USDA United States Department of Agriculture

NRCS and Stream Work

~

an overview of NRCS work related to streams and rivers

Noller Herbert, PE, Director, Conservation Engineering Division, NRCS-NHQ, Washington, DC
and
Jon Fripp, PE, Stream Mechanics Civil Engineer, NRCS-NDCSMC, Fort Worth, Texas

~

CBP AgWG Presentation 21 May 2020

NRCS Natural Resources Conservation Service

1

USDA United States Department of Agriculture

The Issue

- Declining stream quality in the Chesapeake Bay watershed is a function of historic land use and present day urbanization.
- Bay states are considering greater use of stream restoration as part of an overall watershed strategy to meet nutrient and sediment load reduction targets for existing urban development under the Chesapeake Bay TMDL.
- Concerns are TP, TN, and TSS

*Excerpted from the USWG Stream Restoration Expert Panel 2013 report

2

USDA United States Department of Agriculture

The Question:

How NRCS practices ***do*** or ***do not*** fit into the Chesapeake Bay Program's current definition of "stream restoration"*

- Focus of program is on urban streams.
- Stream restoration projects that are designed to protect public infrastructure by bank armoring or rip rap **do not** qualify for a credit.
- The stream reach must be greater than 100 feet in length
- Projects must be directed towards areas of more severe stream impairment
- Most projects will be located on first- to third-order streams
- Stream restoration projects must provide functional lift
- Special consideration is given to projects that are explicitly designed to reconnect the stream with its floodplain or create wetlands and instream habitat features known to promote nutrient uptake or denitrification.
- Stream restoration projects must be part of a comprehensive watershed management plan
- The project must utilize a comprehensive approach to stream restoration design, addressing long-term stability of the channel, banks, and floodplain.

*Basic qualifying conditions excerpted from section 4.2 of the USWG Stream Restoration Expert Panel 2013 report supplemented with material from the 2020 report

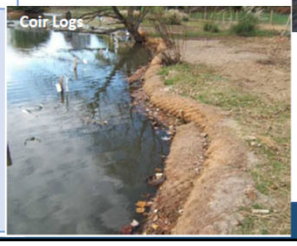
3

USDA United States Department of Agriculture

Table 3. Designation of streambank armoring practices

Tier	Examples
Non-Creditable **Definition: Hard, permanent structures used to protect critical infrastructure and stabilize banks. Techniques are not consistent with long-term, comprehensive restoration approaches.**	• Concrete Retaining Wall • Sheet Piling/Planking • Gabion • Engineered Block Walls • A-Jacks • Dumped Rip Rap
Creditable w/ Limits[1] <1/3 of site? **Definition: Large rock or boulder structures that harden a limited portion of a bank or bank toe in a localized area.**	• Localized stone toe protection • Boulder Revetments • Non-biodegradable soil stabilization mats • Imbricated Rip Rap
Creditable **Definition: Structures that mimic naturally occurring streambank materials, features that provide aquatic habitat function, and limited in-stream grade control.**	• Root wad Revetments • Live stakes/coir logs • Soil lifts[2] • Riffle-weir series (including cobble in appropriate physiographic regions) • Berm-pool cascades • J-hooks and cross-veins

The use of softer natural materials (i.e. vegetation and wood) -- combined with floodplain reconnection -- to stabilize banks and dissipate energy are still recommended because of the functional uplift and habitat benefits provided by these approaches.*



*Excerpted from the USWG Stream Restoration Expert Panel 2020 report

4

4

USDA United States Department of Agriculture

Outline of this talk…

1. NRCS and Streams
   a) History
   b) Planning
   c) Example Work
2. Conservation Practice Standards
   a) What they are
   b) Where they are applied
3. NRCS Technical Guidance
   a) NEH 653
   b) NEH 654
   c) Example Applications

USDA | NRCS | *An overview of Stream Restoration in NRCS* 5

5

USDA United States Department of Agriculture

Natural Resources Conservation Service (NRCS)

https://www.nrcs.usda.gov

MISSION:

The NRCS provides leadership in a partnership effort to help people conserve, maintain, and improve our natural resources and environment

USDA | NRCS | *An overview of Stream Restoration in NRCS* 6

6

USDA United States Department of Agriculture

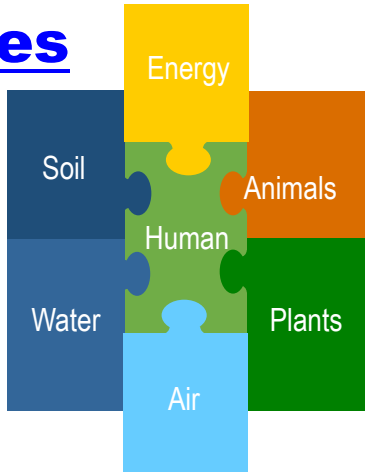
Definition: Natural Resources

Natural Resources include:

- Soil
- Water
- Air
- Plants
- Animals
- Energy
- Human Considerations

➢ **SWAPA+H+E**

These elements need to fit together ~ like a puzzle



➢ **Within a watershed context**

7

USDA United States Department of Agriculture

Natural Resources Conservation Service (NRCS)

https://www.nrcs.usda.gov

- NRCS provides America's farmers and ranchers with financial and technical assistance to voluntarily put conservation on the ground
- Delivers science-based technical assistance to private land owners, local, state and federal agencies and policymakers
- NRCS Conservation districts serves almost every county in the nation
- Provides cost share and financial incentives
- Work with local partners.
- Participation in programs is voluntary
- Support locally-led efforts

Examples of Conservation Programs

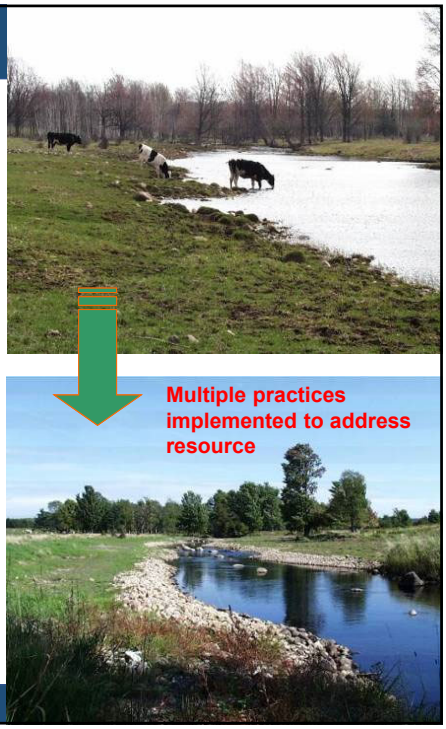
Environmental Quality Incentives Program (EQIP)
Conservation Stewardship Program (CSP)
Soil and Water Conservation Assistance (SWCA)
Wildlife Habitat Incentives Program (WHIP)
Emergency Conservation Program (ECP)
Wetland Reserve Program (WRP)
Emergency Watershed Protection (EWP)
Watershed Protection and Flood Prevention (PL-566)
Upstream Flood Prevention Program (PL-534)
Watershed Rehabilitation
Flood Control Act of 1944 (PL-534) Watershed Protection and Flood Prevention Act of 1954 (PL-566, Small Watershed Program)
Pilot Watershed Program and RC&D program

8

USDA United States Department of Agriculture

How does the NRCS get involved with streambank stabilization and stream restoration projects?

- One landowner
- Several landowners
- Community action/awareness
- Regulatory enforcement: TMDLs, rare or endangered species
- Programs: state, federal, local
- Political impetus



9

USDA United States Department of Agriculture

The Planning Process

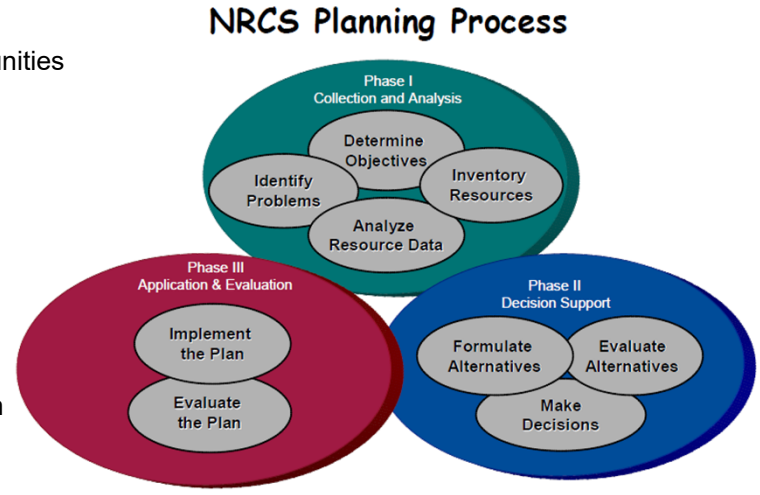
- **Phase I – Collection and Analysis**
- Step 1: Identify Problems and Opportunities
- Step 2: Determine Objectives
- Step 3: Inventory Resources
- Step 4: Analyze Resource Data

Phase II – Decision Support

- Step 5: Formulate Alternatives
- Step 6: Evaluate Alternatives
- Step 7: Make Decisions

Phase III – Application and Evaluation

- Step 8: Implement the Plan
- Step 9: Evaluate the Plan

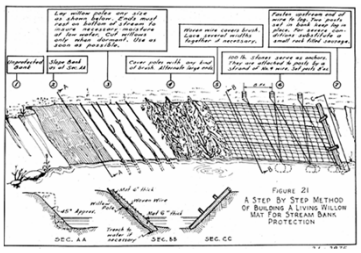


10

USDA United States Department of Agriculture

Natural Resources Conservation Service *and work in channels*

- NRCS has been involved in channel work since the beginning of the agency
- Average annual EQIP program expenditures* of approximately $21 million on channel and channel related work
- Annual Emergency Watershed Work of approximately $70 million**



* Federal Monies. Seven year (2012-2018) average for Conservation Practice Standards 326, 356, 395, 396, 578, 580, 582, 584. Does not include wetlands, riparian buffers or nutrient work
** FY 2018 Emergency work. Includes hurricane recovery

USDA | NRCS | *An overview of Stream Restoration in NRCS* 11

11

USDA Unit

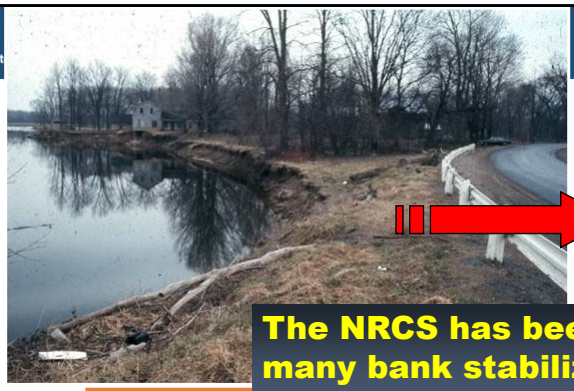


Photo from Don Shanklin

The NRCS has been involved in many bank stabilization projects

USDA | NRCS | *An overview*

12


USDA
United States Department of Agric
Sawmill Creek, MA
Creditable with limits per USWG?
Combinations of Hard Bank Protection and Streambank Soil Bioengineering
The NRCS has been involved in many bank stabilization projects
Creditable per USWG?
USDA | NRCS | An overview of Stre

13


Different Types of Channels are Designed as part of NRCS projects
Some of these may match the
Protocol 1- Sediment
Protocol 2 – Denitrification
Protocol 3 –Floodplain reconnection

14

USDA United States Department of Agriculture

The NRCS work not only provides benefits through stopping damage due to erosion but also benefits from a reduction of sediment load

- ➢ Drainage channels can be impacted by sediment deposition

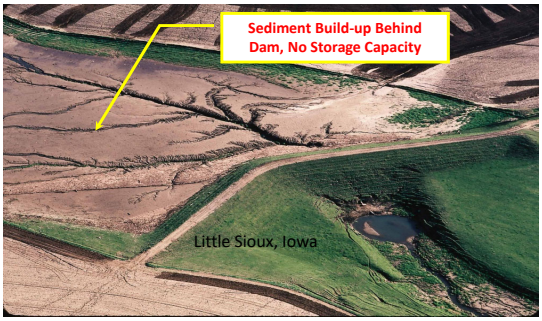
- ▪ Drainage channel invert grade above adjacent ground
- ▪ Drainage is no longer functioning
- ➢ Excessive ponding in pasture

15

USDA United States Department of Agriculture

Sedimentation impacts to Dam Operations are a concern to NRCS

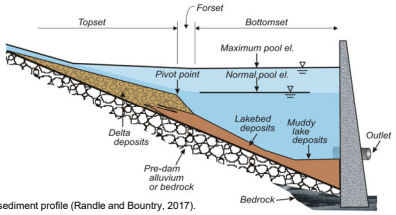
- **Most streams and rivers naturally balance sediment and water through the system**
- **Dam construction modifies this balance**
- **Dams alter the natural flow of water**
- **Dams essentially stop the natural transport of sediment**



- ➢ **Reservoirs hold the water**
- ➢ **Reservoirs hold the sediment**

- **Loss of flood protection**
- **Loss of water storage**
- **Impact water control structures**
- **Bury boat launch ramps**
- **Impacts to release and control**
- **Increased dam safety risks**
- **Aggradation of upstream channels**
- **Water quality impacts**

Recovery of volume through dredging can cost 3 to 5x what it cost to create that volume



Example reservoir sediment profile (Randle and Bountry, 2017).

16

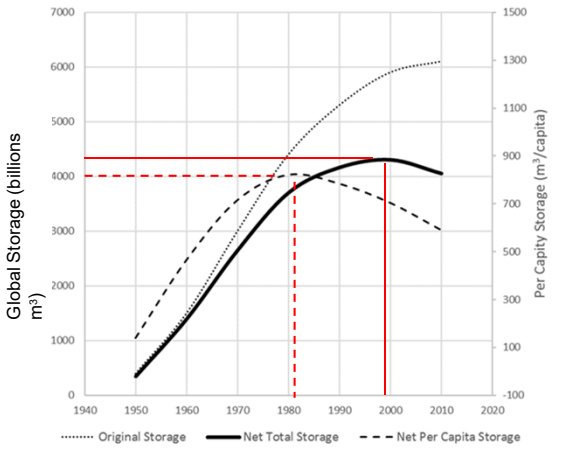
USDA United States Department of Agriculture

Sedimentation is not just an issue for NRCS projects but it is also an international problem….

On a world-wide average, the rate of reservoir storage being lost to sedimentation is greater than the rate of storage being added by construction. World-wide reservoir storage per capita peaked several decades ago. It is now back to 1965 levels due to sedimentation.

2/3rds of reservoir uses are entirely dependent on storage...and we lose and average of 0.2% per year in the US

Reductions in Global Reservoir Storage



George Annandale, 2013

USDA | NRCS | *An overview of Stream Restoration in NRCS* 17

17

USDA United States Department of Agriculture

Impacts on NRCS dams and reservoirs

- Often seen on the outlet works
- Flood detention function is less susceptible to sediment impacts than flood storage function

Costs of bank protection compared to cost of dredging: Costs of bank stabilization recovered in 1-2 years

USDA | NRCS | *An overview of Stream Restoration in NRCS* 18

18

USDA United States Department of Agriculture

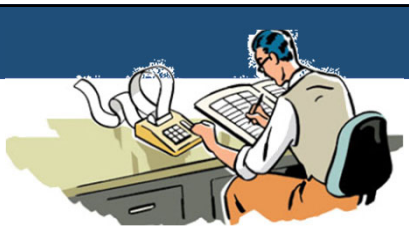
Catchment Protection ~ A Standard NRCS tool

- Example: The watershed should have Soil Conservation and Watershed Protection before building a dam*
  - Maintain Natural Vegetation
  - Control Grazing
  - Maintain Cover on Agriculture (no till, green manure, etc.)
  - Install and Maintain Riparian Buffers
  - Stabilize Gullies (grading, check dams, etc.)
  - Install silt/sediment traps in unstable watersheds
  - Slow Rain Runoff (contour grading, terraces, hillside ditches, micro catchments, etc.)

*May take 3-5 years to fully take affect See http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_010704.pdf

USDA United States Department of Agriculture

Sheet and Rill Erosion



- Value per ton of eroded soil: $5.72
- Benefits are accrued both off-site and on-site.
- Off-site benefits accounted mostly for reductions in **public works costs for removing eroded sediment from waterways**, water quality and recreational benefits
- On-site benefits considered reduced losses of purchased fertilizers due to reduced erosion rates
- Total benefit would likely be larger in highly erodible lands and if related services, such as plant productivity, were included.

Table 4: Comparative return on investment of major conservation programs. Note that the referenced ROIs were completed with different methodologies and at different times, thus these estimates may not be directly comparable.

Program	Cost	Benefit	ROI (Source)
CRP	$1.7 billion	$3.5 billion	$2.19 (Wu & Weber 2012)
EQIP	$2.08 billion	$2.09 billion	$1.01 (NRCS 2009)
CSP [1]	$1.29 billion ($17.89 acre^{-1})	$21.81 acre^{-1}	$1.83-3.95 (present study)

USDA United States Department of Agriculture

Conservation Practice Standards (CPS)

The conservation practice standard contains information on:

- why the practice is applied
- where the practice is applied,
- and it sets forth the minimum quality criteria that must be met during the application of that practice in order for it to achieve its intended purpose(s).

CPS – as with the NEM, they are policy
BUT – they are not construction specifications

21

USDA United States Department of Agriculture

USDA United States Department of Agriculture 584-CPS-1

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

CHANNEL BED STABILIZATION …one example

Code 584

(Ft.)

DEFINITION

Measure(s) used to stabilize the bed or bottom of a channel.

PURPOSE What

This practice may support one or more of the following:

- Maintain or alter channel bed elevation or gradient
- Modify sediment transport or deposition
- Manage surface water and groundwater levels in floodplains, riparian areas, and wetlands

CONDITIONS WHERE PRACTICE APPLIES Where

This practice applies to the beds of existing or newly constructed alluvial or threshold channels undergoing damaging aggradation or degradation that cannot be feasibly controlled by clearing or snagging, establishment of vegetative protection, installation of bank protection, or installation of upstream water control measures.

This practice also applies to channels where the removal of barriers to aquatic organism passage would result in destabilization of the channel bed.

CRITERIA How

Design and install measures according to a site-specific plan in accordance with all local, State, Tribal

Addresses the question: *"what guidelines do we need to follow for this design in the field?"*

584-CPS-3

PLANS AND SPECIFICATIONS

Prepare plans and specifications for specific channel reaches and field sites that describe the requirements for applying the practice to achieve its intended purpose(s). At the minimum the plan will include:

- Topographic map
- Drainage area
- Velocities
- Safety

OPERATION AND MAINTENANCE

Prepare an Operation and Maintenance plan that provides specific instructions for operating and maintaining the system to ensure it functions properly. Provide for periodic inspections and promptly repair or replacement of damaged components.

REFERENCES

USDA, NRCS, Conservation Engineering Division, National Engineering Handbook, Part 653, Stream Corridor Restoration.

USDA, NRCS, Conservation Engineering Division, National Engineering Handbook Part 654, Stream Restoration Design.

USDA, NRCS, Stream Restoration Planning and Design, Fluvial System Stabilization and Restoration Field Guide.

Not a lot of detail – for example, this one is 3 pages

22

USDA United States Department of Agriculture

USDA United States Department of Agriculture 395-CPS-1

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

STREAM HABITAT IMPROVEMENT AND MANAGEMENT

CODE 395

(ac)

…and another example

DEFINITION

Improve, restore, or maintain the ecological functions of a stream and its adjacent floodplain and riparian area.

PURPOSE **What**

This practice is used to accomplish one or more of the following purposes:

- Improve or manage stream habitat by evaluating and addressing factors that impair stream function and structure.

CONDITIONS WHERE PRACTICE APPLIES

All streams and their associated backwaters, floodplains, wetlands, and riparian areas with impaired habitat.

This practice does not apply to— **Where**

- The management of fish and wildlife habitat on wetlands enhanced under this standard.
- Streambed or bank stabilization; instead, use Conservation Practice Standard (CPS) Streambank and Shoreline Protection (Code 580), or CPS Channel Bed Stabilization (Code 584).

This practice may be used in conjunction with other practices to address multiple resource concerns at the site.

CRITERIA **How**

General Criteria Applicable to All Purposes

Use this practice to assess, evaluate, and prescribe a comprehensive plan for stream habitat improvement, including the use of associated practices to address functionally connected floodplains and wetlands.

395-CPS-4

REFERENCES

Bureau of Land Management. 1998. Riparian Area Management: A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas. TR-1737-15.

Federal Interagency Stream Restoration Working Group (FISRWG). 1998, revised October 2010. National Engineering Handbook, Part 653, Stream Corridor Restoration: Principles, Processes and Practices.

Gregory, S V., K.L. Boyer, and A.M. Gurnell, editors. 2003. The Ecology and Management of Wood in World Rivers. American Fisheries Society, Symposium 37. Bethesda, MD.

USDA NRCS. 1998. The Practical Streambank Bioengineering Guide. https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/idpmcpu116.pdf. Accessed October 23, 2018.

USDA NRCS. 2002. Streambank Soil Bioengineering Field Guide for Low Precipitation Areas. https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/idpmcpussbfglpa.pdf. Accessed October 23, 2018.

USDA NRCS. 2004. National Biology Handbook, Aquatic and Terrestrial Habitat Resources.

USDA NRCS. 2008. National Engineering Handbook, Part 654, Stream Restoration Design.

USDA NRCS. 2009. National Biology Handbook, Part 614, Subpart B, Stream Visual Assessment Protocol, Version 2.

USDA NRCS. 2010. National Engineering Handbook, Part 653, Stream Corridor Restoration: Principles, Processes, and Practices.

Lots of references and guidance documents. This is the how-to ….more on this later.

23

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

STREAMBANK AND SHORELINE PROTECTION

(Ft.)

CPS 580 is commonly used

CODE 580

DEFINITION

Treatment(s) used to stabilize and protect banks of streams or constructed channels, and shorelines of lakes, reservoirs, or estuaries.

PURPOSE

- To prevent the loss of land or damage to land uses, or facilities adjacent to the banks of streams or constructed channels, shoreline of lakes, reservoirs, or estuaries including the protection of known historical, archeological, and traditional cultural properties.
- To maintain the flow capacity of streams or channels.
- Reduce the offsite or downstream effects of sediment resulting from bank erosion.
- To improve or enhance the stream corridor for fish and wildlife habitat, aesthetics, recreation.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to streambanks of natural or constructed channels and shorelines of lakes, reservoirs, or estuaries where they are susceptible to erosion. It does not apply to erosion problems on main ocean fronts, beaches or similar areas of complexity.

CRITERIA

General Criteria Applicable to All Purposes

Treatments shall be in accordance with all applicable local, state and federal laws and regulations.

Treatments applied shall seek to avoid adverse effects to endangered, threatened, and candidate species and their habitats, whenever possible.

Treatments applied shall seek to avoid adverse effects to archaeological, historic, structural, and traditional cultural properties, whenever possible.

An assessment of unstable streambank or shoreline sites shall be conducted in sufficient detail to identify the causes contributing to the instability (e.g. livestock access, watershed alterations resulting in significant modifications of discharge or sediment production, in channel modifications such as gravel mining, head cutting, water level fluctuations, boat-generated waves, etc.).

Proposed protective treatments to be applied shall be compatible with improvements being planned or installed by others.

Protective treatments shall be compatible with the bank or shoreline materials, water chemistry, channel or lake hydraulics, and slope characteristics above and below the water line.

End sections of treatment areas shall be adequately anchored to existing treatments, terminate in stable areas, or be otherwise stabilized to prevent flanking of the treatment.

Protective treatments shall be installed that result in stable slopes. Design limitations of the bank or shoreline materials and type of measure installed shall determine steepest permissible slopes.

Designs will provide for protection of installed treatments from overbank flows resulting from upslope runoff and flood return flows.

Internal drainage for bank seepage shall be provided when needed. Geotextiles or properly

Note some of the general guidelines

Treatments that promote beneficial sediment deposition and the filtering of sediment, sediment-attached, and dissolved substances should be considered.

Where toe protection alone is inadequate to stabilize the bank, the upper bank shall be shaped to a stable slope and vegetated, or shall be stabilized with structural or soil-bioengineering treatments.

Consider maximizing adjacent wetland functions and values with the project design and minimize adverse effects to existing wetland functions and values.

Stream corridor vegetative components shall be established as necessary for ecosystem functioning and stability. The appropriate composition of vegetative components is a key element in preventing excess long-term channel migration in re-established stream corridors. The establishment of vegetation on channel banks and associated areas shall also be in accordance with conservation practice standard Critical Area Planting, Code 342.

These do not appear to be in conflict with the Basic Qualifying Conditions described in the 2013 and 2020 USWG Stream Restoration Expert Panel reports

But these NRCS guidelines in the CPS are more inclusive

And NRCS does not require measurements with bank pins, bulk density, TN, TP, etc

24

USDA United States Department of Agriculture

There are many other Conservation Practice Standards (CPS) that affect waterways

CPS	Name	CPS	Name
580	Streambank and Shoreline Protection	647	Fence
584	Channel Stabilization	393	Filter Strip
582	Open Channel	590	Nutrient Management
396	Fish Passage	528	Prescribed Grazing
395	Stream Habitat Improvement	614	Watering Facility
578	Stream Crossings	391	Riparian Forest Buffer
326	Clearing and Snagging	*Etc…etc…etc…etc…*	
472	Use Exclusion		
342	Critical Area Planting		

Several can be applied to address a single problem in a stream or river

USDA | NRCS | *An overview of Stream Restoration in NRCS* 25

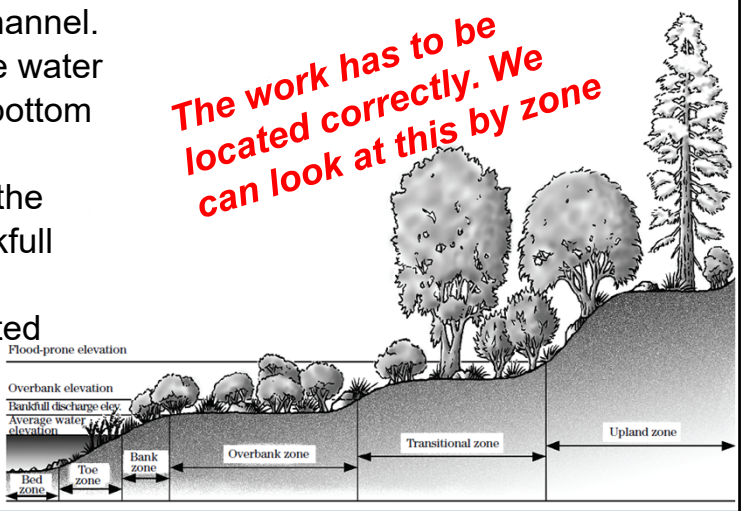
25

USDA United States Department of Agriculture

So where do we apply these CPS?

Bed zone—The bottom of the channel.
Toe zone—Between the average water level and the upper edge of the bottom of the channel.
Bank zone—The area between the average water level and the bankfull discharge elevation.
Overbank zone—The area located above the bankfull discharge

The work has to be located correctly. We can look at this by zone

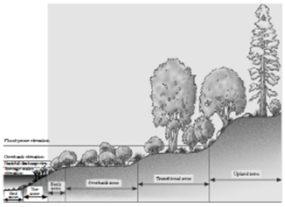
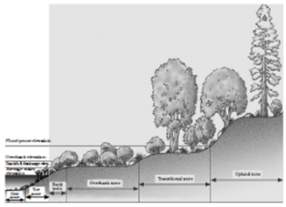


USDA | NRCS | *An overview of Stream Restoration in NRCS* 26

26

USDA United States Departme

Depending on the issue in the channel, a variety of NRCS Conservation Practice Standards can be selected

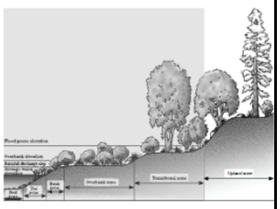
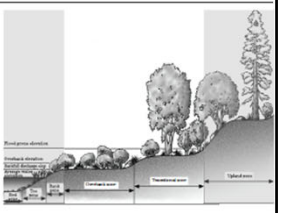
Impairment	Landscape zones	Primary NRCS Conservation Practice Standards	Considerations and effects: accelerated erosion, sediment, and site instability	Landscape zones
Unbalanced channel sediment transport and deposition; unstable channel bed and/or gradient[2]	Bed, toe	Open Channel (582)	Various techniques including channel meander reconstruction at a site will reconfigure the bed and bank topography and influence the extent of overbank and transitional zones and related soil moisture and the selection of vegetation species	
		Channel Stabilization (584)	Measures to support balance and stability will reduce risk of bank recession and damage to overbank zone vegetation	
		Clearing and Snagging (326)	Where practical, restore native vegetation to all bank, overbank and transitional areas disturbed by use, ingress, or egress of obstruction removal equipment	
Accelerated bank erosion and instability[2]	Bank, toe	Channel Bank Vegetation (322)	In the overbank zone nearest the stream, use the same or similar riparian area plant species as channel bank vegetation to provide additional support to controlling bank erosion	
		Streambank and Shoreline Protection (580)	See notes for Channel Bank Vegetation (322), which is the vegetation component of this practice	
		Clearing and Snagging (326)	Restore vegetation (native species where practical) to all bank, overbank and transitional areas disturbed by use, ingress and egress of obstruction removal equipment	

From NEH 654.4

27

USDA United States Department of Agri

Programs recognize that impairments away from the stream can affect a waterway

Impairment	Landscape zones	Primary NRCS Conservation Practice Standards	Considerations and effects: unsuited or insufficient production/land use	Landscape zones
Point source and nonpoint source pollution, water diversions, flow modifications caused by structures (dams), hydrologic modifications caused by urbanization and other changed land uses	Upland	Nutrient Management (590) Residue and Tillage Management (329, 344, 345, 346), Conservation Crop Rotation (328) Conservation Cover (327) Filter Strip (393) Terrace (600) Water and Sediment Control Basin (638) Waste Treatment and Storage (313, 359. 367, 629, 633, 635) Sediment Basin (350) Subsurface Drain (606) Surface Drainage (606, 607, 608) Constructed Wetland (656)	Protection of watershed areas that contribute water, sediment, and chemicals to the stream may be required to reach the restoration goals of the project. Watershed land use and cover, conservation treatments, and the amount of land converted to urban or suburban uses can have significant effects on runoff to the stream, both in terms of lag times and peak flows	
Excessive sediment and/or other pollutants in runoff reaching the channel	Overbank and transitional	Filter Strip (393)	Introduced herbaceous species filter sediment in runoff reaching and passing through the strip. In areas with forest potential, filter strips are used as zone 3 of a riparian forest buffer to filter and slow upland runoff	
		Riparian Forest Buffer (391)	Tree and shrub species further slow upland runoff and aid in the infiltration of pollutant-laden water. Uptake and microbial processes break down nitrates and pesticides. Riparian forest buffers are not intended to withstand unabated upland runoff. Native woody species may not be of sufficient vigor or establish quickly enough for some pollutant loadings	

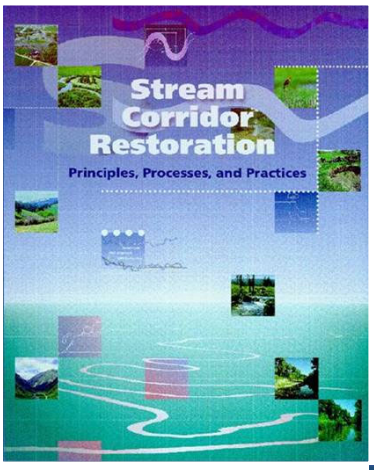
From NEH 654.4

28

USDA United States Department of Agriculture

NEH-653 Stream Corridor Restoration: Principles, Processes, and Practices

- 15 federal-agency effort
- NRCS Leadership role
- Download from www (NRCS)
- Awareness level, principles
- Planning process
- Intro to design and implementation
- Released 1998



While the CPS (and NEM) are 'have to', the NEH are 'how to' and 'ought to'

USDA | NRCS | *An overview of Stream Restoration in NRCS*

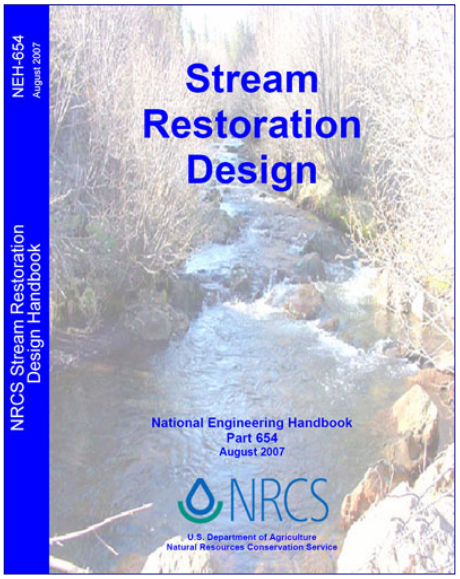
https://directives.sc.egov.usda.gov/viewerFS.aspx?hid=34826

29

USDA United States Department of Agriculture

NEH-654 Stream Restoration Design

- Released 09/20/2007
- NEH-654 provides NRCS field people with tools for designing stream restoration projects.
- Encompasses the full range of natural to structural treatments
- Fully integrate biological / fisheries / habitat issues
- National set of guidelines / tools / procedures



USDA | NRCS | *An overview of Stream Restoration in NRCS*

https://directives.sc.egov.usda.gov/viewerFS.aspx?hid=21433

30

USDA United States Department of Agriculture

Over 200 practitioners from government, private and academic fields have participated in the production of NEH 654

NRCS Natural Resources Conservation Service

Texas Transportation Institute

BURGESS & NIPLE

U.S. FISH & WILDLIFE SERVICE

HUITT-ZOLLARS

FOREST SERVICE U.S. DEPARTMENT OF AGRICULTURE

WISCONSIN DEPT. OF NATURAL RESOURCES

Hungry Canyons Alliance

MOBILE BOUNDARY HYDRAULICS
sediment flow analysis in streams and rivers in one dimension

USDA ARS National Sedimentation Laboratory

THE BIOENGINEERING GROUP, INC.

MACCAFERRI

Red River Basin Riparian Project

THE OHIO STATE UNIVERSITY

Plant Materials Center

Salix. Applied Earthcare

THE WATERSHED INSTITUTE

US Army Corps of Engineers

31

USDA United States Department of Agriculture

NEH654–Contents

- 17 Chapters
- 28 Technical Supplements
- 18 Case Studies
- Terminology section
- References

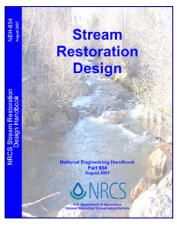


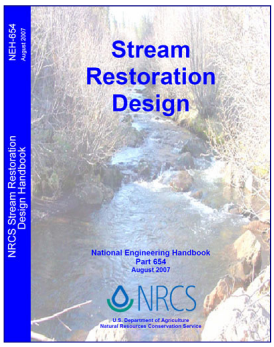
TABLE OF CONTENTS
NEH-654, NRCS Stream Restoration Design Handbook

32

USDA United States Department of Agriculture

NEH654–Chapters "PLANNING"

Chapter 1. Introduction: Ecological and Physical Considerations for Stream Projects
Chapter 2. Goals, Objectives and Risk
Chapter 3. Site Assessment and Investigation
Chapter 4. Stream Restoration Design Process



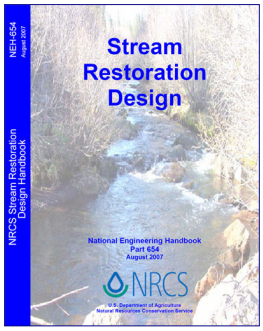
NEH654–Chapters "WATER IN THE STREAM"

Chapter 5. Stream Hydrology
Chapter 6. Stream Hydraulics

USDA United States Department of Agriculture

NEH654–Chapters "STREAM DESIGN"

Chapter 7. Basic Principles of Channel Design
Chapter 8. Threshold Channel Design
Chapter 9. Alluvial Channel Design
Chapter 10. Two-Stage Channel Design
Chapter 11. Rosgen Geomorphic Channel Design
Chapter 12. Channel Alignment and Variability Design
Chapter 13. Sediment Impact Assessments



NEH654–Chapters "DESIGN OF PRACTICES"

Chapter 14. Treatment Techniques Design

Chapter that summarizes and points to many of the tools in the Technical Supplements.

NEH654–Chapters "IMPLEMENTATION + MONITORING"

Chapter 15. Project Implementation
Chapter 16. Maintenance and Monitoring
Chapter 17. Permitting Overview

USDA United States Department of Agriculture

NEH654– Technical Supplements

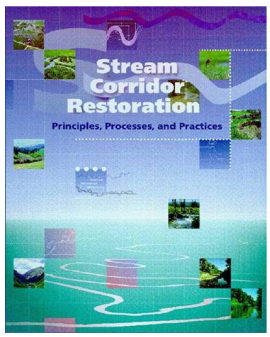
2 –Use of Historical Information for Design
3A –Stream Corridor Inventory and Assessment Techniques
3B –Using Aerial Videography and GIS for Stream Channel Stabilization in the Deep Loess Region of Western Iowa
3C –Streambank Inventory and Evaluation
3D –Overview of United States Bats
3E –Rosgen Stream Classification Technique – Supplemental Materials
5 –Developing Regional Relationships for Bankfull Discharge Using Bankfull Indices
13A–Guidelines for Sampling Bed Material
13B–Sediment Budget Example
14A–Soil Properties and Special Geotechnical Problems Related to Stream Stabilization Projects
14B–Scour Calculations
14C–Stone Sizing Criteria
14D–Geosynthetics in Stream Restoration
14E–The Use and Design of Soil Anchors
14F–Pile Foundations
14G– Grade Stabilization Techniques
14H– Flow Changing Techniques
14 I – Streambank Soil Bioengineering
14J– The Use of Large Woody Material for Habitat and Bank Protection
14K– Streambank Armor Protection with Stone Structures
14L– Use of Articulating Concrete Block Revetment Systems for Stream Restoration and Stabilization Projects
14M– Vegetated Rock Walls
14N–Fish Passage and Screening Design
14O–Stream Habitat Enhancement Using LUNKERS
14P–Gullies and Their Control
14Q–Abutment Design for Small Bridges
14R–Design and Use of Sheet Pile Walls in Stream Restoration and Stabilization Projects
14S–Sizing Stream Setbacks to Help Maintain Stream Stability

USDA United States Department of Agriculture

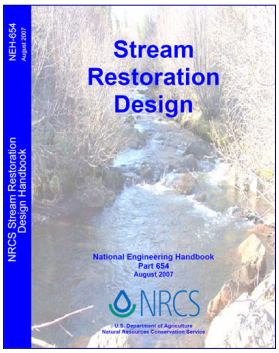
Companion Handbooks

NEH-653: Basic principles, planning.

- NEH-654: DESIGN Tools.



+

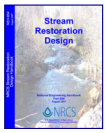


- NEH-654 does not replace NEH-653.
- NEH-654 depends on the basic principles in NEH-653.

USDA United States Department of Agriculture

Example Application

- Much of the on bank / in stream work is done to protect ***Natural Resources*** – i.e. farmland and infrastructure



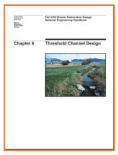
37

USDA United States Department of Agriculture

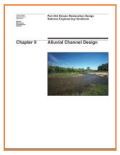
Example Application

- Bank stabilization
- Range of discharges and sediment
- Range of stable slopes/widths/depths estimated with analytical techniques for alluvial channels
- Threshold design criterion used to confirm stability
- Sediment impact assessment
- Structural bank/grade stabilization and stream bank soil bioengineering

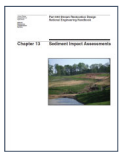
NEH 654.8



NEH 654.9



NEH 654.13



And NEH 654.14

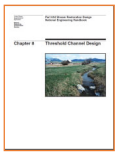
38

USDA United States Department of Agriculture

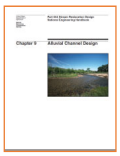
Example Application

- Bank stabilization
- Range of discharges and sediment
- Range of stable slopes/widths/depths estimated with analytical techniques for alluvial channels
- Threshold design criterion used to confirm stability
- Sediment impact assessment
- Structural bank/grade stabilization and stream bank soil bioengineering

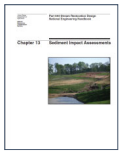
NEH 654.8



NEH 654.9



NEH 654.13



And NEH 654.14

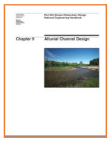
39

USDA United States Department of Agriculture

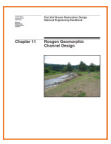
Example Application

- Habitat enhancement
- Range of discharges and sediment
- Range of stable slopes/ widths/ depths estimated with analytical techniques for alluvial channels
- Natural Channel Design criteria used for structures
- Sediment impact assessment

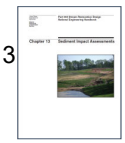
NEH 654.9



NEH 654.11



NEH 654.13



And NEH 654.14

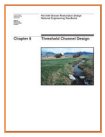
40

USDA United States Department of Agriculture

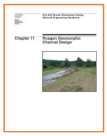
Example Application

- Bank Stabilization, Habitat Enhancement/restoration, Aesthetics
- Range of discharges and sediment
- Range of stable slopes/widths/depths estimated with analytical techniques for alluvial channels
- Threshold design criterion used to confirm stability
- Natural Channel Design criteria used for structures
- Structural bank stabilization and stream bank soil bioengineering
- Sediment impact assessment

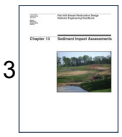
NEH 654.8



NEH 654.9



NEH 654.11



NEH 654.13

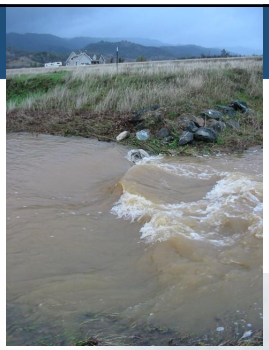
And NEH 654.14

41

USDA United States Department of Agriculture

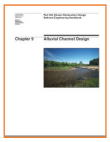
Example Application

- Bank stabilization, Channel Restoration
- Range of stable slopes/widths/depths estimated with analytical techniques for alluvial channels
- Threshold design criterion used to confirm stability
- Check alignment (Bend radius)
- Sediment impact assessment
- Structural bank/grade stabilization and stream bank soil bioengineering

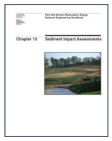


NEH 654.8

NEH 654.9



NEH 654.12



NEH 654.13

And NEH 654.14

42

USDA United States Department of Agriculture

Example Application

- Habitat restoration
- Small channel, minimal sediment inflow
- Reference reach based initial dimensions
- Threshold design criterion used to confirm stability
- Channel alignment
- Sediment impact assessment – a quick check
- Streambank soil bioengineering treatments limiting conditions

NEH 654.8

NEH 654.11

NEH 654.12

NEH 654.13

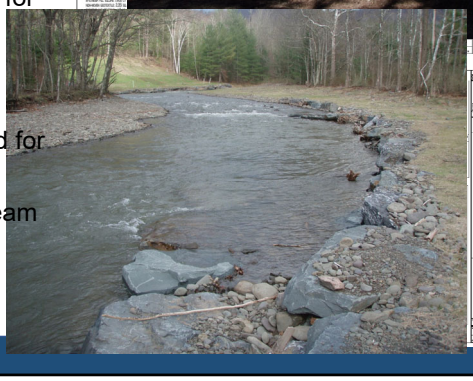
And NEH 654.14

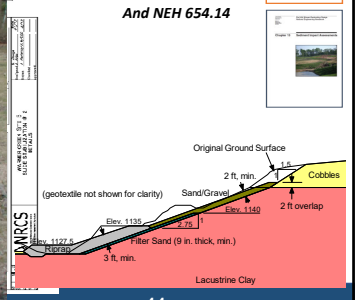
43

USDA United States Department of Agriculture

Example Application

- Stop Suspended Load/Wash Load Contribution, Bank Stabilization, Habitat Enhancement/Restoration, Aesthetics
- Range of discharges and sediment
- Range of stable slopes/widths/depths estimated with analytical techniques for alluvial channels
- Threshold design criterion used to confirm stability
- Natural Channel Design criteria used for structures and outline
- Structural bank stabilization and stream bank soil bioengineering
- Sediment impact assessment





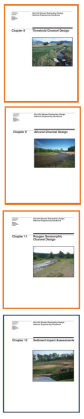
NEH 654.8

NEH 654.9

NEH 654.11

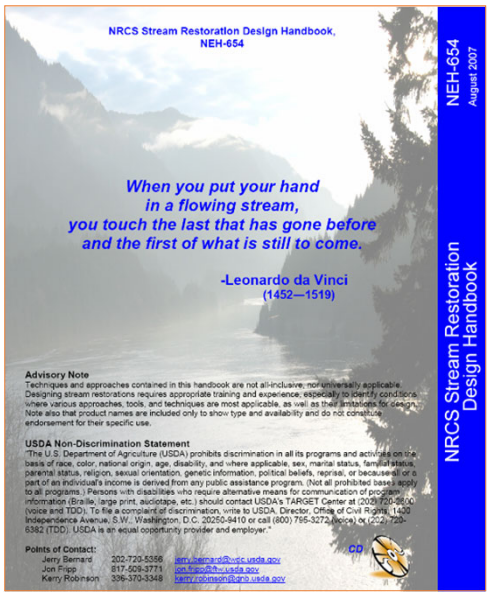
NEH 654.13

And NEH 654.14



44

USDA United States Department of Agriculture



NRCS Points of Contact:

Jerry Bernard
National Ecologist
Washington, DC
Retired

Jon Fripp
Stream Mechanics Engineer
NDCSMC, Fort Worth, TX
817-509-3771
jon.fripp@usda.gov

Kerry Robinson
Hydraulic Engineer
East Natl Techn. Support Center
Greensboro, NC
Retired

USDA | NRCS | *An overview of Stream Restoration in NRCS* 45

45

USDA United States Department of Agriculture

Quantifying Pollutants…

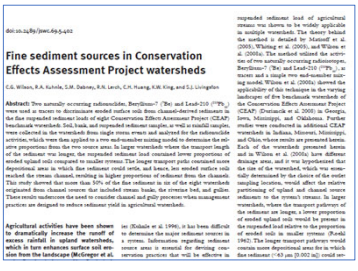
- Engineering addresses the fix
- Legacy phosphorus in channels and in streambanks
- Field sources

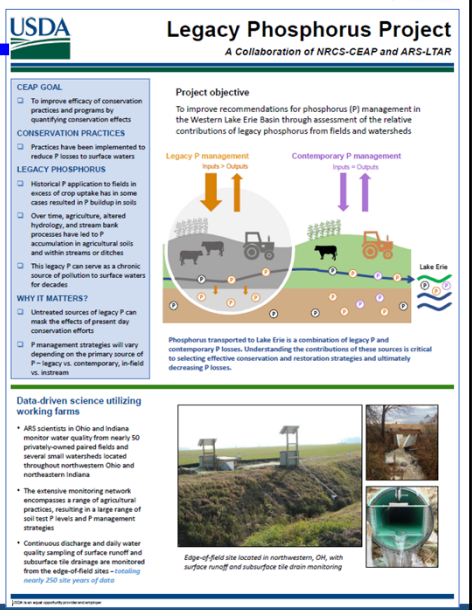
➢Requires research

➢Suggest collaboration with ARS

CEAP insights: >50% of the fine sediment in 6 of 8 watershed originated from stream banks, riverine beds, and gullies.

Phosphorus TMDL for Lake Champlain June 2016—P Sources: Ag land 40%, stream instability 22%


Fine sediment sources in Conservation Effects Assessment Project watersheds



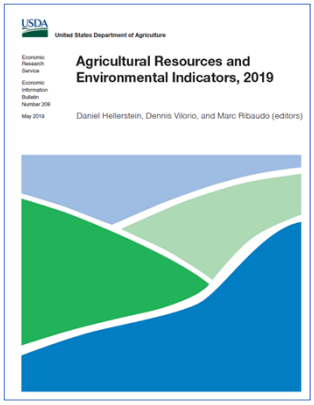
USDA | NRCS | *An overview of Stream Restoration in NRCS* 46

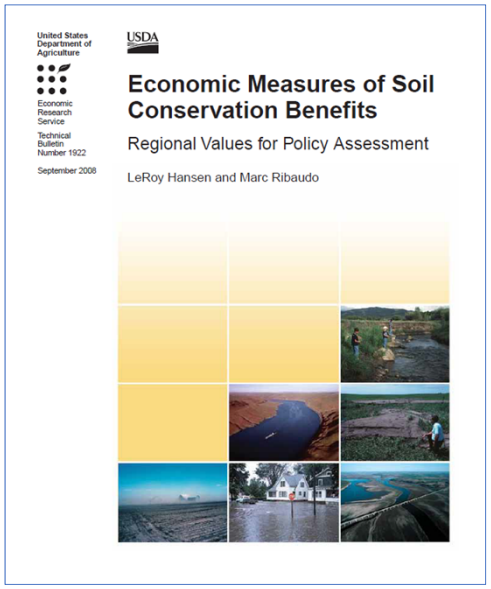
46

USDA United States Department of Agriculture

Economics…

- Requires an economist



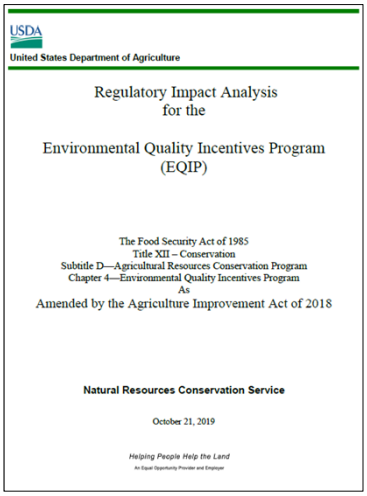


NRCS economists collect and analyze data on benefits

USDA United States Department of Agriculture

Sheet and Rill Erosion

- There are several conservation practices funded by EQIP* that reduce sheet and rill water erosion on cropland.
- National Resource Inventory (NRI) data and EQIP data indicate erosion reductions of 8.6 to 10 tons per acre per year*.
- ***Reduction of Fertilizer Nutrient Loss:*** $11.92 per acre per year**
- ***Improved water quality:*** $42.40 per acre per year**
- Other benefits: Air quality, wildlife, energy, irrigation, productivity…



* Environmental Quality Incentives Program (EQIP)
**2007 dollars, Since 1992

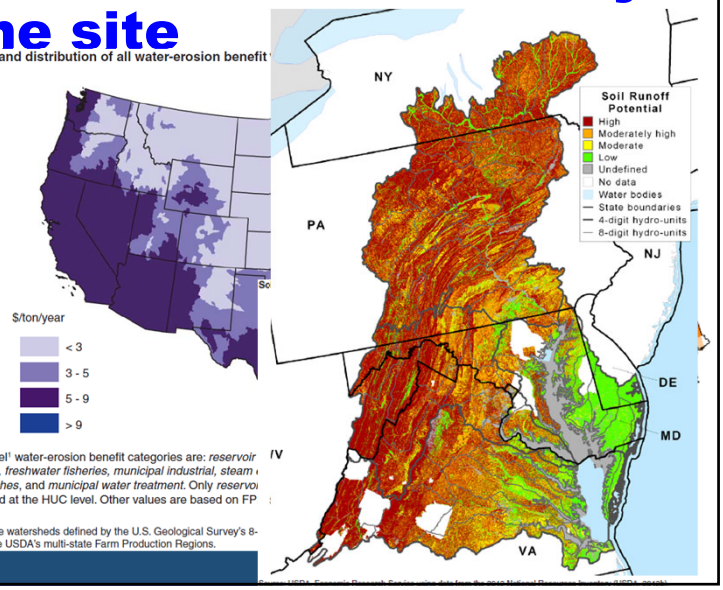
USDA United States Department of Agriculture

Soil Loss and Benefits of Practices Vary by Region...*AND* the site

The Soil Conservation Benefit Categories

Categories	Consumer/producer surplus gain due to	Level of aggregation	Range of values ($/ton)	Year estimated
Reservoir services	Less sediment in reservoirs	HUC	0 to $1.38	2007
Navigation	Shipping industry avoidance of damages from groundings	HUC	0 to $5.00	2002
Water-based recreation	Cleaner fresh water for recreation	HUC	0 to $8.81	1997
Irrigation ditches and channels	Reduced cost of removing sediment and aquatic plants from irrigation channels	FPR	$0.01 to $1.02	2007
Road drainage ditches	Less damage to and flooding of roads	FPR	$0.20	1986
Municipal water treatment	Lower sediment removal costs for water-treatment plants	FPR	$0.04 to $1.45	1989
Flood damages	Reduced flooding and damage from flooding	FPR	$0.10 to $0.77	1986
Marine fisheries	Improved catch rates for marine commercial fisheries	FPR	0 to $0.93	1986
Freshwater fisheries	Improved catch rates for freshwater commercial fisheries	FPR	0 to $0.12	1986
Marine recreational fishing	Increased catch rates for marine recreational fishing	FPR	0 to $1.57	1986
Municipal & industrial water use	Reduced damages from salts and minerals dissolved from sediment	FPR	$0.07 to $1.47	1986
Steam powerplants	Reduced plant growth on heat exchangers	FPR	$0.04 to $1.05	1986
Soil productivity	Reduced losses in soil productivity	FPR	$0.37 to $1.21	1990

Range and distribution of all water-erosion benefit



HUC-level[1] water-erosion benefit categories are: *reservoir fisheries, freshwater fisheries, municipal industrial, steam road ditches,* and *municipal water treatment.* Only *reservo* estimated at the HUC level. Other values are based on FP

[1]HUCs are watersheds defined by the U.S. Geological Survey's 8-
[2]FPRs are USDA's multi-state Farm Production Regions.

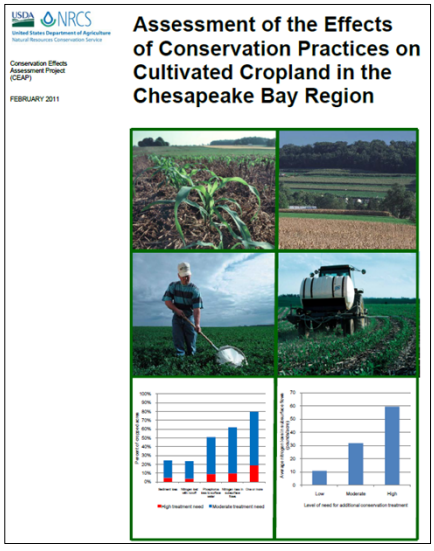
USDA | NRCS | *An overview of Stream Restoration in NRCS*

49

USDA United States Department of Agriculture

Key Findings:

- ***The voluntary, incentives-based conservation approach is working.*** Farmers have made good progress in reducing sediment, nutrient, and pesticide losses from farm fields through conservation practice adoption throughout the Chesapeake Bay region.
- ***Opportunities exist to further reduce sediment and nutrient losses from cropland.*** Acres with a high level of need consist of the most vulnerable acres with the least conservation treatment and the highest losses of sediment and nutrients.
- ***Targeting enhances effectiveness and efficiency.*** Targeting critical acres significantly improves the effectiveness of conservation practice implementation.
- ***Comprehensive conservation planning and implementation is essential.*** Suites of practices that include soil erosion control and comprehensive nutrient management—appropriate rate, form, timing, *and* method of application—are required to simultaneously address soil erosion, nutrient losses in runoff, *and* loss of nitrogen through leaching

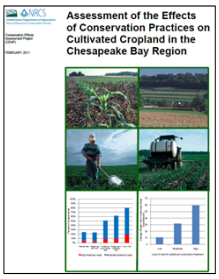


USDA | NRCS | *An overview of Stream Restoration in NRCS*

https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcsdev11_023934.pdf

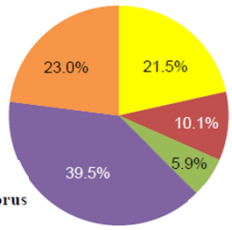
50

USDA United States Department of Agriculture

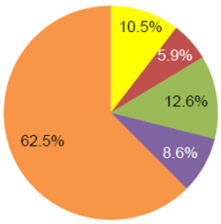


Work to help the Chesapeake Bay needs non urban work

Sediment delivered to rivers and streams

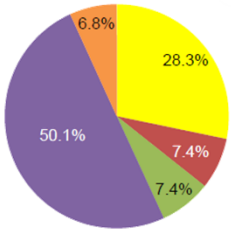


Land Use (exclusive of water)

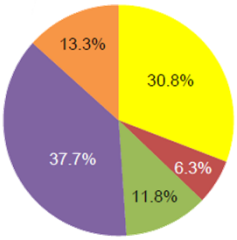


Cultivated cropland
Hayland
Pasture and grazing land
Urban land
Forest and other

Total phosphorus



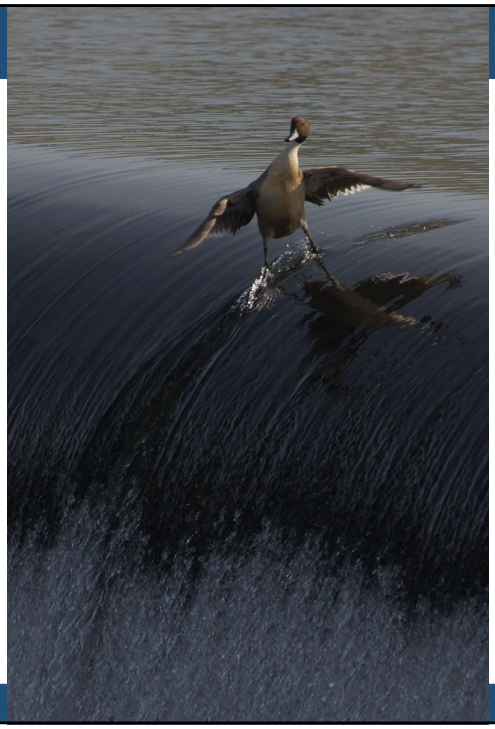
Total nitrogen



51

USDA United States Department of Agriculture

Questions?



52