

# Achieving Higher Quality Restoration Along Pipeline Rights-of-Way



*An Overview of Pipeline Construction Impacts with  
Recommendations for Reducing Environmental Damage*

Principal Author  
**Leslie Sauer**

An Expert Report Prepared for  
**the Delaware Riverkeeper Network**

*May 2014*  
Bristol, Pennsylvania



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**The Delaware Riverkeeper Network champions the rights of our communities to a Delaware River and tributary streams that are free-flowing, clean and healthy.**

The Delaware Riverkeeper Network gives voice, strength and protection to the communities and waterways of the Delaware River. Through independent advocacy, and the use of accurate facts, science and law, DRN works to ensure the rich and healthy future that can only exist with a clean, healthy and free flowing river system.

The Delaware Riverkeeper Network is unique in that it is founded upon the expectation of personal and community responsibility for river protection, as personified by the Delaware Riverkeeper. DRN is the only grassroots advocacy organization that operates watershed-wide and empowers communities with the engaged interaction and information needed to succeed in protecting our River and region now and into the future.

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*Front cover photo: Leslie Sauer*

*Back cover photos (clockwise from top): M. van Rossum, J. Zenes, F. Zerbe, F. Zerbe, J. Zenes*

## Foreword

Even though shale gas development is currently prohibited within the boundaries of the Delaware River watershed, the explosive growth of shale gas infrastructure is still impacting the communities of the watershed profoundly—a watershed that provides drinking water to 17 million people living in New York (including residents of New York City), Pennsylvania, New Jersey and Delaware. Pipelines, compressor stations and liquefied natural gas facilities intended to take shale gas to new markets in the United States and abroad are being proposed and pursued rapidly within the watershed’s boundaries. These projects illustrate the many harms this infrastructure imposes upon human and natural communities as well as the many deficiencies of current law associated with their proposal, review and construction.

Deficiencies include, but are not limited to, a lack of any rational planning; the failure to apply for and comply with reviews mandated by the National Environmental Policy Act; the failure of both federal and state agencies to implement water, air and wildlife protection laws in a way that genuinely achieves real protection; the lack of the political will and resources at the state, regional and federal level to fully implement and enforce community protection laws; and an absence of state laws necessary to protect habitats, waterbodies, and forests of public and private landscapes. These lands serve as the critical natural green infrastructure that protects communities from environmental harm. These habitats underpin the region's economic development and ensure the health, safety and quality of life of our communities. And yet it is these habitats that are so cavalierly ruined by pipeline development.

Four pipelines expansion projects have already cut through the Delaware River watershed since 2011. These projects have left permanent scars across communities, created pollution, increased stormwater runoff, and damaged natural areas important to wildlife, recreation and ecotourism as well as damaging the economic values that each of these brings.

In addition, eight new and/or expanding interstate pipeline projects are proposed for the Delaware River watershed. New pipelines and pipeline expansions are proposed to cut through:

- Broome, Delaware, Orange and Sullivan Counties in New York
- Berks, Chester, Delaware, Lebanon, Monroe, Montgomery, Pike, Schuylkill and Wayne Counties in Pennsylvania;
- Gloucester, Hunterdon and Sussex Counties in New Jersey; and



*Top to bottom: Right-of-way clearing for expansion of the Tennessee Gas Company's pipeline, J. Zenes; Pipeline under construction in Pike County, PA, T. Carluccio; Greenlick compressor station in Susquehannock State Forest; PAForestCoalition.org.*

- New Castle and Kent Counties in Delaware.

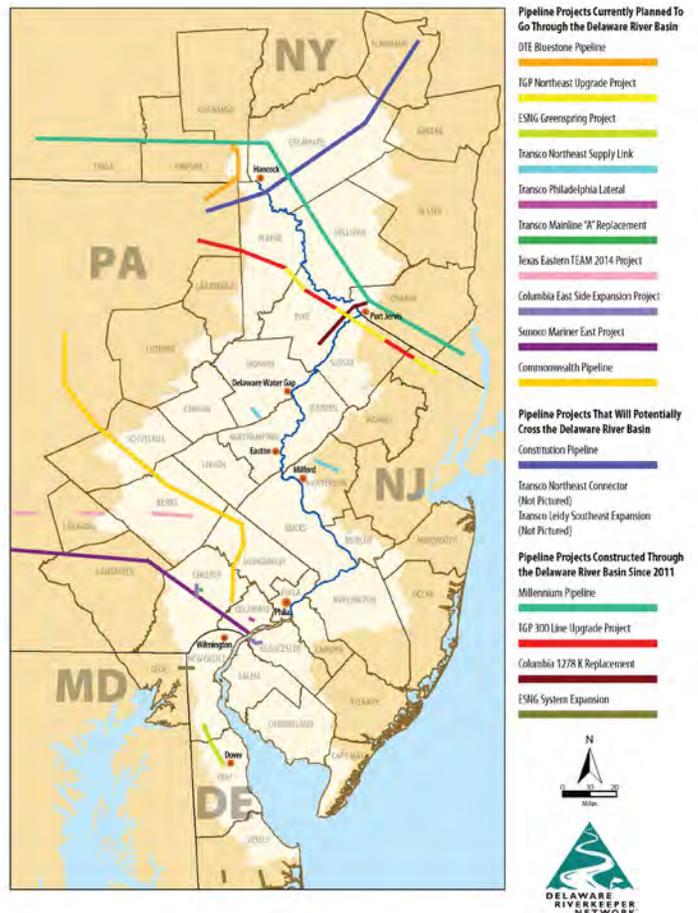
These pipeline projects will be cutting through communities, residential neighborhoods, mature and pristine forests and habitats, and through our highest quality and most valued streams and wetlands. Pipeline cuts are invasive, damaging and permanent.

Due to the irreparable harms shale gas development inflicts on communities and the environment, the Delaware Riverkeeper Network is opposed to all shale gas development and its associated infrastructure. Instead, the Delaware Riverkeeper Network supports sustainable energy as a focus of present and future energy investment and development. But, to the extent that there are pipeline projects now planned for our watershed and beyond, there are ways to dramatically reduce the harms they inflict when they do get through.

The recent frenzy of pipeline construction has highlighted many areas where current practices need significant improvement. To prepare this report, we started from the assumption that—in order to minimize harmful impacts on our environment and communities—we all want the best science and best technology to be used when pipelines pass through our neighborhoods, farmland and natural areas. The Delaware Riverkeeper Network turned to Leslie Sauer, an author and leader in ecological restoration, for insight into how harms from pipeline construction could be minimized or avoided. Ms. Sauer is a founder and former principal of the Philadelphia-based ecological planning and design firm, Andropogon Associates, Ltd.

This report complements a video lecture presented by Ms. Sauer. In both the lecture and this report, she discusses the harms that current pipeline construction practices cause, but she also provides recommendations that, if implemented, would avoid, minimize or at least dramatically reduce many of these harms. This expert report has been prepared to advise legislators, government bodies, regulators, decision-makers, and the public to encourage better practices, laws, and regulations should the proposed pipelines be permitted.

*Maya K. van Rossum*  
 Maya K. van Rossum  
 the Delaware Riverkeeper

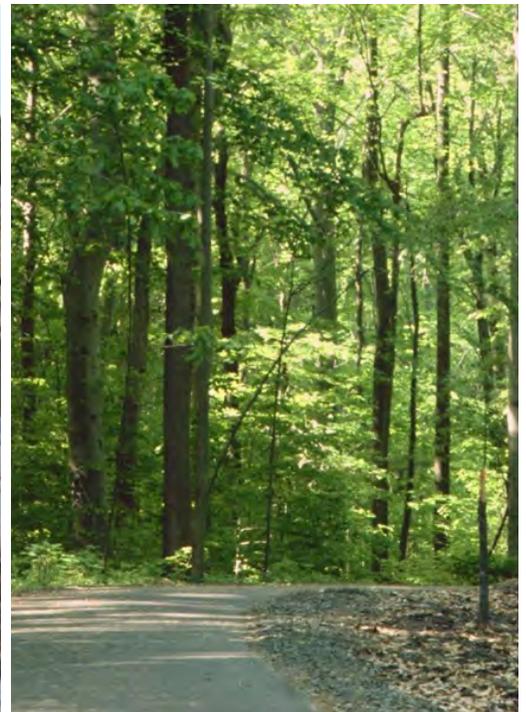


*Pipeline projects currently planned to pass through the Delaware River watershed. Map prepared by the Delaware Riverkeeper Network.*



*This is a bad way to build a pipeline.*

Below left, an open cut in-stream water crossing



*There is a better way.*

Above right, a pipeline was rerouted through a park to follow an existing trail wherever possible to limit the creation of new edge.

*Above left: Cutting through the Lackawaxen River in Pike County, PA, for a pipeline ROW, A. Stemplewicz  
Above right: ROW through a protected forest in Morris County in New Jersey, L. Sauer  
Opposite page: the Delaware Riverkeeper, Maya van Rossum, F. Zerbe*



*Clockwise from top left: Columbia Gas Company's pipeline ROW carving across Pike County, PA, F. Zerbe; Construction of the Tennessee Gas Pipeline Company's North East Upgrade project, F. Zerbe; Removing sediment from Cummins Creek, Pike County, PA, after a rain event, J. Zenes*

# Achieving Higher Quality Restoration Along Pipeline Rights-of-Way: An Overview of Pipeline Construction Impacts with Recommendations for Reducing Environmental Damage

Leslie Sauer

## SUMMARY

For decades, pipeline construction has received limited oversight with minimal demands on construction practices, except at a few sites such as wetlands. Regulation is inadequate and, unfortunately, government agencies, in an effort to foster infrastructure development, have often reduced permitting requirements and costs without considering the environmental and community impacts of these decisions. Pipeline routes often intentionally target natural areas, such as state parks, forests and other wildlands. Over time, pipeline rights-of-way have become wider which magnifies the harms inflicted on both ecological and human communities. With no federal, state, or local regulatory agency tasked with evaluating the full impact of individual pipeline projects or the additive effect of multiple pipeline projects, cumulative impacts of pipeline projects are largely ignored. Also, the opportunity for public participation occurs long after the time when proposed pipeline routes or proposed construction can be affected.

Current pipeline construction practices, as well as longer term right-of-way management, impact both terrestrial and aquatic ecosystems and can result in impacts to surface water and ground water quality. The pipeline construction process often entails unnecessary environmental damage. Loss of vegetation and soil compaction are more obvious, but landscape-scale changes to the watershed are occurring without acknowledgement or mitigation. Moreover, forest fragmentation and edge effect are being ignored. Seven key changes could dramatically reduce the damage to forests and watersheds from pipeline construction: Better enforcement and compliance; More comprehensive baseline assessment; Higher compensation for damages; Narrower rights-of-way; Better methods to reduce compaction; More effective stabilization and restoration; and Better monitoring and management.

## Introduction

The network of underground gas pipelines in this country is extensive and growing, especially with the energy industry pushing to move more gas from unconventional drilling wells to market. Pipeline siting, construction and management threaten both the ecological and human communities that they pass through, over and under, yet regulation of pipelines is limited with little opportunity for public input as to the paths they take or how they will be constructed. Currently, no federal, state, or local regulatory agency is tasked with evaluating the cumulative impacts of natural gas pipeline projects and associated infrastructure construction. Furthermore, the common practice by pipeline companies of segmenting large interstate pipeline projects into smaller projects allows them to avoid more thorough review and controls. However, simple changes in pipeline siting and construction practices could dramatically reduce the damage to forests and watersheds from pipeline construction. In the Delaware River watershed, the Delaware River Basin Commission (DRBC) has the power to conduct cumulative reviews for pipeline projects, at least for that portion of the project that is within the boundaries of the Delaware River watershed. This paper

provides an overview of the impacts of pipeline construction, examines the changes in pipeline construction and management that could lessen impacts, and identifies the regulations that could be adopted by a government body like the DRBC to better protect both our ecological and human communities.

## Unnecessary Harms Caused by Insufficient Regulation, Poor Right-of-Way Planning, and Failure to Consider Cumulative Impacts

The demands of pipeline construction and operation influence selection of pipeline right-of-way planning, but the selection process often fails to consider the full cost of individual pipelines or the additive effect of multiple pipelines. Moreover, opportunities for the public to influence pipeline selection in order to protect ecological or human communities are limited.

*Pipeline routes often intentionally target natural areas*  
Cost is always a significant factor in pipeline route selection. Publicly protected open space is often a first target when pipeline routes are being selected because the cost to acquire access to construct a pipeline through public lands is typically less and often brings with it less opposition (when taken on the whole).

Access to land for pipeline construction is usually acquired through an easement from the landowner providing a right to pass, or right-of-way (ROW), to the pipeline company. Many older ROWs cross landscapes that would receive preferential protection today, just as other pipelines now are often embedded in suburbs that did not exist when they were first built. Yet because it is automatically assumed that expanding an existing line will do less harm than a wholly new ROW, the mistakes of the past are sometimes compounded. At the same time it is also easy to understand why it might be difficult to suggest a new ROW through a built-up landscape in order to avoid expansion in a natural area, regardless of what the actual impacts might be.

A surprisingly difficult consideration when picking a new pipeline route is avoiding other lines already in place. There is an amazing array of pipelines crisscrossing our landscape already. More should be required of the pipeline project planners to cooperate with other pipelines and the existing network already in place to share in efficient transport of gas rather than build new lines. This problem is aggravated by the complete lack of comprehensive planning for this infrastructure. Piecemeal permitting further fractures a process that is already atomized by different ownerships and jurisdictions. Cumulative impacts are ignored altogether.



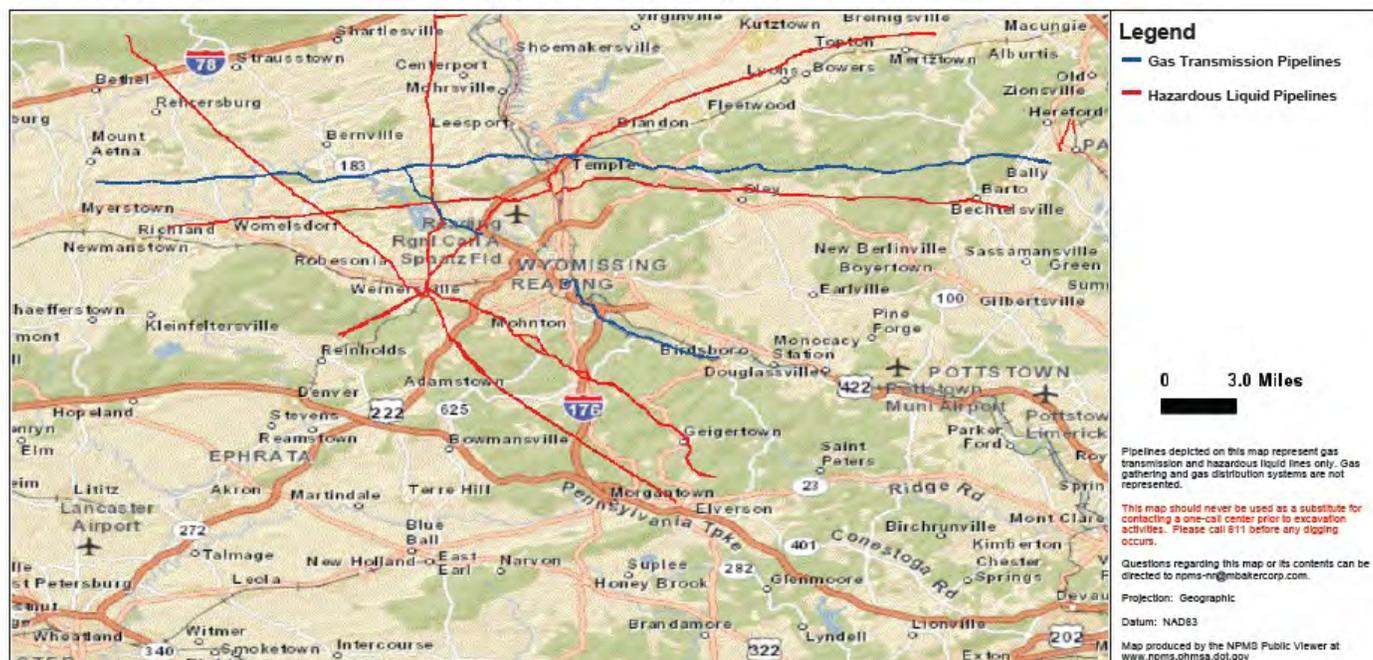
*Pipeline ROW work on Kittatinny Ridge in New Jersey's High Point State Park, M. van Rossum*

*State forests and other wildlands need a higher degree of protection*

The open space taxpayers have bought to protect watersheds and conserve local biodiversity is improperly treated as a convenient reserve for gas production and transmission as well as road construction and other infrastructure. Although protected from residential and commercial development, these lands are being increasingly compromised by pipeline and power line infrastructure projects. State and federal governments have failed to put in place the needed legal protections for our large-scale public landscapes and



## NATIONAL PIPELINE MAPPING SYSTEM



*A map of the Reading, PA, area created using the National Pipeline Mapping System (NPMS) Public Map Viewer online. Users can view NPMS data one county at a time. The pipelines shown include gas transmission pipelines (blue) and hazardous liquid trunklines (red). Data for gathering or distribution pipelines is not available through the NPMS Public Map Viewer.*

their ecological integrity. In addition, there is a body of laws related to power project infrastructure that in fact undermines preservation of lands at the local level—interstate pipelines are exclusively under the jurisdiction of the Federal Energy Regulatory Commission (FERC)—and makes public lands among the most vulnerable areas for infrastructure routes.

Because intact public lands often have important habitats, state and federal reviews are done to identify possible locations of threatened and endangered plants and animals. Agencies identify sites associated with rare, threatened and endangered species and make recommendations along the entire route of every pipeline to avoid harming these species. Examples of recommendations can include relocation of a proposed route or a reduced ROW width. But such adjustments are limited to known sightings of threatened and endangered species. Species that are considered to be rare or of conservation concern, but do not have threatened or endangered status, are not protected.

This effort to respond to known sightings of threatened and endangered species is not an adequate substitute for a broader consideration of the cumulative pipeline route and ROW impacts. In many instances, more could be done to minimize harm, especially for state listed species which appear to get less protection than federally listed species. For example, in one case in Pennsylvania, a pipeline company was required to collect seed from an endangered state plant located in the ROW corridor. Scattering that seed after the ROW was installed was a requirement of the permit, but stronger protections and measures could have been required to either avoid this area entirely or, at a

minimum, ensure that the endangered plant was able to re-establish after the ROW was completed, demonstrating performance as well as compliance.

### *Overly wide ROWs magnify the level of harm*

The width of ROWs has incrementally widened over time as larger equipment is used despite the fact that there are many options for significantly narrowing down a ROW to minimize vegetation clearance and reduce damage to soils. Today ROWs are kept minimally vegetated, dependent on herbicides and intensive mowing, but in the past pipelines and other ROWs often supported successional native species. The combination of a wider ROW and management strategies focused on minimizing healthy regrowth compounds the ecological harms. FERC currently recommends a 75 foot ROW, but the 100 foot ROW has become routine, and with no strong pressure to minimize damage, thousands of acres that once were field or forest are now maintained as relatively barren. Safety concerns, the scale of construction and increased security have contributed to the current over-wide ROWs. Narrower ROW's could greatly reduce overall impacts and permanent cuts in the landscape.



*Local residents protest the Tennessee Gas Pipeline Co.'s North East Upgrade project, F. Zerbe*

### *Public involvement often comes too late*

Selection of the pipeline route is the first concern and often is decided upon well before opportunities for the public to participate in the planning process are provided. By the time pipeline permit applications are made public, it is generally considered too late to make any modifications to many aspects of the pipeline. The decision-making process should engage communities early on and in multiple ways and venues as well as throughout the process to ensure community concerns and local resources are identified, addressed and protected. However, in the current system, those interested in influencing pipeline routes must pro-actively seek out information early in the planning process, stay informed about decisions re-



*An overly wide pipeline ROW, M. van Rossum*

garding new and expanded routes, and educate themselves about opportunities to make comment. And the reality is that often the site design is done before the public has any fair opportunity to become aware or to be heard.



*Pipeline cuts are invasive, damaging and permanent. Looking west from Kittatinny Ridge towards Pennsylvania, J. Zenos*

#### *Cumulative impacts are ignored*

Pipelines, both at the individual project level and when considered cumulatively, have a substantial effect on water resources as well as both the ecological and human communities that they pass through, over and under. Current pipeline construction practices, as well as longer term ROW management, impact both terrestrial and aquatic ecosystems resulting in impacts to surface water and ground water quality. Impacts include, but are not limited to:

- Sediment pollution,
- Exacerbated erosion,
- Loss of macroinvertebrate and fish spawning habitats,
- Adverse affects to wetlands and marshes,
- Permanent removal of riparian vegetation,
- Loss of forest lands, forest fragmentation, changes in forest ecology and increased edge effect,
- Increased surface water runoff,
- Thermal impacts,
- Redirection of groundwater and surface water flows.
- Releases of drilling muds,
- Creation of sinkholes due to drilling, and

- Air pollution resulting from methane and other air contaminants.

As long as this list is, there are still many more impacts which are both individual and cumulative.

Cumulative impacts may span the length of each individual pipeline project, but cumulative impacts can also result from the expanding array and numbers of pipelines across a watershed, region, state and the nation. The sheer number of pipeline ROWs is growing, but the cumulative impacts continue to be ignored.

Currently, no federal, state, or local regulatory agency in the Delaware River watershed is tasked with evaluating the cumulative impacts of natural gas pipeline projects and their associated infrastructure, which can include access roads and compressor stations. In fact, pipeline companies intentionally segment large pipeline projects into smaller projects to avoid more thorough review and controls. While the DRBC has the power to conduct cumulative reviews, at least for that portion of a pipeline project that is within the boundaries of the Delaware River watershed, it has refused to fully exercise that legal authority.

In 2013, the DRBC agreed to partially examine pipelines passing through locations included in the agency's Comprehensive Plan, but for all other pipelines, the DRBC is taking no action other than regulating water withdrawals for hydrostatic testing to check for leaks in pipelines.



*Construction of a natural gas gathering line pipeline, T. Carluccio*

## Impacts of Pipelines Constructed Today

We focus here on the landscape-scale impacts of pipelines, however, all of these consequences are relevant at the local level as well.

*The construction process often entails unnecessary watershed impacts*

The construction process for a pipeline is fairly simple and entails digging a ditch to accommodate the pipe. Before digging, the vegetation is cleared along the whole ROW and the top soil is reserved, either beside the trench or in a work area. The pipe itself is brought to wooden cradles along side the trench where segments are bent as needed, coated and welded before being placed in the trench by a side boom. The side boom, a piece of equipment that lifts and handles the pipe, is typically the heaviest piece of equipment on site. Once the pipe is laid and the trench refilled, the whole process just moves on up the route. It may take only a few days to complete a given stretch.



*A side boom preparing to lower pipe into a trench, J. Zenes*

After the pipe is laid and the trench filled, the site is reseeded and stabilization matting is used in areas where erosion is a probability. The landscape is often seeded with non-native plants in an attempt to stabilize soils quickly, then “allowed to revegetate naturally,” except that today any plant growth is regularly mowed or herbicided to maintain a relative wasteland across a pipeline ROW that may be 100 feet wide or wider.

The state specifies what techniques should be used at wetlands and stream crossings, including the appropriate ROW widths. All of these terms and conditions are incorporated in permits issued for a pipeline. Dur-

ing construction, a log of site work is posted online to insure compliance with permit requirements that were agreed to with the state, FERC and other regulatory agencies.



*Heavy construction equipment backfilling a trench along a pipeline ROW, F. Zerbe*

The loss of vegetation may be the most apparent impact, but soil changes are the most pernicious. The single biggest problem is soil compaction, which may be as high as 98%, the same as concrete. Rainwater often runs off the ROW like a stream, creating gullies in the adjacent landscape, which leads to erosion and sedimentation locally.



*Failure of erosion controls at pipeline construction site Mountain Road Montague, New Jersey, J. Zenes*

Once soil has been disturbed and compacted, it is very difficult to restore its capacity for water infiltration. Re-ripping the soil with a chisel plow is a partial solution to surface compaction, but it leaves

behind an exceedingly erodible surface and does not address the issue of recharge. Ripping deep enough to effect recharge would destabilize large areas of the landscape and be almost impossible to re-stabilize. The damage from soil compaction, loss of vegetation, increased runoff, erosion, and resulting pollution has effects well beyond the boundaries of the ROW where it originates. Sensitive agricultural lands crossed by pipelines are also harmed by soil disturbance and compaction.



*Clearing forested wetlands in Montague, New Jersey, in advance of pipeline construction, J. Zenes*

Current pipeline construction restoration requirements are very low; they rely primarily on cool grass seeding and erosion blankets and often have poor long term results after the two required maintenance and monitoring seasons for the agencies. Even with such low stabilization standards, the rate of compliance is abysmal. For example, between June 2011 and October 2011, in just two counties in Pennsylvania there were 32 documented sediment discharge violations along the route of the Tennessee Gas Pipe-



*Sediment pollution overwhelms controls and floods wetlands, F. Zerbe*

line Company's 300 Line project. Imagine how many such violations go unobserved.

Pipelines can also dewater the headwater areas through which they pass and change the hydrology of wetlands areas along the route. Taken with the loss of vegetation and soil compaction, these impacts cause landscape-scale changes to the watershed yet they are neither acknowledged nor mitigated.

*Forest fragmentation and edge effect are ignored*

Like the watershed, the forest is also impacted well beyond ROW boundaries. The creation or expansion of a ROW through forest creates a continuous open wound called the 'edge effect.' While the edge effect can be positive when confined to small canopy gaps in a closed forest, edge effects are detrimental when they occur along a continuous seam of fragmentation. Increased wind movement facilitates movement of weedy propagules and invasive species deep into the forest where they find the way suddenly wide open for them with abundant new ground to colonize. Predators and parasitic birds like cowbirds use these corridors to access otherwise difficult to find prey.



*A continuous scar fragmenting both forest and waterway, F. Foley*

ROWs are like highways bringing the elements of the developed world into otherwise undisturbed areas. Increased windthrow during storms often creates further loss of more mature trees in the forest area adjacent to the ROW. With the repeated and continuous forest fragmentation that results from pipeline construction and maintenance, the species of the forest interior decline, something that has already happened to 90% of forest interior birds. This effect often extends up to 300 feet from the actual edge of the disturbance (i.e.,

the ROW clearing), making a corridor of at least 700 feet wide of disturbance with every 100 foot ROW.

Often a new pipeline uses and expands an existing corridor that may have multiple pre-existing lines. The amount of new edge may be halved using this approach when compared to a new ROW corridor, but this practice has resulted in some ROW corridors becoming, unnecessarily, hundreds of feet wide—this amounts to large habitat losses and a boundary that is increasingly capable of blocking the movement of some species of plants and animals. The existing requirements to protect a few very rare species is insufficient to prevent the general degradation of the forest from this kind of fragmentation. Interior forest is imperiled and cannot be replicated on small-scale sites or over short periods of time. Once lost, forest interior is gone and cannot be restored. Lost with it are those plants and animals that are restricted to the forest interior.



*Pipe for the 325 Loop of Tennessee Gas Pipeline Co.'s 300 Line project in cradles in the New Jersey Highlands, J. Wagner*

### **Changes That Could Make a Difference**

Current FERC and erosion and sediment control guidelines are inadequate to meeting the challenges of the current pipeline construction boom. State and other federal agencies aren't filling the regulation gap. Unfortunately in an effort to foster infrastructure development, government agencies often seek to reduce permitting requirements and costs without adequately counting the environmental and community impacts of these decisions.

It is increasingly apparent that serious effort with companies and agencies is required to develop new

construction strategies and Best Management Practices (BMPs) that better protect our ecological and human communities. A more coordinated approach by regulators is needed to change a process that has for decades received limited oversight and upon which limited demands have been made, except at a few sites such as wetlands. The potential role for FERC, the U.S. Department of Transportation (USDOT) and state environmental agencies in a new pipeline construction paradigm cannot be overstated.

Seven key changes could dramatically reduce damage to forests and watersheds from pipeline construction:

1. Better enforcement and compliance,
2. More comprehensive baseline assessment,
3. Higher compensation for damages,
4. Narrower ROWs,
5. Better methods to reduce compaction,
6. More effective stabilization and restoration, and
7. Better monitoring and management.



*Key changes could reduce harms resulting from pipeline construction, M. van Rossum*

#### *1. Better enforcement and compliance is vital*

The primary regulations pertinent to pipeline construction are the same that apply to new development and road construction. For example, erosion and sediment control regulations for pipelines employ many of the same techniques used with other construction projects. Required techniques may be as simple as reseeding and mulching or as complex as horizontal directional drilling under a river. Regulatory require-

ments vary somewhat from state to state and individual agreements between the pipeline company and the landowner may modify or expand requirements. These regulations are, however, only as good as the extent to which there is full compliance. Unfortunately, the Delaware Riverkeeper Network (DRN) has documented numerous failures in both compliance and performance.

In 2012, DRN staff and trained volunteers monitored pipeline construction activities along the Tennessee Gas Pipeline Company's 300 Line project and documented unstabilized sediment, damaging wetland crossings, scant mulch, and mediocre vegetation growth at many rights-of-way. DRN also logged and responded to pollution report calls from citizens documenting pipeline pollution. As a result of DRN's work, over 17 notices of violation were issued for the 300 Line project in Pike County during Spring 2012 alone. Wayne County also found violations along this pipeline project during the same time period.

According to the Tennessee Gas Pipeline Company's own estimates, the 300 Line project "temporarily" disturbed 108 wetland acres and permanently destroyed 22.9 wetland acres within the Delaware River watershed. The company was required to restore the temporarily disturbed wetlands, but delayed these activities until amphibian populations were already present in these areas for breeding. DRN notified state and local agencies to request that the invasive wetlands work be delayed until the young amphibians present could grow to adulthood and move on, but the agencies allowed the Tennessee Gas Pipeline Company to go forward.

Nor does compliance with permit requirements guarantee that the erosion and sediment controls employed will perform as anticipated on site. A real problem is the underlying assumption that the standards are met automatically when regulations are complied with. Often, this is not the case, in part because the techniques recommended are inadequate to the task.

The purpose of environmental regulations may be to protect native species and watersheds, but the actions taken to implement those regulations are not achieving their goal. Looking just at regulations intended to protect rare, threatened and endangered species, no new baseline studies are required before construction, and existing records as to the presence of these species along proposed pipeline routes are incomplete, leaving these species unprotected.



*DRN staff document an old growth forest in the path of pipeline construction, J. Zenes*

Many natural areas currently being targeted for pipeline construction are on soils, or rock, and difficult to stabilize, resulting in erosion. Severe compaction often disrupts water patterns and further contributes to erosion and sedimentation. DRN has documented many examples of failed stabilization efforts for new pipeline construction with serious and on-going deleterious impacts to the surrounding habitats, demonstrating the need for better enforcement by regulators. Like DRN, regulators could work with trained local volunteers to better ensure that violations do not go unobserved.

We must also look at failures of compliance and performance and prevent them in the future with expanded BMP's mandating better performance on the



*Tennessee Gas Pipeline Company's crossing of Shimers Brook, a trout stream in New Jersey, J. Zenes*

ground. Some examples of better construction and management are described below. None are untested. All have been implemented with success on a pipeline in Pennsylvania or New Jersey. All require more effective oversight by agencies as well as expanded jurisdictions and better BMPs.



*Attempted stabilization of a pipeline ROW on steep slopes, J. Zenes*

## 2. Better baseline assessment is important

The purpose of baseline monitoring is to inform route selection and the determination of appropriate methods for construction, restoration and management for various segments of the route. Baseline monitoring can help to customize a process that is otherwise a one-size-fits-all approach.

In addition, more complete baseline monitoring would help make up for our currently incomplete records for rare, threatened and endangered species of plants and animals. In preserved lands and healthy ecosystems, full on-the-ground monitoring is vital

and should not be sacrificed to speedy construction. Cultural and historic resources should be monitored in much the same way.

Problems such as excessive herbivory and the extent of exotic invasives species should also be documented as part of the monitoring. Knowledge of exotic and invasive species should be used to develop and carry out ROW management prescriptions. Specific actions could include treatment prior to tree clearance, treatment for up to five years after construction, and requirements to wash equipment coming from areas with invasive species present before entering less disturbed landscapes along the construction route.



*With no cost associated with lost ecological functions and values, natural areas are targeted for pipeline construction, F. Foley*

## 3. Natural area impacts need greater compensation

The cost of crossing natural areas is under-compensated. Typically there is no payment made for lost ecological functions and values when interior forest is damaged by fragmentation or disturbance. Without recognition of the damage being caused, no dollar value is associated with the loss of interior forest and there is no incentive to reduce forest impacts. This failure makes natural areas artificially cheap to cross, shifting real costs and losses to taxpayers, effectively subsidizing the pipeline.

The thorough assessment of site conditions, called for above, will be a vital component of the negotiation of the true cost of crossing publicly owned and preserved landscapes. Compensation should reflect the damages to a site's function as a natural landscape and recreation area as well as the need to effect high quality stabilization and habitat establishment.



*Construction documents detailing trees to be removed as well as trees to be saved, L. Sauer*



Narrowed pipeline ROW with fencing to protect trees, L. Sauer

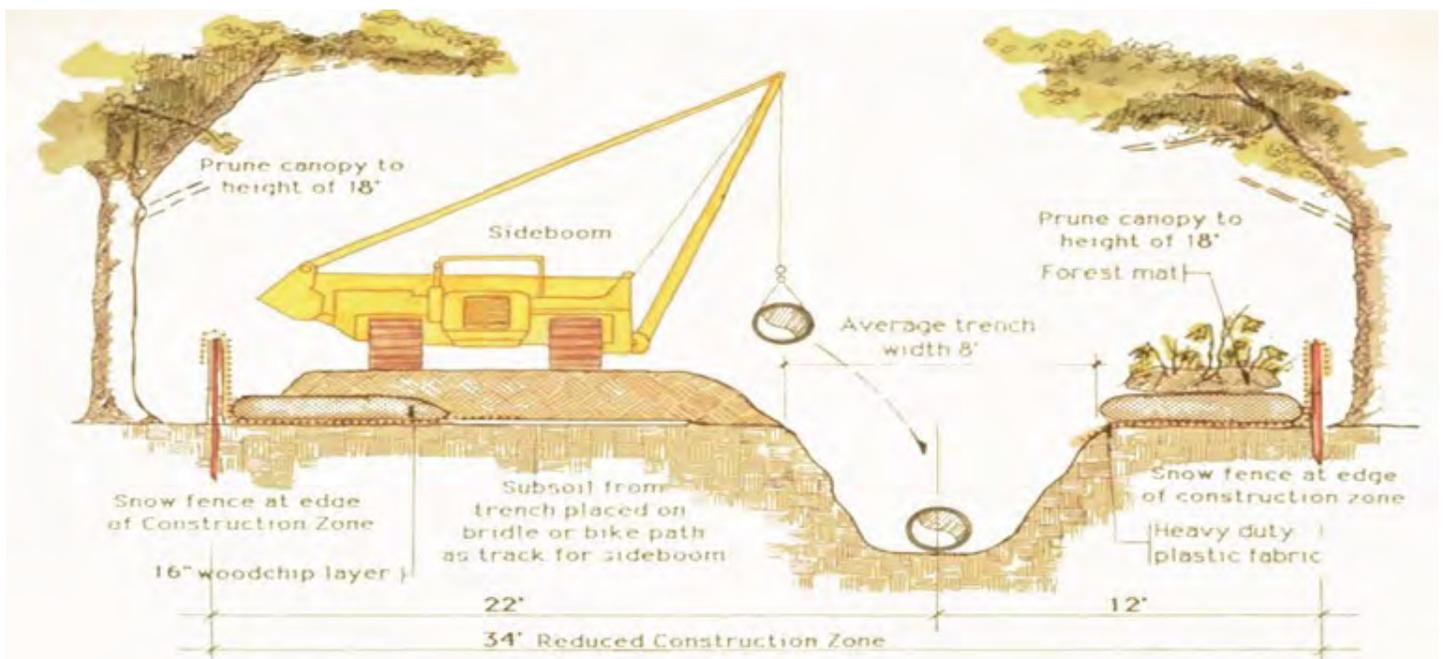
#### 4. Narrower ROWs need to be applied more widely

ROWs must be narrowed to the greatest degree possible. In short, every foot matters. While 100 foot ROWs are now the norm, 30 to 50 foot ROWs were commonplace in the past. Not only were narrower ROWs commonplace, but they can be mandated today when there is a need to protect habitat for a rare plant or animal, or a wetland or other special ecosystem. FERC's *Upland Erosion Control, Revegetation, and Maintenance Plan* and *Wetland and Waterbody Construction and Mitigation Procedures* recommend limiting pipeline construction ROWs to 75 feet. There is no reason that narrower ROWs should be limited to exceptionally sensitive ecosystems; they should be the norm, not the exception.

When there is a need for modification, even in today's pipeline construction projects, flexibility is common and many alternatives to conventional construction techniques may be employed. This includes methods such as 'stove-piping' where the pipe is welded in the trench eliminating the need for a cradle, which in turn reduces the width of the ROW needed. In another method, called 'dragging,' the pipe is welded in a work area and then literally dragged through the trench. Many streams are crossed with horizontal directional drilling (HDD) and have no above ground trench at all, except at either end of the drill.

Typically where alternative methods, such as HDD are employed, additional work area is required at either end of that section of pipe. Additional work areas, when designated, represent another area for serious negotiation concerning need for and the size of the area to be disturbed. Clearing for HDD landing pads and other work areas should be minimized to keep the ROW narrow.

Whenever a ROW is narrowed, safety becomes more of a concern. Additionally, not all methods are applicable everywhere and flexibility may be required. Even the rather proscribed system currently employed recognizes that adaptive methods and construction practices may need to be modified based on field conditions at the time. However, alternatives are currently restricted to a very few sites today. It is essential that pipeline companies and regulators begin viewing for-



Habitat protection measures that can be used during pipeline construction including working a side boom over a cushion of mulch, L. Sauer



*Pipeline construction practices can result in tree death even for trees outside the disturbance zone, J. Zenes*

ests and other natural landscapes as worthy of the increased protection that can come from reduced ROWs and more flexible construction strategies. Less impactful construction practices should not be the exception; they should become the norm as these methods are technologically feasible and are cost competitive.

In addition to the use of alternative construction methods, the use of smaller and lighter construction equipment could also be used to reduce the ROW width as well as soil impacts. The size of the pipe is obviously a limiting factor here. Nonetheless one pipeline company, Napp Greco, installed a three foot diameter pipe in a 34 foot-wide ROW through a protected forest in Morris County, New Jersey. Imagine how much less damage there would be with 34 foot ROWs. Simply reducing the 100 foot ROW, a size that is routinely used in this area, to 75 feet would result in a 25% reduction in the direct damage to vegetation, habitat and soils.

#### *5. Post-construction compaction needs to be reduced*

Even within a narrowed ROW, compaction can be reduced significantly. One opportunity to minimize compaction is by working heavy equipment on top of a cushion made of the wood chips generated on site during the removal and chipping of trees and the sub-soil from the excavation of the pipeline trench.

Along the Tennessee Gas Pipeline Company's 300 Line and Northeast Upgrade (NEUP) projects, mulch from the chipping of removed vegetation was blown into the adjacent forest, in some instances, to a depth of over three feet, which causes unnecessary impacts to areas outside of the ROW. In some areas, this deep mulch has caused bark rot, and mature trees buried in the mulch are showing signs of stress (groundcover



*Mulch blown into state forest land adjacent to the route of the Tennessee Gas Pipeline Company's Northeast Upgrade project, J. Zenes*



*Deep piles of mulch caused bark rot and tree death, S. Rando*

plants were also buried). Instead, these reserved materials could have been used to reduce harm rather than create more harm.

Compaction rarely reaches more than 12 to 18 inches below the surface. A cushion of wood chips and sub-soil can completely protect the topsoil and plant propagules beneath this layer. Contractors can also use wood chips and sub-soil to add depth over an existing pipeline if the current soil cover is insufficient to allow equipment to work over it.

This practice would allow for narrower ROWs by making it possible for the side boom to work over an existing pipeline along a shared pipeline corridor. Working over a cushion of wood chips and soil also eliminates the need to find land elsewhere for stockpiling or disposal of these materials, further reducing the size of work space requirements and the associat-



*A side boom working on a cushion of soil in a narrowed ROW, L. Sauer*

ed disturbance. Various commercial mats are another option, but are costly. Using soil from the site eliminates or reduces the need to stockpile this material.

A fabric layer over the natural ground prior to wood-chip stockpiling can be used to delineate the original grade and protect herbaceous species and the rootstocks of woody vegetation that has been cut for construction purposes. These areas can rebound very quickly with original vegetation back in place only days after the trench is refilled as the over-burden is removed. When combined with the use of smaller equipment, this can meet the goal of no loss of infiltration. Soil disturbance can be limited to the ground cover over the trench and any areas actually graded during construction for access which, in turn, could reduce the amount of soil compaction along the ROW by as much as 90% in places.

In areas where reseeding is needed, stabilization with locally native grasses and sedges would also maintain and increase infiltration rates over time. One third of the roots of woodland sedges die each year creating continuous openings deep into the soil to help with infiltration. Cool season grasses currently used for revegetation do not, especially when mowed which produces shallow root systems.

Independent third party certification should be required to evaluate and verify infiltration rates along the route of the completed pipeline to ensure actual compliance with the requirement not to increase runoff. FERC guidelines call for the use of penetrometers or other such equipment to evaluate and compare compaction along the construction route and adjacent

undisturbed areas. This work should be completed and the results posted online. Remedial work should be undertaken where necessary.

Soil compaction can further be reduced by using narrower access ways, which by definition results in a smaller area of compacted soil. FERC currently recommends that only a 10 foot wide strip be maintained with annual mowing for access. There are three foot diameter pipes in the region with eight foot-wide access ways with occasional wider areas, or passing sites, along the pipeline route that can accommodate a wide range of equipment.

*6. Stabilization and restoration goals need to be met more effectively*

When the area of disturbance has been reduced, stabilization becomes easier. Where a wood chip and soil cushion has been used beneath heavy equipment, the land beneath this cushion should need little or no further stabilization once that cushion is removed. The area over the trench may be the only ground requiring planting. One innovative strategy used in Morris County, New Jersey, was to lift the sections of soil and vegetation over the trench, just like sod is lifted, and stockpile them on the side of the trench opposite the side boom. This eliminated the need to segregate and stockpile topsoil and avoided destroying the propagules of existing plants. When these sods of forest soil and roots were replaced over the trench, no further stabilization was required.

Where the original vegetation cannot be replaced over the trench, permanent stabilization BMPs should be



*Stockpiling of forest soil and roots for later replacement over the pipeline trench, L. Sauer*

developed using species native to each section of the route. The same native grasses and sedges that promote rainwater infiltration also sequester up to a ton of carbon yearly per acre. This is a small but important step toward mitigating the impacts of the clearance of trees from the ROW and providing a better habitat than the typical cold season grasses that are often used currently. Only locally native stone should be used and only organic stabilization products should be used, including mulch and soil blankets.

#### *7. Management and access need to be reevaluated and modified*

Recent management practices for pipelines have dramatically reduced the habitat values of ROWs. Once ROWs provided habitat for many early successional species, but today they are more like wastelands, or worse, sources of invasives into the forest interior.

Security concerns that arose after the terrorist attacks of September 11th, 2001 are in part responsible for current management practices. However, security can be addressed while still providing for more ecologically sound management. New management guidelines need to be developed. Some pipelines could have additional surveillance provided by the landowner in the form of management and/or recreational use in the vicinity of the pipeline. Pipeline companies should also anticipate providing long-term protection along a ROW from the ATV use that often begins after a pipeline cuts through an area. These vehicles cause even more soil disturbance, erosion and impacts to waterbodies.

If the ROW is narrowed and the existing soil and vegetation have been protected, and sods have been lifted and replaced over the trench, no further management is required after the trench is refilled as long as invasives are absent. In some forest interior areas, narrow ROWs may permit closed canopy management which would dramatically reduce edge effect and could, in fact, eliminate it over time.

Currently post-construction pipeline revegetation efforts are often sparse or fail completely. Reseeding and additional management may need to be undertaken, but often are not. Poorly stabilized ROWs are rapidly colonized by exotic, invasive vegetation, which can invade previously undisturbed natural areas nearby. Permits typically state that invasive vegetation will be managed, but ROWs all across the Delaware Valley are nonetheless overwhelmed by invasive plants.



*DRN staff lead a ROW tour after pipeline construction, S. Rando*

Until we have more effective BMP's that truly replace lost ecological values, monitoring and maintenance over a longer term than the two years that is typically required is greatly needed. This is especially important concerning soil stabilization and invasives management. Better stabilization BMPs are needed to address often extreme conditions. Solutions from the developed landscape, such as bringing in topsoil, are not suitable for natural areas.

With more extreme drought and large rainfalls due to climate change, maintenance plans, measures and windows are more important than ever. After all, the regulations presume that the site will be restored to its previous condition. However, ongoing management may be threatened by plummeting natural gas prices and tighter budgets, so additional bonding should be considered to ensure adequate stabilization over time.

#### **Regulations to Protect the Forest and Watershed**

As the current pipeline construction process is not without regulation now, many of the key changes recommended here can be incorporated into permitting by simply shifting focus or expanding available options. However, new regulation is needed to require that cumulative impacts are documented, addressed, and avoided or mitigated. Without additional protection, preserved lands are likely to be encroached upon little by little, with devastating cumulative impacts.

*Landscape-scale forest and watershed protection are needed*

Better protection is needed for lands we consider already protected. Giveaways of public land for pipe-

line ROWs should be avoided if at all possible. To safeguard the most sensitive lands, zones should be established within protected lands where roads, ROWs, etc., are prohibited. Stream and wetland crossings should be avoided as should routes through steep slopes, since these slopes are often problem areas.

Given the region-wide impacts of pipeline construction, we need regional-scale forest protection as well as state-level forest protection. In addition to creating sanctuaries, we need to regulate improved forest protection in all contexts, including greater protection for high quality landscapes, limits on permitted vegetation clearance and grading, restrictions on increasing runoff, recharge requirements, and banning the use of invasive species. Cumulative impacts need to be recognized and monitored with effective metrics on the ground, rather than on paper. Requiring inventories of plant and animal species and establishing costs for loss of mature trees would go a long way to encouraging pipelines to be sited in areas where mature forests do not exist.



*As they are maintained today, pipeline ROWs are sources of invasives into the forest interior; F. Foley*

#### *Expanded assessment and monitoring are essential*

You cannot avoid damaging valued resources if you don't know where they are. You cannot defend your management if you don't monitor its effects. You cannot claim that compaction has not changed if you do not measure it. And so expanded requirements for assessment before construction and monitoring both during and after construction are essential regulatory requirements. Better mapping is also needed, especially of sensitive wetland and waterbodies.

Where community watchdog groups and non-profits organizations are active, as is the case in Pennsylvania, where the development of shale gas infrastructure has become a big concern for communities, pipeline companies should value public input, and encourage safe participation and vigilance by citizen monitors. Unfortunately, this is not often the case. During work on NEUP, the Tennessee Gas Pipeline Company hired private security to deter and harass trained pipeline watch volunteers. Such practices should be forbidden.



*DRN staff monitoring a construction crossing of Big Flat Brook, a trout stream, in High Point State Park, New Jersey, F. Zerbe*

#### *Alternative construction methods are needed*

Agencies should encourage collaboration among contractors, community organizations and non-profits to creatively tackle the need to cushion heavy vehicles, to reduce soil compaction, to remove vegetation, and to restore ROW vegetation. Wherever possible, trees should replace trees. Efforts should be made by the pipeline company to plant larger native tree species stock versus bare root seedlings. As much of Pennsylvania has large deer populations that browse on young shoots, deer exclosures and tree shelters should be installed. In rocky landscapes, excavated boulders and stone can be arrayed to protect new plantings. These measures will increase the rate of recovery.

#### *Current stabilization BMP's are inadequate and need to be expanded*

Instead of close cropped landscapes, we need restoration BMPs centered on diverse native species, native grasslands, wildflower meadows, young woodlands and shrublands designed to provide permanent sta-

bilization. In forested landscapes cut by pipelines, efforts should be made to require understory, ground-cover, midlayer and canopy layer native species to reflect the vertical diversity important in thriving forested areas and needed for forest interior birds.

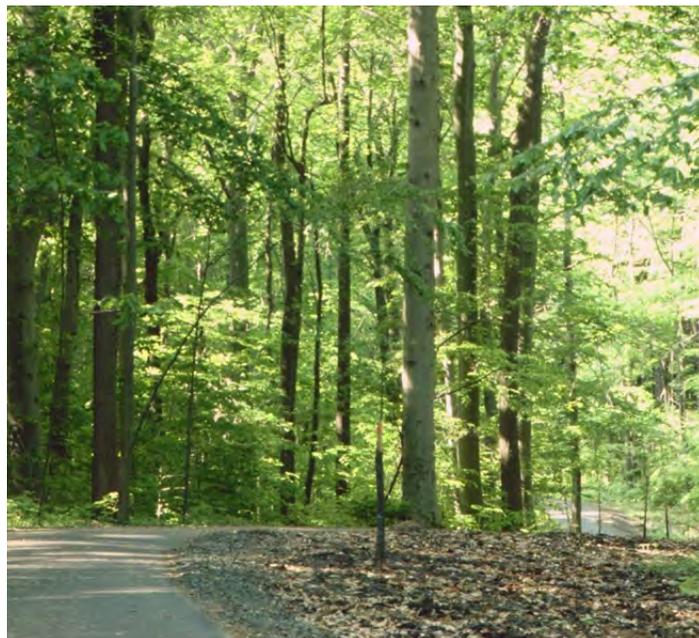


*Pipeline ROW fenced immediately after construction to protect newly replaced forest sods and to define long-term access routes, L. Sauer*

*Alternative management strategies need to be developed and implemented*

The dialogue on ROW management must include not only concerns for safety and terrorism but also ecological concerns. Current application of the US-DOT's Pipeline and Hazardous Safety Administration rules maximizes negative impacts to forests and watersheds. The 30 feet of a ROW over a pipeline is required to be tree-free; a 10 foot access way must be kept even more closely cropped, but close mowing creates shallow ineffective root systems, especially on steep slopes and poor soils.

One alternative is maintaining native grasslands and sedge meadows within the tree-free portion of a ROW. In an emergency, any vehicle needing the 30 feet will not be deterred by tall grasses. Beyond the 30



*An exemplary pipeline installation at Loantoka Park, Morris County, New Jersey, L. Sauer*

feet, successional woody forest vegetation could be re-established. Maintaining successional woodlands in part of the ROW could provide habitat for many declining species. Some closed-canopy options would help address the consequences of fragmentation.

FERC's wetland guidelines also call for re-establishing riparian vegetation for 25 feet into the ROW on either side of the stream.

*Compliance requires improved oversight*

The failure rate for compliance with even the current minimal standards illustrates a failure of oversight. In addition to regulatory compliance, we need to include in-the-field evaluation of actual performance of critical factors, in particular infiltration and recharge with independent, third-party verifications and input from the community and watchdog organizations. Additional bonding may be needed to improve compliance. New legislative efforts should not allow for circumventing important existing regulatory protections.



*Red spotted newt from wetland in the path of a pipeline ROW, F. Zerbe*



*Opposite page, clockwise from top: Looking east toward the Kittatinny Ridge from Ridge Road in High Point State Park, New Jersey, J. Zenes; DRN staff person documents construction of a pipeline ROW where pipes have been bent to go under Sawmill Road in High Point State Park, J. Zenes; A stream in the upper Delaware River watershed, F. Zerbe; Protest displaying wood from mature trees cut for a pipeline ROW, F. Zerbe; Sediment overwhelms erosion controls, J. Zenes*



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