PA COUNCIL OF TROUT UNLIMITED
POLICY ON STREAM CHANNELIZATION & MAINTENANCE
OCTOBER 2022

**BACKGROUND**

Channelization, sometimes referred to as dredging, has a long history in Pennsylvania, extending from the early colonial period, through extensive logging in the mid to late 1800s and right up to the present. The damage done to streams has been immense. Channelization eliminates complex stream features such as riffles, deep pools, in-stream structure including large wood, overhead cover, and spawning areas. It results in wide, shallow, ditch-like channels that eliminate or reduce habitat for trout and other aquatic species that trout depend on for survival. Many streams that were channelized over a century ago have not yet recovered their natural channel and form.

Stream channelization refers to several types of channel modifications, usually done in an effort to provide flood protection. Channelization is intended to move floodwater more quickly downstream. The goal is to prevent the natural occurrence of streams spilling over their banks onto their floodplains during high water flows. This is usually done in an attempt to protect manmade infrastructure, including buildings and roads that have been built in the floodplain.

Stream channels are typically widened and/or deepened by moving heavy machinery directly into the streambed. Stream substrate and gravel bars are commonly dug out and removed. Stream banks are often excavated to widen the stream channel. Natural meanders are usually straightened in the process and boulders and woody material removed. Stream banks are often lined with riprap, gabions, or even concrete, to prevent streams from readjusting to their natural channel and form. All of these in-stream activities destroy food and cover for cold water species. The clearing of trees and shrubs from adjacent floodplains further damages streams and their riparian corridors. Removing riparian vegetation and the shade it provides increases water temperature. The lack of woody material created by removal of streamside vegetation eliminates important habitat and food resource elements for trout and other coldwater species.

**FLOODING AND FLOODPLAINS**

Stream channelization may reduce or prevent localized flood damage, but with the typical consequence of more intense or frequent flooding at downstream locations. Importantly, it has severe negative impacts on stream health and can produce unintended consequences, which have a detrimental effect on trout habitat and other aquatic species that trout depend on for survival. Stream channelization removes the ability for the stream to access its floodplain, preventing the stream from dissipating energy and accelerating flooding downstream. This process also leads to further stream channel incision as the stream attempts to dissipate energy by downcutting. Channel incision leads to increased sediment loads and habitat degradation. Stream channelization also reduces the natural denitrification processes that take place in the benthic layers of streams, which is especially harmful in watersheds with nutrient issues.

> "Dredging has both short and long-term effects on the natural and human environment. Some or all of the following may occur during or after dredging operations:
> • increased water flows downstream and increased flooding,
> • disturbance caused by vehicle and equipment access,

• destruction of stream bank and aquatic vegetation,
• disruption of the aesthetic values of the stream corridor,
• removal, release, or rearrangement of sediments,
• reduction of water quality,
• remobilization of contaminants,
• increased turbidity,
• lowered water tables,
• increased erosion and sedimentation,
• alteration of hydrology,
• alteration of hydraulics (current patterns and flow),
• increased bank instability and erosion,
• alteration of fish habitat,
• alteration of fish spawning habitat,
• alteration of benthic habitat,
• disruption or removal of benthic communities,
• reduction in height of high frequency, low- level flood events over the short term unless it is properly maintained, and
• false sense of security following dredging."
(West Virginia Statewide Flood Protection Plan, page 231-232, https://www.wvca.us/flood/pdf/wv_statewide_plan.pdf )

Floodplains occupy only a small percentage of Pennsylvania land, but they are vital in maintaining water quality and the survival of the biota of streams and their riparian areas. Floodplains are, in fact, part of a river's bed and naturally transport a portion of a river's volume during intermittent high flow periods. It is predicted that by mid-century, Pennsylvania will "experience increasing intensity of extreme weather events "and "have episodes of drought interspersed with extreme rainfall events, leading to an average 8 percent increase in rain and causing statewide inland flooding events." (2021 Pennsylvania Climate Action Plan) As long as development in floodplains is allowed to continue, flood damage will increase, and property owners will continue to exert political pressure to channelize streams. There are no federal or state statutes prohibiting building in floodplains. Why are natural floodplains so important?

"Natural floodplains provide flood risk reduction benefits by slowing runoff and storing flood water. They also provide other benefits of considerable economic, social, and environmental value that are often overlooked when local land-use decisions are made.
Floodplains frequently contain wetlands and other important ecological areas which directly affect the quality of the local environment. Some of the benefits of floodplains to a functioning natural system include:

- Fish and wildlife habitat protection
- Natural flood and erosion control
- Surface water quality maintenance
- Groundwater recharge
- Biological productivity
- Higher quality recreational opportunities (fishing, bird watching, boating, etc.)"

(FEMA, Benefits of Natural Floodplains, https://www.fema.gov/floodplain-management/wildlife-conservation/benefits-natural )

"Floodplains provide numerous flood loss reduction benefits as a result of their unique natural functions. Rivers and streams shape floodplain topography and influence riparian habitats and riverine ecosystems. Likewise, the physical characteristics of the floodplain shape water flows and can provide flood loss reduction benefits to include the following:

- **Excess water storage**: Except in narrow, steep valleys and areas of coastal bluffs, floodplains allow floodwaters to spread out and temporarily store excess water. This reduces flood peaks and velocities and the potential for erosion. One acre of floodplain flooded 1 foot deep holds approximately 330,000 gallons of water. Flood storage is particularly important in urban areas where even small floods, for example from a 5- or 10-year storm, can cause severe damage.
- **Flow rate and erosion reduction**: In their natural vegetated state, floodplains slow the rate at which the incoming overland flow reaches the main water body in the area. Vegetation also reduces shoreline erosion. In coastal areas, floodplain features such as beaches, sand bars, dunes, and wetlands act as natural barriers to dissipate waves and protect back-lying areas from flooding and erosion.
- **Slowing runoff**: A natural floodplain has surface conditions favoring local ponding and flood detention, plus subsurface conditions favoring infiltration and storage. Slowing runoff across the floodplain allows additional time for the runoff to infiltrate and recharge available groundwater aquifers when there is unused storage capacity. The slowing of runoff provides the additional benefit of natural purification of water as local runoff or overbank floodwater infiltrates and percolates through the floodplain alluvium (flat land area adjacent to a stream).
- **Flow regulation during non-flood periods**: During non-flood periods, groundwater discharge acts to naturally regulate the flow in a river or the level of a lake or pond. In other words, during periods of abundant water, the water can enter the groundwater system whenever there is available capacity rather than contribute to seasonal flood peaks. During low flow periods, the water flows from the higher groundwater system into lower surface waters, so that the frequency and duration of extremely low flows is reduced."

(FEMA, Benefits of Natural Floodplains, https://www.fema.gov/floodplain-management/wildlife-conservation/benefits-natural )

**STATE GUIDELINES**

The current PA DEP guidance pertaining to channelization and stream maintenance can be found in their booklet, "Guidelines for Maintaining Streams in Your Community." (https://files.dep.state.pa.us/Water/FactSheets/StreamMaintenance/StreamMaintenanceBooklet_forWeb.pdf ). The guidance utilizes a Green Light (Go), Yellow Light (Slow Down) and Red Light (Stop) to illustrate what "maintenance" can be done without a permit and what activities require DEP guidance or approval.

Under current guidance the following Green Light actions do not require DEP notification, pre-approval, or additional permits:

- Removing woody debris and manmade debris materials from the stream, banks, and riparian areas by hand or using handheld equipment
- Removing above items using heavy equipment from the bank; equipment should not enter the stream or dig into the streambed
- Removing gravel and debris in and close to bridges and culverts (Note: review permit conditions first)

- Crossing a flooded stream for emergency access to your property if conditions are safe

For the following Yellow Light actions **call DEP first—Notification, pre-approval, or emergency permits may be required:**

- Rebuilding roads and bridges across streams
- Streambank stabilization projects, including riprap
- Removing gravel bars from the stream channel using heavy equipment
- Repairing a bridge or culvert, or removing one in danger of failure

The following Red Light actions **require permits from DEP, and possibly from the U.S. Army Corps of Engineers or other agencies:**

- Redirecting the flow of a stream by reshaping gravel bars, or moving gravel to the streambank
- Moving/relocating a stream
- Dredging or damming streams, or creating dikes
- Building a new bridge or culvert

(PA DEP, "Guidelines for Maintaining Streams in Your Community." (https://files.dep.state.pa.us/Water/FactSheets/StreamMaintenance/StreamMaintenanceBooklet_forWeb.pdf)

**ALTERNATIVES TO CHANNELIZATION**

The following excerpts from "Post-Flood Cleanup Alternatives along Stream Corridors in Central Pennsylvania Helping Resolve River and Land Use Conflicts in an Economically and Ecologically Sustainable Manner" help to better understand the conflict between people's land use expectations and river dynamics.

> "Managing the conflict between people's land use expectations and river dynamics should be based on an examination of alternatives and cost-benefit analyses, in both the short and long-term, to both private and public interests. To avoid the growing conflict between the changing course of Pennsylvania rivers and our land use expectations, the environmental agencies (Pennsylvania Department of Environmental Protection), fisheries agencies (U.S. Fish and Wildlife and Pennsylvania Fish and Boat Commission), and U.S. Army Corps of Engineers (USCOE) in collaboration with its partners must:
> (A) acknowledge these on-going physical processes and the circumstances leading to the conflict between nature and man today;
> (B) understand and be able to articulate the implications and consequences of different conflict management options; and
> (C) develop the ability to effectively address conflicts with riverine systems through the application of one or a combination of the following alternatives.
>
> There are generally four different river corridor management alternatives for resolving historic and ongoing conflicts between river dynamics and land use expectations (Kline and Cahoon, 2010):
> A. Channelization: Maintain rivers in a channelized state through dredging and bank armoring applications. Active revegetation and long-term protection of a wooded riparian buffer is important to this alternative.
> B. Active Geomorphic: Restore or manage rivers to a geomorphic state of dynamic equilibrium

through an active approach that may include human-constructed meanders, floodplains, and bank stabilization techniques. Typically, the active approach involves the design and construction of a management application or river channel restoration such that dynamic equilibrium is achieved in a relatively short period of time. Active riparian buffer revegetation and long-term protection of a river corridor is essential to this alternative.
C. Passive Geomorphic: Allow rivers to return to a state of dynamic equilibrium through a passive approach that involves the removal of constraints from a river corridor thereby allowing the river, utilizing its own energy and watershed inputs to re-establish its meanders, floodplains, and self maintaining, sustainable equilibrium condition over an extended time period. Active riparian buffer revegetation and long-term protection of a river corridor is essential to this alternative.
D. Combinations of the Above Alternatives: Use a combination of alternative approaches to accommodate the varying constraints that typically occur along a project reach."

The authors suggest that "gravel removal and bank armoring may be the necessary short-term "band-aid" solutions that are applied in areas of irresolvable conflict until significant watershed problems can be documented through geomorphic assessment and addressed through the application of best management practices." Their "goal is to focus on the long term benefits of a geomorphic corridor management approach which can benefit both property owners and riparian ecosystems. The largest challenge will not be in applying the science to understand the river's slope and planform requirements, but rather how to redefine the relationship of public and private investments with fluvial dynamics in an equitable manner over time within a watershed. The larger short term costs associated with using a geomorphic-based approach, where land conversion is necessary, become more acceptable and economically justifiable where channelization projects have failed repeatedly or in post flood remediation where major erosion, property damage, and channel avulsions have occurred. A passive geomorphic approach may be the most desirable alternative due to its lower maintenance costs but is highly dependent upon landowners willing to accept what may be significant changes in land use expectations. It is extremely important that State and Federal agencies involved with river resource management work together to provide economic incentives and technical assistance to towns and landowners to make decisions that resolve immediate conflicts with the long term watershed solutions in mind…"
(Hayes, Benjamin R.; Kochel, R. Craig; and Newlin, Jessica, "Post-Flood Cleanup Alternatives along Stream Corridors in Central Pennsylvania Helping Resolve River and Land Use Conflicts in an Economically and Ecologically Sustainable Manner" (2018). Technical Reports . 1.
https://digitalcommons.bucknell.edu/technical-reports/1)

The following chart depicts the costs and benefits of Gray versus Green infrastructure from "Grey Vs. Green: The Benefits of Natural Flood Control in a Changing Climate", authored by Trygg Danforth following the devasting flooding in the northeast from Tropical Storm Irene in 2011.

**Table 1: Costs and Benefits of Gray vs. Green Flood Infrastructure**

| | **Gray Infrastructure**: Channelized, dredged and cleared rivers | **Green Infrastructure**: Natural rivers connected to functioning floodplains |
|---|---|---|
| Response to Floods | Perpetuates flood energy downstream, increasing vulnerability. Transports sediment and debris downstream. Promotes lateral incision as well as upstream and downstream erosion and downstream deposition. | Slows flood energy through boundary roughness and sinuosity. Floodplains attenuate floodwaters and release them over time leading to decreased flood peaks. |
| Construction and Maintenance Costs | Bank armoring alone costs between $211,000 and $528,000 per mile. Costs of dredging, gravel mining, debris removal and channel reconstruction are unknown. | None. However, initial restoration of channelized reaches is needed. Restoration costs vary between $64,000 and $354,000 per mile depending on the size of the stream and scope of the restoration needed.[38] |
| Effects on Fish and Wildlife | Loss of critical habitat and key river features such as riffles, deep pools and in-stream structure. Loss of shaded riparian zones and access to productive floodplains and wetlands. | Provides a diverse array of critical in-stream habitat, as well as shaded riparian zones and access to productive floodplains and wetlands. |

## PA COUNCIL OF TROUT UNLIMITED RECOMMENDATIONS

Given the background information and current research described above, the PA Council of Trout Unlimited has the following recommendations pertaining to stream channelization and maintenance.

1. Channelization practices need to be greatly reduced or, ideally, eliminated in their entirety in favor of natural floodplain restoration.
2. Environmental assessments should be conducted prior to the issuance of any permits for stream channel or floodplain modifications.
3. Flood recovery funds should be prioritized for activities that protect the flood carrying capacity of the floodplain, including stream, floodplain, and wetland restoration projects, inclusive of restoring riparian corridor herbaceous and forested cover and other green infrastructure. Invest funds effectively and reasonably to restore the floodplain and to reduce future losses. (Draft 2022 Pennsylvania State Water Plan)
4. Adjust state funding programs to assure they offer a preference for locating or relocating structures outside the floodplain. (Draft 2022 Pennsylvania State Water Plan)
5. The Commonwealth of Pennsylvania must be encouraged to develop laws and regulations to discourage, and ultimately eliminate, development on floodplains, consider ways of addressing the “loss of tax base” for the municipality associated with floodplain restoration and relocations and provide incentives for landowners.
6. County planning commissions, in consultation with DEP and Pennsylvania Emergency Management Agency (PEMA), should require all municipalities to enact and enforce a floodplain ordinance consistent with DEP, PEMA, and Federal Emergency Management Agency (FEMA) standards. (Draft 2022 Pennsylvania State Water Plan)
7. Encourage the General Assembly to fund, promote, and support water resource restoration projects through appropriate legislation. Water resource restoration projects to fund, promote, and support include, but are not limited to, the following (Draft 2022 Pennsylvania State Water Plan):
    a. Projects that reconnect streams to an active floodplain
    b. Projects that remove anthropogenic impairments such as legacy sediments along streams
    c. Projects that reestablish wetlands and restore degraded wetlands, especially in floodplains and in headwater areas

    d. Projects that remediate actively eroding streambanks and use native woody and herbaceous vegetation best management practices to stabilize soils and trap sediments
    e. Projects that restore riverine forms and processes while providing geomorphic stability, prevent head-cuts, bed scour, and other forms of channel degradation
8. New and replacement bridges and culverts should be adequately sized and designed to allow passage of flood flows and debris without the need for channel alterations.
9. The aquatic benefits of large woody material in streams needs to be promoted to change the negative perception of large wood in streams by the public.
10. On public resource lands, such as national and state forests, state parks, state game lands, PA Fish & Boat Commission properties, and county and municipal park lands, channelization should be prohibited in its entirety. Managing these public lands in ways compatible with maintaining healthy streams and riparian ecosystems would serve as an example for good land management on private lands.
11. Educational programs must be developed to inform all Pennsylvanians about the functions of stream and riparian ecosystems, the effects of stream channelization, the laws in place protecting against encroachment, and the consequences of breaking these laws.
12. The public is encouraged to promptly report channelization activities to their county conservation district, PA Fish and Boat Commission regional office and/or PA DEP regional office, if enforcement action is needed.

References.


1. West Virginia Statewide Flood Protection Plan, page 231-232, https://www.wvca.us/flood/pdf/wv_statewide_plan.pdf

2. FEMA, Benefits of Natural Floodplains, https://www.fema.gov/floodplain-management/wildlife-conservation/benefits-natural

3. PA DEP, “Guidelines for Maintaining Streams in Your Community.” (https://files.dep.state.pa.us/Water/FactSheets/StreamMaintenance/StreamMaintenanceBooklet_forWeb.pdf

4. Hayes, Benjamin R.; Kochel, R. Craig; and Newlin, Jessica, "Post-Flood Cleanup Alternatives along Stream Corridors in Central Pennsylvania Helping Resolve River and Land Use Conflicts in an Economically and Ecologically Sustainable Manner" (2018). Technical Reports . 1. https://digitalcommons.bucknell.edu/technical-reports/1

5. Trygg Danforth, “Grey Vs. Green: The Benefits of Natural Flood Control in a Changing Climate”

6. Draft 2022 Pennsylvania State Water Plan