Fixing A Broken Trout Stream

Donegal Creek Restoration Project
Written by Mark A. Metzler

The Donegal

LANCASTER COUNTY
CONSERVATION DISTRICT

DONEGAL
FISH & CONSERVATION ASSOCIATION

Donegal Creek is located in the northwest corner of Lancaster County, Pennsylvania. This limestone stream has a 17.2 square mile watershed and flows through some of Lancaster County's most fertile farmland. Approximately 91% of the Donegal's watershed is in agricultural production, while the balance is comprised of urban landuse and sporadic woodlots.

Donegal Creek is commonly divided and referred to by one of its three distinct sections; those being the main stem (Donegal Creek), the east branch (Charles Run) and the west branch (Donegal Springs). The west branch is by far the best for general water quality. Large springs located in the headwaters provide a dependable flow of cold, crystal-clear water producing an optimum cold water fishery.

In contrast, the east branch, although originating from similar spring sources, is influenced to a greater degree by surrounding agricultural and urban landuse. The east branch suffers from chronic bouts of thermal pollution and sedimentation. In its pristine state, one can only conclude the east branch had been a cold water fishery, similar to its western twin, but now would best be described as a warm water fishery masquerading as a cold water fishery outside the summer months.

The main stem, as logic should dictate, is a combination of the two branches. Water temperatures remain cool enough through the summer months to support a year-round cold water fishery. Sedimentation problems have been greatly reduced due to recent restoration efforts. The upper half of the main stem maintains the typical limestone stream appearance, while the lower half begins to take on characteristics more common of freestone streams.

The Donegal flows into Chickies Creek near Marietta, Pennsylvania, which in turn flows into the mighty Susquehanna River and ultimately the Chesapeake Bay.

For the most part, Donegal Creek is accessible to the general public with ample signage indicating appropriate conduct and restrictions. Fence stiles near public roads provide strategic entrance to fenced areas of the stream. In addition, many areas of the stream are easily accessed at the various bridge crossings. Many fisherman, hunters, hikers and bird watchers enjoy what this stream has to offer.

To many people, Donegal Creek means trout fishing! The main stem includes a 2.4 mile "delayed harvest fly-fishing" stretch, while the rest of the main stem and branches are open to "bait fishing." Both the Pennsylvania Fish and Boat Commission and the Donegal Fish and Conservation Association stock trout during the spring and fall months. In addition to the stocked trout, an angler may encounter wild stream-bred brown trout when fishing the main stem and wild rainbow and brown trout (progeny from egg plantings) when fishing the west branch.

Numbered circles represent the 8 monitoring stations used to collect data throughout the Donegal Creek Restoration Project.

Past & Present

In 1994, Tom Moore of the Donegal Fish and Conservation Association was becoming increasingly concerned with the physical condition of his local trout stream. He recalled earlier years when he and his two sons would enjoy angling success, but all that seemed to be changing, literally eroding away.

Ken Depoe, another local angler, was also quite aware of the situation; in fact had been since 1965 when he first organized the Donegal Fish and Conservation Association for the specific purpose of improving Donegal Creek. He and a handful of volunteers experienced success though constantly hampered by a limited budget.

Early endeavors focused on the main stem and in 1966 the original "fly-fishing only" area, now labeled as "delayed harvest fly-fishing", was established. Depoe realized the damage free ranging livestock were causing and had installed single-wire electric fences along the stream corridor where permitted to do so.

In time however, a few of the key properties changed ownership and many of the past improvements were rendered useless. The 1970's were not kind to the Donegal. Hurricane Agnes of '72 rearranged the creek to its liking, instigating "down on the farm" stream encroachment and realigning activities.

The Donegal's fishery meagerly existed through the remaining '70s and '80s. Agricultural landuse took on a new found intensity. Farmers in the area increased production and diversified their operations in an attempt to make ends meet. Dairy and other livestock operations were expanded while appropriate measures for controlling nutrients and over-grazing were at times lacking.

Trout fishing in the Donegal was more or less limited to a "put and take" scenario. In 1992, the Pennsylvania Fish and Boat Commission released the results of a survey they had performed on the east branch (Charles Run). In short, the survey found Charles Run to be severely degraded, lacking in water quality, diversity of aquatic life and habitat.

The Commonwealth's "State Water Plan" sang a similar tune. Out of 104 highly degraded watersheds, the Donegal (considered part of the Chickies Creek Watershed) ranked 14th on the priority list for clean-up. Only 13 other watersheds in the entire state were considered to be more polluted by non-point source pollution.

So in 1994, the Donegal Fish and Conservation Association sought the assistance of the Lancaster County Conservation District. District employees Travis Martin and Mark Metzler worked with Moore and managed to install the first of many fencing projects on the Donegal's west branch.

At the same time, this budding partnership of fisherman and conservationists realized it needed more money if restoration efforts were to advance downstream. The District started to pursue a large section 319 grant from the Commonwealth's Department of Environmental Protection.

In March of 1996, the partnership's dream came true when they started spending their $136,671 section 319 allocation. In time, the partnership would be the recipients of other cash and labor donations allowing further project expansion.

Troubleshooting

Ken Depoe (left) and Tom Moore (right) of the Donegal Fish and Conservation Association enjoy a spring morning on the Donegal's fly stretch.

Donegal Dilemas

- *Sedimentation*
- *Nutrient overloading (Nitrogen)*
- *Thermal pollution*
- *Structural habitat loss*
- *Stormwater surges*
- *Lack of groundwater recharge in developing areas*

The way in which land is used within a stream's watershed ultimately influences stream health. Wise use of land and water result in healthy aquatic resources, while abuse results in degradation. The Donegal, like other streams of the Commonwealth, is at the mercy of those people inhabiting its watershed.

As mentioned earlier, 91% of the Donegal's watershed is in agricultural production. Therefore, it is only reasonable to expect that particular landuse to have the greatest influence on water quality; and indeed that is the case.

By volume, sediment is the largest pollutant to Donegal waters. The partnership feels strongly that the majority of Donegal's sedimentation problem had stemmed from streambank erosion and, to a lesser degree, cropfield erosion.

Prior to 1994, approximately 4.5 miles of Donegal Creek was negatively impacted by free ranging livestock (mainly dairy herds). Trampling cattle destroyed streambank vegetation, leaving banks in a raw condition prime for erosion during high water flows. Many sections of the creek were extremely wide and shallow in these pasture-type settings when compared to less disturbed areas.

Too much of a good thing can be bad. Such is the case when considering the nutrient load in the average sample of Donegal water. Nitrate readings are routinely high and have regularly exceeded 40 ppm (greater than 10 ppm is considered too high for human consumption) over the past four years. Nitrate readings seem to peak during periods of drought, indicating a contaminated groundwater supply. Excessive algae blooms and thick mats of duckweed, as can be seen on the east branch (Charles Run), provide visual evidence of such nutrient overloading.

The Donegal also suffers from thermal pollution, though recently planted forest buffers are beginning to provide some "re-leaf" in the pasture settings.

A lack of in-stream structural habitat, routine surges of ripping stormwater and a lack of sufficient groundwater recharge complete the list of Donegal ailments. Some of the ailments are easily and quickly addressed, others are not. The partnership feels it has or can continue to successfully combat problems such as sedimentation, thermal pollution, structural habitat loss and to some extent nutrient overloading. Controlling stormwater generated from urban sprawl and its related reduction in groundwater recharge however will provide future challenges!

Winning Support

Landowners willing to cooperate with restoration activities are of utmost importance. Without their involvement, there simply is no project!

Early on, the partnership adopted the "golden rule" as its policy for dealing with landowners. "Do unto others as you would have them do unto you" seemed well received by the landowners involved. The partnership realized they could not go on private property and force the project and its ideals.

After the first fencing project in 1994, the partnership sponsored an open house and invited area farmers to come take a look. The process was repeated in '95 with a second fencing project and public workshop. People in the area started to wonder what was going on, which provided a marvelous opportunity to share the restoration dream.

In the Fall of '95, the partnership either hand delivered or mailed a letter and questionnaire to each of the 23 landowners identified in the original 6.7 mile project area. The letter described the partnership and its goal of restoring Donegal Creek. It also described the pursuit of the section 319 grant and requested their support. Nineteen of the 23 landowners mailed back the questionnaire and expressed an interest in participating to some degree.

The partnership was delighted with the landowners' response and has tried its best to maintain a sound relationship with all landowners. To this end, the Donegal Fish and Conservation Association has agreed to maintain all streambank fencing as well as other stream improvements.

Landowners were not asked to sign any sort of agreement, rather all work was done on a verbal "gentlemen's agreement." This verbal agreement seemed to surprise many landowners who thought they'd be asked to make a written commitment and be locked into some sort of program criteria; unable to escape for who knew how many years.

The partnership also makes an attempt at winning the support of visiting public. Fifteen sign boards have been installed throughout the project area which describe the restoration activities and stress appropriate conduct while on the property. Fishing regulations, catch and release procedure and other related informational items are also posted.

A constructed sign board informs the general public of acceptable conduct. A fence stile provides easy access over the stream-bank fencing.

Money

Stream restoration comes with a price tag, Fence materials, stone for cattle crossings, wood for sign boards and the like aren't free. The partnership to date (Feb.'99) has collected the following grants and cash donations.

Received Grants And Cash Donations

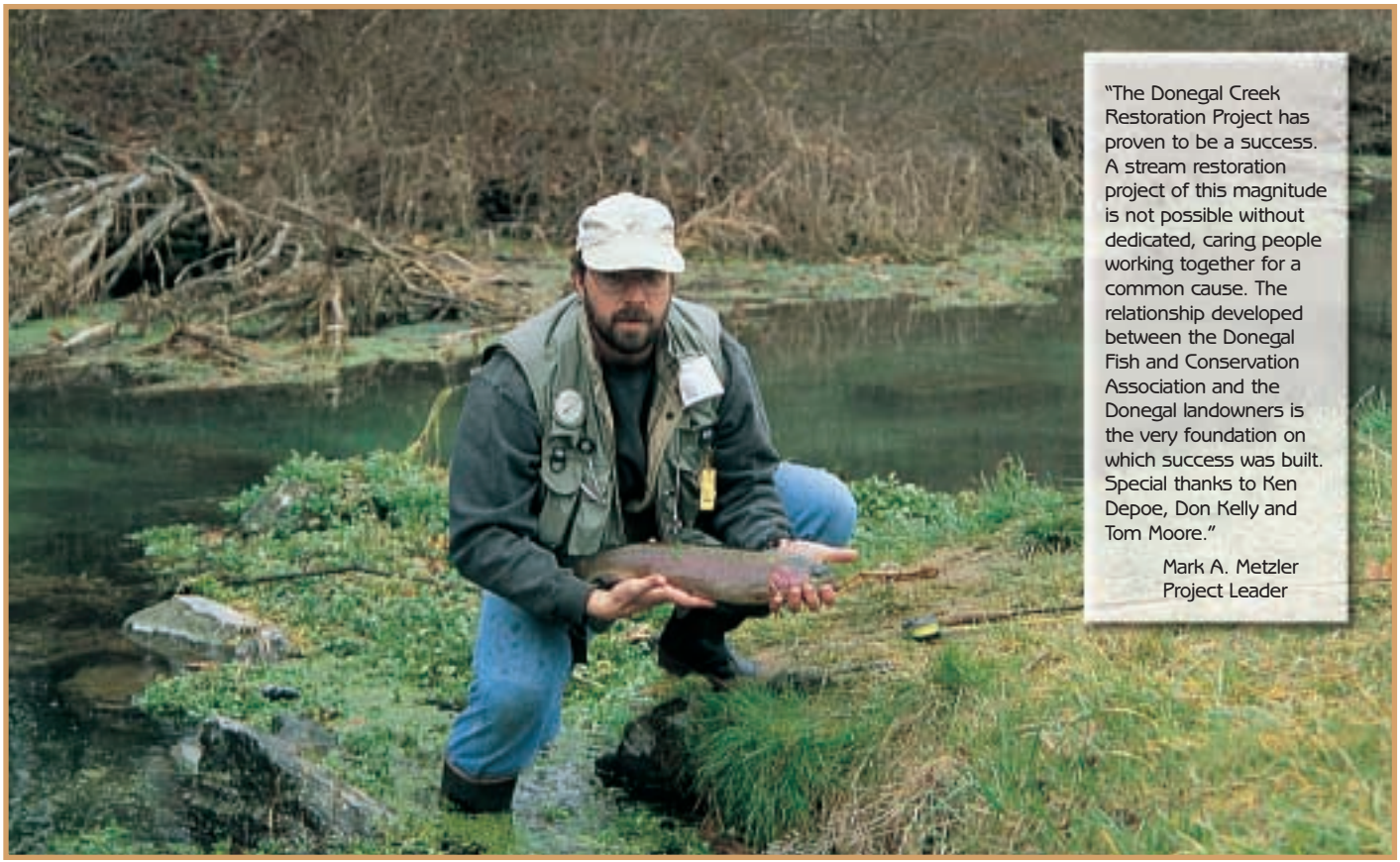
AMOUNT	CONTRIBUTOR
$ 136,671	Pennsylvania Department of Environmental Protection
$ 15,000	Donegal Chapter of Trout Unlimited
$ 6,000	Federation of Fly Fishers
$ 3,000	PA Trout
$ 1,000	Donegal landowner
$ 500	Columbia Fish and Game
$ 313	Octoraro Wetland Nurseries, Inc.
$ 75	Donegal High School Outdoors Club

$162,559 Total

Note the following:

The above only reflects received grants and cash donations. The above chart does not account for all of the volunteer labor since 1994. Such labor at a minimal rate of $6.00 per hour is conservatively estimated to be over $26,900.

The Donegal Chapter of Trout Unlimited (TU — not to be confused with the Donegal Fish and Conservation Association) has donated $15,000 toward Donegal improvements. Donegal TU allows the partnership to use this money where and when it's needed; thus money can be saved for possible emergencies and future maintenance work.



"The Donegal Creek Restoration Project has proven to be a success. A stream restoration project of this magnitude is not possible without dedicated, caring people working together for a common cause. The relationship developed between the Donegal Fish and Conservation Association and the Donegal landowners is the very foundation on which success was built. Special thanks to Ken Depoe, Don Kelly and Tom Moore."

Mark A. Metzler
Project Leader

Allies

Working relationships with other conservation oriented groups is a key ingredient in Donegal's success story. Such groups provide vital funding, labor, technical assistance and crucial project credibility.

The following groups have participated in the restoration of Donegal Creek:

Alliance for the Chesapeake Bay	(labor)
Boy Scouts of America	(labor)
Chesapeake Bay Foundation	(labor, technical assistance)
Columbia Fish and Game	(cash donation)
Donegal Chapter of Trout Unlimited	(cash donation, labor)
Donegal High School	(cash donation, labor)
Federation of Fly Fishers	(grant)
Jimmy Buffet Society, Parrotheads of Paradise Chapter	(labor)
Lancaster County Youth Conservation School	(labor)
Octoraro Wetland Nurseries, Inc.	(cash donation)
PA Trout	(grant)
Pennsylvania Department of Environmental Protection	(grant, technical assistance)
Pennsylvania Fish and Boat Commission	(technical assistance)
Pennsylvania Game Commission	(material donation)

Although paid for their services, it is only appropriate to recognize Abel Construction Company, Inc. (excavation), Flyway Excavating, Inc. (excavation) and LB Fencing (fencing) for a job well done. All three of these private businesses went out of their way several times to accommodate the construction schedule. They also served as a valuable source of information and on several occasions suggested a better and more cost-effective way of accomplishing the job.

Pennsylvania Fish & Boat Commission biologists survey aquatic life in Donegal's west branch.

A nice "hold-over" brown trout was discovered with the use of electro fishing gear. The limited use of such equipment provides valuable information for those involved in fishery management.

Cows Outside, Fish Inside

The benefits of installing fencing to deny free cattle access to streams are numerous. Continued cattle trampling results in eroded banks and increased sedimentation, loss of native vegetation, destroyed in-stream habitat and direct fecal and urine deposits.

Streambank fencing protects streambanks, promotes re-vegetation, enables forest buffer plantings, protects in-stream habitat and eliminates cattle loafing in the stream channel.

Herd health is improved as well and is especially evident in dairy herds where clean drinkable water results in good milk production. Cattle are more prone to injury when clamoring up and down muddy, rocky and debris covered streambanks. Water born and carried diseases such as mastitis are less apt to develop in a clean, mud free herd of dairy cows.

Since 1994, the partnership has installed just about seven miles of fencing (counting both sides of stream) on 11 Donegal farms. In addition, three other farms have installed their own streambank fencing. All of this fencing has more or less eliminated free cattle access from the bulk of Donegal Creek.

Thus far, the partnership has spent roughly $49,900 for fence installation, related equipment and maintenance supplies. Some simple math indicates that the seven miles of fencing cost about $1.35 per foot to install and maintain. The partnership believes they have the ability to maintain this fence for at least ten years based on the purchased maintenance supplies and anticipated damage.

The partnership has installed a two-wire, high-tensile electric fence for all fencing projects so far. The fences are normally powered by a 12-volt solar charger and are equipped with lightning protection systems. All posts are pounded. Corners and ends are braced and constructed of 8 foot posts. In-line posts are 7 feet long.

The average Donegal stone ford cattle crossing is 18 feet wide and 40-50 feet long. A typical crossing takes 30-40 tons of R-4 rock to create a solid base and an additional 15-20 tons of 2B stone to create a smooth finish. An average crossing takes between 3-5 hours to install depending on the topography and machinery used. Twenty-six crossings were installed at a cost of about $15,670 averaging $600 per crossing.

The partnership also installed 38 fence stiles (ladders) to provide easy access over streambank fencing. Visiting public appreciate the fact they don't have to crawl under and over electric fences.

Note the provided sample of fence installation costs for a typical meandering stretch of Donegal Creek. The particular fencing project described in the sample contained two stone ford cattle crossings, three watering holes (a fenced area where cattle can get a drink but are not permitted to cross the stream) and numerous corners. Corners, ends and crossing locations dramatically add to the cost of the fencing project.

6/30/97

9/17/98

Before and after photographs of streambank fencing on the Donegal's west branch.

Sample: Salunga Acres Fencing Project on Main Stem

(price includes installation)

Length of Fence *(includes both sides of stream and accounts for fence consisting of 2 wires, tensioners, springs and small hardware fasteners)*	6,116 feet @ $.75/foot =	$ 4,587
Braces *(braced corners and ends)*	46 @ $25/brace =	$ 1,150
Spring Gates *(gates at crossings and watering holes)*	14 @ $17.50 =	$ 245
Flood Gate Controllers *(keeps lower wire at crossings from shorting during high water)*	10 @ $11 =	$ 110
Lightning Arresters *(grounds fence during lightning strike)*	20 @ $7.50 =	$ 150
Ground Rods *(for solar charger and lightning arresters)*	24 @ $10 =	$ 240
Solar Charger *(12 volt)*	1 @ $300 =	$ 300
		TOTAL $ 6,782

8/11/95

12 volt solar charger powers streambank fencing. Notice cattle-crossing in background.

3/18/97

Donegal Fish and Conservation Association members Ken Depoe (left), Jay Brubaker, (right) and Drew Mummau (top) install a fence stile on Donegal's main stem.

6/28/97

A lush buffer between the Donegal and one of its many cattle pastures.

Building Buffers

PREFERRED PLANTINGS FOR DONEGAL BUFFER ESTABLISHMENT
(floodplain and limestone soil environment)

SPECIE NAME	SURVIVABILITY
Ash, green (Fraxinus pennsylvanica)	excellent
Ash, white (Fraxinus americana)	excellent
Birch, river (Betula nigra)	good
Buttonbush (Cephalanthus occidentalis)	fair
Dogwood, red-osier (Cornus sericea)	excellent
Dogwood, silky (Cornus amomum)	excellent
Dogwood, white-flowering (Cornus florida)	good
Elderberry (Sambucus canadensis)	good
Hackberry (Celtis occidentalis)	fair
Hickory, shagbark (Carya ovata)	fair
Hickory, shellbark (Carya laciniosa)	fair
Maple, red (Acer rubrum)	good
Maple, silver (Acer saccharinum)	good
Oak, pin (Quercus palustris)	good
Oak, red (Quercus rubra)	good
Pine, white (Pinus strobus)	fair
Poplar, hybrid (Populus deltoides x Populus nigra)	excellent
Serviceberry (Amelanchier canadensis)	fair
Sycamore (Platanus occidentalis)	good
Walnut, black (Juglans nigra)	good
Willow, "Banker's" dwarf (Salix cotteti)	excellent
Willow, "Streamco" (Salix purpurea)	excellent
Winterberry (Ilex verticillata)	fair

In recent years, there has been an increasing interest in the establishment of forest buffers along stream corridors; and for good reason.

A riparian forest buffer, as defined by the Executive Council of the Chesapeake Bay Program, is ***"an area of trees, usually accompanied by shrubs and other vegetation, that is adjacent to a body of water and which is managed to maintain the integrity of stream channels and shorelines, to reduce the impact of upland sources of pollution by trapping, filtering and converting sediments, nutrients, and other chemicals, and to supply food, cover, and thermal protection to fish and other wildlife."***

Since 1994, the partnership has either re-established, enhanced, and/or protected approximately 13 acres of forest buffer along 6.7 miles of Donegal Creek. Forest buffers are typically located within streambank fencing corridors and vary from 10 to 100 feet in width. Most buffers average 15 to 20 feet in width.

Bare root seedlings were used for most planting projects, although some containerized and balled stock was planted. "Live stakes" were also used to establish Streamco and Dwarf Bankers willows and Red Osier and Silky dogwoods. Most hardwood seedlings were protected with tree tube protectors which proved a worthwhile endeavor considering survival rates averaged 70%. Approximately 3,000 trees and shrubs were planted at a cost of $3,250.

The majority of planted trees and shrubs were native species, though some exotics were used for specific purposes such as hybrid poplar for establishing quick shade.

Before & After

Forrest buffer planting on Donegal's west branch. The buffer is 50' wide and includes 2 rows of shrubs.

3/6/97

9/17/98

4/27/97

9/17/98

Before & After

Forrest buffer planting on Donegal's east branch. The buffer in some locations exceeds 100' in width. Notice the use of tree protector tubes.

Keeping the Streambank Out of the Creek

In recent past, eroding streambanks were the greatest source of sediment to Donegal Creek. It was not uncommon to see bare, vertical and undermined streambanks in most Donegal pasture settings. Continuous cattle trampling and grazing left banks in a raw, unprotected condition; prone to erosion during rain events.

In locations where streambank erosion had been severe, the stream channel typically became unnaturally wide and shallow. Eroding banks allowed the stream to expand, while eroded soils were deposited in the channel. In-stream habitat was covered in a blanket of mud while water temperatures rose above tolerable thresholds for cold water species.

Often, streambank fencing was all that was necessary to stop and reverse the erosion process, but in some situations actual bank stabilization was necessary.

The partnership used a variety of methods for stabilizing eroded banks. Most common, was the construction of log and rock deflectors which served to gently steer water flows around critical areas, as well as provide fish cover. When deflectors are positioned correctly, gravel bars (point bars) build up just downstream of the deflector and begin to re-establish the bank.

Mudsills were also installed. A mudsill is basically a cantilevered log deck, topped with rock and soil. Sills are more costly and time consuming to install, but result in better overhead cover for fish.

"Porcupine" deflectors were utilized in headwater areas where stream velocity and volume didn't pose a "wash out" threat. Instead of using rocks, discarded Christmas trees are used to build a deflector. Outside edge and strategic inner trees are wired and staked to the stream bottom. Porcupines do an incredible job of filtering and trapping sediment. Materials are free and machinery is not needed to install the trees, just lots of hands.

Very little of the normal "rock riprapping" of banks was done. Simply covering an eroded bank with rock is unnatural in appearance and offers less habitat feature than when that same rock is utilized in a deflector. However depending on the size of the riprap (rock), aquatic insects, fish fry and the like do benefit.

To date, the partnership has spent approximately $9,750 on streambank stabilization. Rock (riprap) was purchased for a cost of $8.60 per ton delivered. Trackhoe work averaged $85 per hour and backhoe work averaged $56 per hour. Approximately 90 deflectors, mudsills and other similar structures were built in the interest of bank stabilization.

Before & After

The installation of 2 rock deflectors and streambank fencing repaired this badly eroded streambank on Donegal's east branch. This all took place within one year.

6/17/97

9/17/98

1/14/95

6/28/95

Before & After

Used Christmas trees were utilized to build this "porcupine deflector." Notice the extremely wide and shallow stream channel in the first photo compared to the second photo.

This photo series shows, from top to bottom, stream improvement work that took place in the Donegal's main stem. Improvements consisted of installing 2 log deflectors, 1 inverted "V" dam, 1 cattle crossing, 2 fence stiles, streambank fencing and a forrest buffer planting.

6/25/96

7/12/96

9/17/98

3/28/97

This is a view of Monitoring Station #2 on the Donegal's west branch. In 1997, there were no trout in this pasture. After improvements such as re-fencing plus the installation of deflectors and log "bumps", trout could again be seen sipping blue-winged olive mayflys from the surface in 1998.

5/30/98

Something Fishy

Structural habitat is vital to the survival of any aquatic organism from the simplest life form to the most complex. The general term "structural habitat" is used to describe a vast array of physical features that provide a service or services to a specific specie or multiple species of the aquatic community. Such habitat can include log jams which serve as protective cover for fish, gravel substrates that support spawning, shallow weed beds that provide forage for aquatic insects and a plethora of other such structures that provide some service or benefit.

The partnership, being mostly comprised of trout fisherman, is most aware of the "no structure, no fish" relationship. Much of the Donegal lacked quality structure. Certain structural elements that should have been present were not.

When considering those elements necessary for trout propagation, the Donegal lacked suitable areas for spawning. Trout require clean, sediment-free gravel in which to lay their eggs. Since the Donegal suffered from a sedimentation problem, most gravel bed areas were smothered in silt and offered little spawning potential.

The Donegal also lacked adequate protective cover for adult trout and other large fish species. In many cases, there simply weren't enough places to conceal larger fish from predators. Adult survival was very limited.

Case in point: In 1993, the Pennsylvania Fish and Boat Commission pre-season stocked the west branch (Donegal Springs) with approximately 200 brown and rainbow trout. One day later, they only recovered (using electro-fishing gear) nine trout in that very water, proving their suspicions — the trout took off downstream in search of something better.

When properly installed, habitat structures can produce almost immediate, positive results. Fish are very mobile and are quite capable of finding newly installed habitat features. The Donegal Partnership loves to create in-stream habitat. It is amazing what benefits can be derived from a pile of rocks and three or four logs. Of course, knowing where to put what kind of structure is of utmost importance.

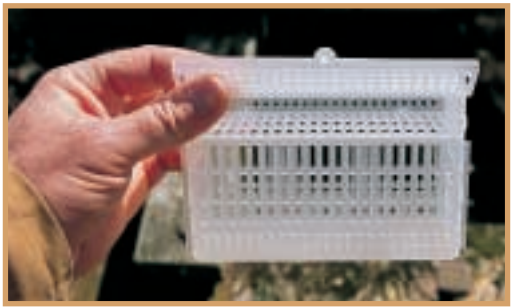
Inappropriate structure construction and location can and will do more harm than good. Jack dams, for example, can be very damaging to a low gradient stream like Donegal Creek when misused. Poorly placed jack dams provide little intended scouring effect and serve rather to trap sediment upstream of the device thus causing a localized sedimentation problem.

Rock and log deflectors are the mainstay of Donegal in-stream structures for several reasons. First, much of the Donegal is located in pasture settings where the stream has steadily grown unnaturally wider and shallower. Strategically placed deflectors help narrow the channel, restore bank stability, provide cover and help "wash" spawning gravels.

Mudsills, half-logs (a submersed log ripped in half length wise and anchored off the stream bottom), fish houses (a submersed lattice type fashion of logs and/or wood boards), inverted "V" dams (two logs in the shape of a "V" submersed with the point facing upstream-water falls over and into the center of the "V" creating a scoured hole), log bumps (a submersed log placed perpendicular to the flow-water goes both over and under the log often resulting in a scoured hole and a clean gravel bed immediately downstream), jack dams (low head dam used for scouring a hole) and boulder placement and propping (strategically placed rocks to create feeding lanes, pocket water and riffles) have also been installed in the Donegal where appropriate.

So far, the partnership has spent roughly $33,000 on in-stream habitat/cover and related equipment and supplies.

A Whitlock vibert box is ready for egg loading. Approximately 500 eggs can be placed in the top portion of the box.



A "sac fry" discovered 2" deep in the Donegal's substrate. Trout need clean, sediment-free gravel for reproduction.

Shown are "eyed" trout eggs. The black dots are pre eyeballs, while the white colored eggs are dead and should be removed.

A 5" rainbow trout, progeny from an earlier vibert box planting. Notice the beautiful markings void of any hatchery fin damage.

Don Kelly, limnologist for the Donegal Fish and Conservation Association plants a vibert box in a prepared gravel bed.

A 5" brown trout, also a vibert box progeny.

Playing Mother Trout

Back in the days of William Penn, native brook trout (Salvelinus fontinalis) swam in Donegal Creek. In the late sixties, a wild population of brown trout (Salmo trutta) also inhabited Donegal waters. But by 1994, few if any wild trout could be found. A few brown trout fingerlings showed up occasionally in Pennsylvania Fish and Boat Commission surveys, but their limited presence was insignificant.

Establishing a wild population of trout in Donegal waters remains a goal of the Donegal Creek Restoration Project. Tom Moore, in particular, has developed "wild trout fever" and in March of 1996 began looking for a cure. Moore's quest lead to the discovery of "Harriman Trout Company" in St. Ignatius, Montana and their wild strains of rainbow (Salmo gairdneri) and brown trout.

Each year since 1996, the partnership purchases several thousand brown and rainbow trout eggs and plants them in the head-waters of Donegal's west branch. The eggs are not simply thrown into the creek, but rather placed in Whitlock vibert boxes which are carefully positioned into prepared gravel beds.

Whitlock vibert boxes have upper and lower compartments. "Eyed" eggs are placed into the box's upper compartment. When the eggs hatch, the "sac fry" wiggle and swim into the lower portion of the box where they spend a few days absorbing their yolk sac. From there, the fry swim out of the box and into the surrounding gravel. The fry spend several weeks hiding and feeding in the voids of the stream gravel and vegetation until large enough to venture into the main flow.

A "no fishing-propagation area" has been established in the west branch headwaters where the egg boxes are planted. The partnership has been tracking the progress of the egg box progeny and know for a fact that some fish have reached adulthood and have left the sanctuary waters.

In 1998, two different year classes were seined repeatedly in the propagation area. A creel census was conducted on the first day of trout season below the propagation area and revealed several egg box brown and rainbows harvested by fisherman. Members of the Donegal Fish and Conservation Association also reported catching several egg box progeny when fishing the west branch.

The egg plantings have been successful to a degree, but it would not be honest to say the Donegal has a self-sustaining population of wild trout-YET! Time will tell and until then, we'll keep "playing mother trout".

FIGURE 1

	Station	1	2	3	4	5	6	7	8
pH	MEAN	7.79	7.93	8.17	8.18	8.41	8.32	8.44	8.36
	STDEV(+,-)	0.53	0.53	0.51	0.58	0.39	0.45	0.37	0.44
Water Temp °C	MEAN	11.62	11.57	12.97	13.23	12.62	12.39	12.07	12.73
	STDEV(+,-)	1.33	2.83	5.84	5.59	5.06	4.38	4.97	5.04
Ammonia - N ppm	MEAN	0.05	0.03	0.05	0.05	0.04	0.04	0.03	0.13
	STDEV(+,-)	0.07	0.05	0.12	0.12	0.07	0.06	0.05	0.37
Nitrate ppm	MEAN	30.70	32.47	27.62	25.30	30.80	32.27	32.47	31.55
	STDEV(+,-)	19.25	15.99	16.45	14.79	16.46	15.23	16.90	18.10
Orthophosphate ppm	MEAN	0.01	0.01	0.01	0.01	0.00	0.02	0.01	0.01
	STDEV(+,-)	0.02	0.03	0.02	0.01	0.01	0.04	0.02	0.01
Total Alkalynity ppm	MEAN	243.52	242.00	219.05	214.60	230.05	227.05	226.50	241.11
	STDEV(+,-)	37.07	26.97	44.16	53.54	43.82	40.89	32.70	37.45
Total Hardness ppm	MEAN	301.23	293.36	325.39	309.37	301.63	287.15	301.00	317.05
	STDEV(+,-)	44.66	45.53	121.92	117.67	66.43	55.25	60.07	70.32
Calcium Hardness ppm	MEAN	159.20	156.65	225.76	204.35	164.00	156.76	157.07	164.13
	STDEV(+,-)	82.89	90.84	189.58	126.79	103.11	95.83	99.27	95.53
Magnesium Hardness ppm	MEAN	157.68	162.76	145.44	144.24	165.94	156.95	172.94	187.44
	STDEV(+,-)	90.67	98.69	102.75	100.22	100.00	95.23	91.71	103.97
Oxygen ppm	MEAN	7.96	9.09	11.83	11.51	11.64	11.43	11.71	11.12
	STDEV(+,-)	1.62	1.62	2.11	2.27	1.32	1.77	1.85	1.76
Carbon Dioxide ppm	MEAN	18.52	15.99	9.82	9.19	6.63	9.09	6.34	5.95
	STDEV(+,-)	7.38	6.02	3.43	3.78	1.75	6.32	3.75	4.32

Don Kelly (left) and Sean Sullivan (right) of the Donegal Fish and Conservation Association are shown here sampling water chemistry and macroinvertibrates at Monitoring Station #7 on the Donegal's main stem.

Tom Moore (left) and Don Kelly (right) seine Monitoring Station #6 for larger fish.

Hows It Going?

Despite the relatively small size of Donegal Creek, proper analysis of its biological and chemical interactions becomes rather complex. Since 1994, the partnership has monitored the health of Donegal Creek at eight strategically located monitoring stations. Macroinvertebrate and vertebrate communities and densities, general water chemistry and stream channel hypsography data was and continues to be collected on a regular basis (see enclosed map for monitoring station locations).

Throughout the eight monitoring stations, 17 different species of fish, 35 species of macroinvertebrates and nine species of aquatic plants have been recorded. Fish, macroinvertebrate and plant specie communities vary from station to station as does substrate (streambed) composition.

The substrate of Donegal Creek can be described as being one or a combination of the following compositions: (1) anoxic muck, (2) oxygenated mud, (3) clay, (4) sand, (5) gravel, (6) rock, (7) rock pavement. Optimally, a substrate composed of interspersed areas of all the various compositions would be desirable and provide greatest specie diversity. Highly degraded sections of the Donegal consistently had anoxic muck and oxygenated mud substrate compositions; a consequence of accelerated erosion and sedimentation.

Despite restoration activities, the Donegal's chemical makeup remains relatively unchanged with the possible exception of local changes in dissolved gasses where installed structures increased turbulence. **Figure #1** depicts the various mean chemical values for each monitoring station. Even though fairly large standard deviations were utilized (a result from averaging four years worth of seasonal changes), some significant differences and similarities can be noted.

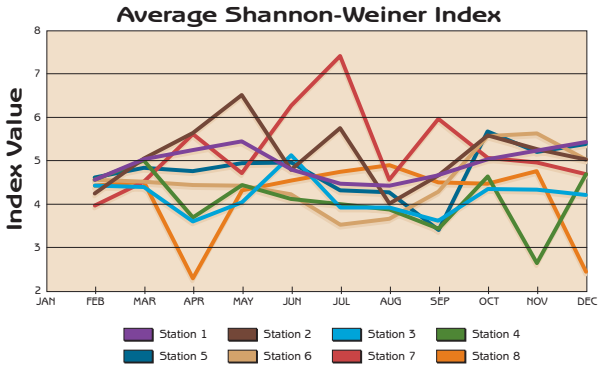
For example, pH steadily increases from station #1 (located in the headwaters of the west branch and an area of significant groundwater input) through station #5 (the first monitoring station downstream of the east branch/west branch confluence), then levels off.

Dissolved oxygen levels increase and carbon dioxide levels decrease as one advances downstream. These two gases are highly variable over a 24-hour period as a result of photosynthesis pulling carbon dioxide out while diffusing oxygen into the spring-fed stream.

Unfortunately, nitrate-nitrogen levels remain high throughout all eight stations. Close examination of the collected data shows nitrate levels are highest during drought periods and lowest during high stream flow conditions when surface runoff dilutes nitrate concentrations. Such findings indicate a nitrate contaminated aquifer. The nitrate form of nitrogen does not readily attach to soil particles and is prone to leach into the groundwater supply. Too much manure and fertilizer leads to nitrate leaching and groundwater contamination.

It is safe to classify Donegal Creek as a limestone stream. Total hardness and total alkalinity levels exceeded 300 ppm and 200 ppm, respectively. Acid precipitation is not a threat to Donegal's well-being considering the concentrations of calcium and magnesium.

FIGURE 2



The Shannon-Weiner Index of Diversity was utilized for determining specie diversity among the monitoring station. Index values over 7 are considered rich in diversity, while values under 2 are considered lacking in specie diversity. The index does not indicate specie density, just diversity. In general, diversity values for all stations drop slightly during midsummer. Values peak during late spring and early fall, probably a result of aquatic plant establishment and an increase in detritus respectively. Index trends for all stations can be seen in **Figure #2**.

Monitoring station #1 is located in a wooded setting in the headwaters of the west branch (Donegal Springs). Mottled

FIGURE 3 - Average densities adjusted to 10 sq. ft.

Station	1	2	3	4	5	6	7	8
Common Carp				1.0				
Creek Chub	1.0	1.0	0.6	1.5	2.0	1.0	1.0	
Blacknose Dace	20.0	20.0	1.1	1.9	2.7	4.0	4.9	2.8
Longnose Dace					1.0	1.0		3.5
Redside Dace	0.7	6.9	1.3	0.3	1.0	1.3	1.5	1.0
Common Shiner				12.0				
Bluntnose Minnow				2.0		1.0		1.0
Cutlips Minnow						1.3		1.0
White Sucker	0.7	0.5	0.5	2.0	0.9	2.3	0.8	1.6
Tessellated Darter		3.0	1.2	1.5	0.8	1.5	2.8	2.1
Mottled Sculpin	3.8	1.6	2.5		1.7	1.7	1.2	1.6
Eastern Banded Killifish			4.4	3.8			0.5	
Largemouth Bass				1.0				
Pumpkinseed			0.5					
Brook Trout	0.8						0.5	
Brown Trout	2.0	1.3	0.5	0.6	0.6		0.6	0.8
Rainbow Trout	0.8	0.8			1.0		0.5	
Crayfish (misc.)	0.0	0.0	2.5	4.5	5.9	7.8	10.0	8.7
Snail (misc.)	77.5	6.9	23.0	3.4	5.5	6.3	6.0	2.5
Leech (misc.)	3.8	13.8	5.5	4.4	3.8	5.0	2.5	2.5
Caddisfly Larvae (misc.)	44.5	8.8	10.0	103.0	9.8	20.3	5.0	13.7
Mayfly Nymph (misc.)	0.0	0.0	5.8	10.0	18.6	16.2	4.0	8.7
Amphipod (Scud)	246.5	110.0	11.5	10.0	134.9	63.7	23.0	40.9
Isopod (Sowbug)	540.0	511.8	16.8	38.3	397.9	252.6	57.0	21.8
Bloodworm	11.3	148.8	70.0	17.4	7.5	15.6	28.6	21.2

Hows It Going? (continued)

sculpin (Cottus bairdi) is the dominant fish specie, with redside dace (Clinostomus elongatus) and blacknose dace (Rhinichthys atratulus) frequenting the station to a lesser degree. Sowbugs (Isopoda) and scuds (Amphipoda) comprise the bulk of the invertebrate population. The substrate is mainly comprised of rock and gravel with sand and silt filling most voids. Although fish densities never exceeded 20 individuals per 100 square feet, macroinvertebrate populations ranged from 10,000 to 40,000 individuals per 100 square feet.

Monitoring station #2 is located in a pasture setting approximately 500 feet downstream from station #1. Prior to restoration activities, station #2 was severely impacted by a free ranging dairy herd. The stream channel was extremely wide and shallow. Little in-stream cover and plant life existed. Since the introduction of streambank fencing and structural habitat, station #2 is coming alive. Prior to improvements, bloodworms (Chironomus species) dominated the invertebrate population, but now sowbugs and scuds are becoming the more dominating species as the muddy substrate is replaced with clean gravel and rock outcroppings. Various dace and mottled sculpin are the dominant fish species.

Monitoring stations #3 and #4 are located in pasture settings in the east branch (Charles Run). These stations are an anomaly despite their close proximity to the Donegal's main stem. Charles Run simply does not act like the rest of Donegal Creek. Cold water fish species have been replaced with warm water species such as the banded killifish (Fundulus diaphanus). White sucker (Catostomus commersoui), blacknose dace and mottled sculpin are also common finds at these stations except for the hot summer months when water temperatures drive these species to cool deep pools and spring seeps. In future years, Charles Run will hopefully change back into a cold water fishery as forest buffer plantings grow and provide critical shade.

Monitoring stations #5 and #6 are located on the main stem, just below the confluence of the east and west branches. Both stations are located in a pasture setting and are very similar in appearance and character. The substrate at both stations is mainly comprised of gravels with a scattering of rock outcrops. Some sand and silt is present, but a fair number of voids in the rock and gravel persist. The stream channel at both stations is deeply incised and prone to flash flooding events.

Tessellated darter (Etheostoma olmstedi), blacknose dace and mottled sculpin are common residents of stations #5 and #6, while sowbugs and scuds dominate the invertebrate community. Mayfly nymphs (Stenonema, Ephemerella and Baetis species) are also common at these two stations.

Monitoring station #7 is located on the main stem, approximately 2,500 feet downstream from station #6. Station #7 is located in a pasture setting and had been negatively impacted by free ranging beef cattle prior to streambank fence and structural habitat improvements. Blacknose dace were always present, but their numbers rose considerably as a result of restoration improvements. Sowbugs dominate the invertebrate community. The last and most downstream monitoring station (#8) is located on the main stem with a wooded setting providing plenty of shade. Station #8 has a rocky bottom with sand and silt filling most voids. The fish population is mostly comprised of various dace species, while the invertebrate community is rather varied with sowbugs, scuds, various mayfly and caddis (order: Trichoptera) species.

Mark Metzler (left) and Tom Moore (center) receive the "1997 Watershed Protection Award" from the Pennsylvania Association of Conservation Districts on behalf of the Lancaster County Conservation District/Donegal Fish and Conservation Association Partnership.

Don Kelly gives a streamside presentation to a visiting group from Lancaster's North Museum.

4/26/97

Jack Hubley of WGAL's "Call of the Outdoors" videos Lamonte Garber of the Chesapeake Bay Foundation planting a tree on Donegal's east branch. In 1997,the Donegal Creek Restoration Project was featured on Call of the Outdoors.

Spread the News

Good news travels fast. Since 1994, the Donegal Creek Restoration Project has received its share of media attention. We've hosted numerous workshops, lead on-site tours and have given quite a few presentations to school and church groups, sportsmen clubs and environmental organizations. Listed below are a few examples of our achievements in the area of public relations.

AWARDS

1995 **"Award for Community Innovation"** presented by the Chesapeake Bay Local Government Advisory Committee
1997 **"Watershed Protection Award"** presented by the Pennsylvania Association of Conservation Districts

PUBLICATIONS

1995 **"Chesapeake Bay Communities"** by the Environmental Protection Agency
1996 **"Forest and Riparian Buffer Conservation - Case Studies"** by the USDA/Chesapeake Bay Program
1997 **"Restoring a Bay Resource"** by the USDA/Chesapeake Bay Program
1997 **"Earth Day Snapshot"** by the PA Department of Environmental Protection
1997 **"Volunteer Monitoring Programs"** by the PA Department of Environmental Protection
1998 **"National Directory of Volunteer Environmental Monitoring Programs"** by the Environmental Protection Agency
1998 **"Forest Buffer Toolkit"** by the Alliance for the Chesapeake Bay

TELEVISION

1997 **"Call of the Outdoors"** - WGAL Lancaster, PA

TOURS, PRESENTATIONS AND WORKSHOPS

1994 Donegal Open House
1995 Fencing Workshop
1996 Tour for Berks and Lebanon County Conservation Districts
1996 Tour for the Pennsylvania Association of Conservation Districts
1996 Tour for the North Museum
1996 Tour for the Lancaster County Academy
1997 Tour site for the Governor's Greenways and Trails Conference
1997 Tour and presentation to the **"PA Chesapeake Bay Riparian Forest Buffer Initiative Steering Committee"**
1997 Riparian Reforestation Field Day, co-hosted with the Alliance for the Chesapeake Bay
1998 Presentation to the PA Federation of Sportsmen Clubs at Annual Banquet
1998 Presentation to **"Forestry Committee"** at the National Association of Conservation District Annual Meeting

NEWSPAPER ARTICLES

10-15-94 *Lancaster Farming*
10-19-94 *Neighbors* - Lanc. County west
5-10-95 *Neighbors* - Lanc. County west
12-95 *Bay Journal*
5-3-96 *Lancaster New Era*
9-20-96 *Lancaster New Era*
4-22-97 *Lancaster New Era*
4-22-97 *Lancaster Intelligencer Journal*
5-4-97 *Lancaster Sunday News*
8-10-97 *The Philadelphia Inquirer*
9-18-97 *York Daily Record*
11-5-97 *Lancaster Intelligencer Journal*
4-2-98 *Lancaster Intelligencer Journal*

What Did It Cost ?

Many people who have seen the restoration work are often curious as to the cost of various items. The following information should provide some insight.

GENERAL BUDGET CATEGORIES FOR SECTION 319 GRANT

(Total Grant - $ 136,671)

Fencing Systems, Components and Tools	$ 51,285.60
Stone Ford Cattle Crossings	$ 16,852.50
Fish Enhancement Structures and Equipment	$ 33,346.40
Forest Buffer Systems	$ 4,666.32
Streambank Stabilization and Equipment	$ 10,219.48
Signs for Landowners	$ 419.76
Internship	$ 9,380.70
Photographs, Camera, Office Supplies, Final Report	$ 3.500
Equipment	$ 7,000
TOTAL	**$ 136,670.76**

In addition to the section 319 grant shown above, a **$52,880** (39%) in-kind match was generated for the project. The $52,880 in-kind match includes donated money and labor. When receiving a section 319 grant, the grantee needs to produce a minimum 25% in-kind match.

MISCELLANEOUS COSTS

High-tensile, two-wire fence *(including solar charger, lightning protection, installation and maintenance gadgets)*	$ 1.35/foot
Solar charger (12 volt)	$ 270
Eight foot, 8-10 inch diameter, pressure treated fence post	$ 10
18 foot by 50 foot stone ford cattle crossing (installed)	$ 600 - $1,000
Donegal fence stile materials (you build and install)	$ 80
One ton of delivered rock	$ 8.60 - $11
Tree seedling	$ .50 - $1.50
Tree protector with wood stake	$ 1.70
Trackhoe with operator	$ 80 - $ 110/hour
Backhoe with operator	$ 50 - $65/hour
Gas powered drill	$ 385
Average chainsaw	$ 350
Twelve inch diameter, 15 foot long pin oak log (picked up at mill)	$ 6.50

College intern, Steve Bowman prepares a Donegal sign board. The shed is owned by the Donegal Partnership and houses necessary maintenance equipment and materials.

Tom Moore of the Donegal Fish and Conservation Association wrestles with a spunky Donegal Rainbow.

Involving the general public in restoration activities generates a feeling of ownership. The Donegal High School shop class constructed 24 fence stiles.

Steve Bowman trims vegetation under one of many Donegal fences.

Two Steps Forward, No Steps Back

Great progress has been made towards the restoration of Donegal Creek and there are no intentions of letting past accomplishments fall by the way side. Maintaining improvements, such as the 7 miles of installed streambank fencing, will be a top priority in future years.

The partnership plans on expanding restoration efforts in the east branch. A water quality basin will be installed in a residential subdivision in 1999. The one acre basin will contain wetlands and should serve to filter stormwater flow and provide groundwater recharge. Water quality basins will be promoted in other developing areas of the watershed as well.

The future of Donegal Creek looks promising as long as people continue to care about this precious little jewel nestled in the heart of Pennsylvania farm country.

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DONEGAL
Trout Unlimited

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