles)	5th Order Streams (miles)	6th Order Streams (miles)	0th Order Streams (miles)	Total Stream Mileage in Watershed	Total Stream Bank Length in Watershed	Total Mileage of Eroding Stream Banks*
Bentley Creek Watershed	43.7	20.6	6.5	4.6				75.4	150.8	**10.3**
Chemung River Watershed	41	17.5	9.8	0.6	2.8			71.7	143.4	**9.8**
Laning Creek Watershed	15.4	6.1	8.6					30.1	60.2	**4.1**
Satterlee Creek Watershed	11.6	7.1	1					19.7	39.4	**2.7**
Seeley Creek Watershed	18.8	3.6	4.8					27.2	54.4	**3.7**
South Creek Watershed	30.7	10.6	8.3					49.6	99.2	**6.8**
Sugar Creek Watershed	161.2	70	30.4	23.5				285.1	570.2	**38.8**
Susquehann River Watershed	302.1	131.1	42.5	32.9	6.5	27.3	53.3	595.7	1191.4	**81.1**
Towanda Creek Watershed	303	107.6	45.6	39.7	25.6			521.5	1043	**71.0**
Wappasening Creek Watershed	73	32.6	11.3	13				129.9	259.8	**17.7**
Wyalusing Creek Watershed	87.7	38.8	19.7	1.7	16.9			164.8	329.6	**22.4**
Wysox Creek Watershed	109.7	51.3	29.2	8.2	4.1			202.5	405	**27.6**

Grand Total Stream Bank Mileage in Bradford County
4346.4

Grand Total Eroding Stream Bank Mileage in Bradford County
295.9

Values Generated from BCCD Assessment of Sugar Creek Watershed's 2nd, 3rd, and 4th Order Streams

Total Erosion Sites Identified	166	**Total Erosion Sites Identified**	166
Total Length of Sites (feet)	178161	**Total Length of Sites (mile)**	33.7
Total Area of Sites (square feet)	1208324	**Total Area of Sites (square mile)**	0.043
Average Site Length (feet)	1073	**Average Site Length (mile)**	0.20
Average Site Height (feet)	7.8	**Average Site Height (mile)**	0.0015
Average Site Area (square feet)	7279	**Average Site Area (square mile)**	0.00026

Percentage of Eroding Streams for Sugar Creek Watershed's 2nd, 3rd, and 4th Order Streams **13.6%**

* It is being assumed that 13.6% of total stream banks of each watershed are eroding.