Why Watersheds?

An Organizing Unit

Using watersheds as an organizing and planning unit for natural resource management allows:

- ✓ Clear physical definition of an entire natural system that includes critical ecosystems across varying jurisdictions
- ✓Developing a whole system context for individual decisions and actions, and for measuring outcomes
- ✓Collection and analysis of varying data to describe an entire system and relate interactions and interdependencies among its parts
- ✓Demonstrates connections between communities at multiple scales and the natural resource systems that sustain them

Basic Dynamic Elements

Each must be considered in context with the others

Economics

- *Markets*
- *Incentives*
- *Intrinsic values*
- *Commerce*
- *Agricultural production*

Ecological

- *Terrestrial habitats*
- *Aquatic habitats*
- *Biodiversity*
- *Successional systems*

Physical

- *Hydrology*
- *Geology*
- *Chemistry*

Social

- *Culture*
- *Regulation*
- *History*
- *Arts*

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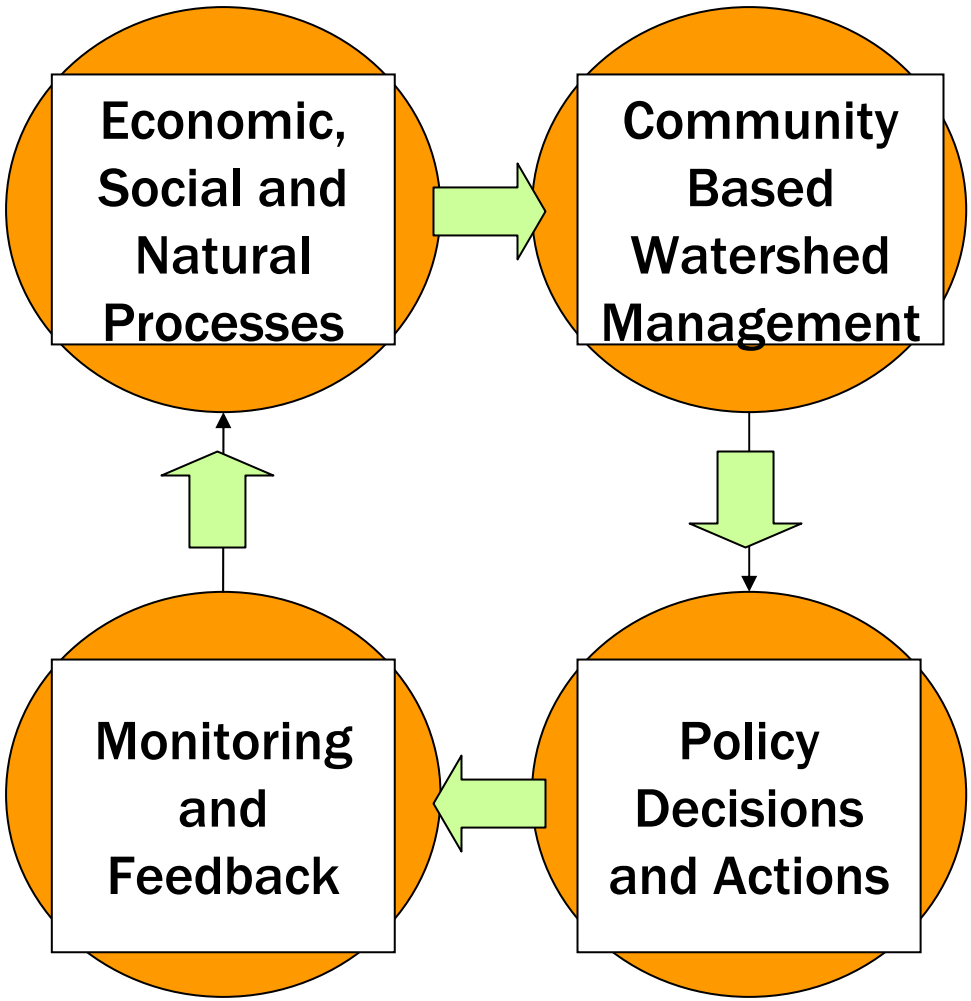
The “Watershed Approach”

- A geographic description:
  - the work or focus area redefined by watershed boundaries
  - work is carried out as before, but in a different boundary
- A program in itself
  - separate programs or divisions are established
- A systems context
  - The reference context for information gathering, decision analysis, actions and performance measurement

Learning Based Adaptive Management

Performance-based decision making



Watershed Conditions

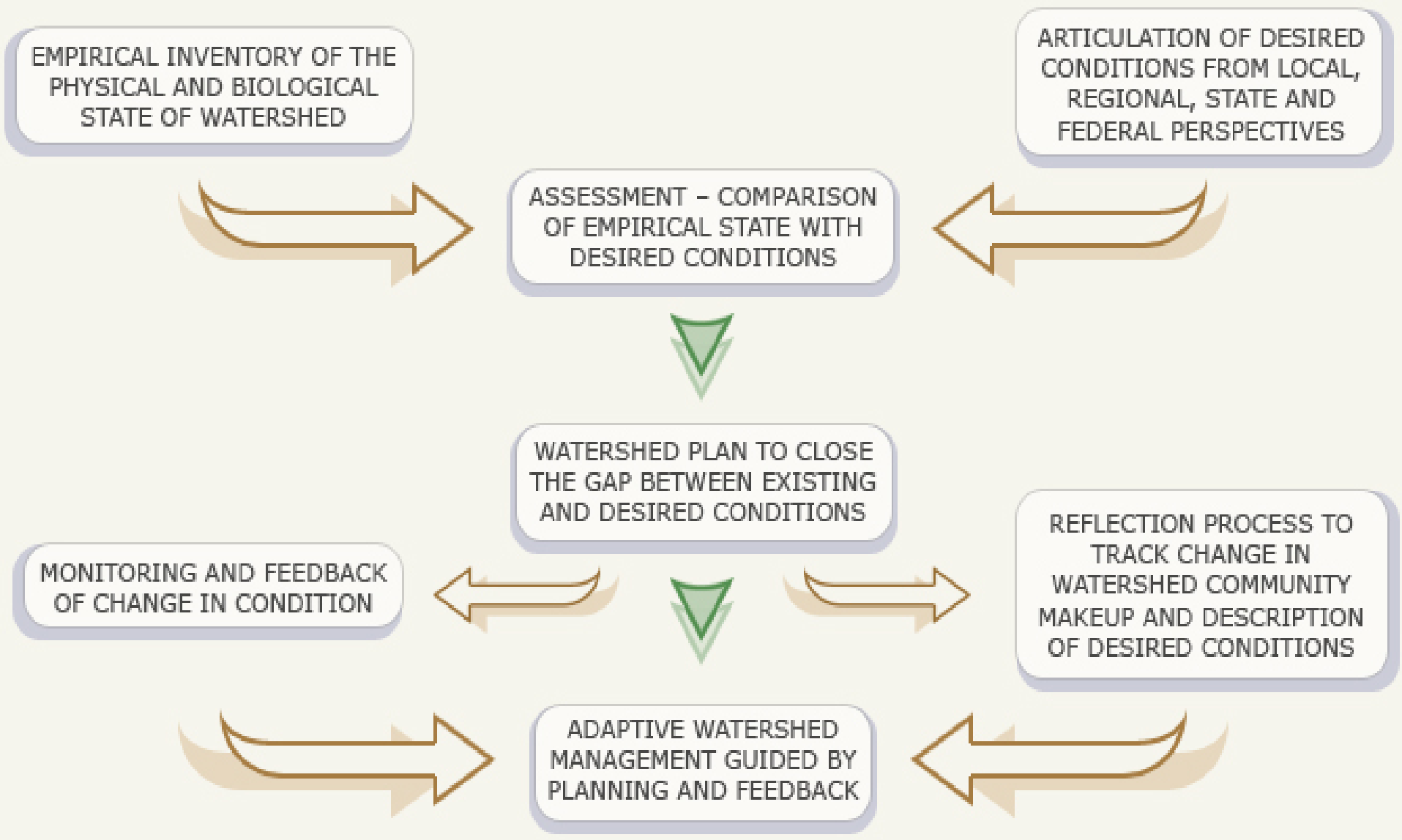
A watershed has no intrinsically good or bad condition. It simply reacts to change according to the laws of physics. It is in “good” or “bad” condition only in relation to human values. Humans value certain species, and we therefore work hard to protect salmon and bald eagles. Mosquitoes and termites threaten humans, however, so we work equally as diligently to eliminate those life forms from our midst.

We cannot, then, discuss watersheds without discussing ourselves.

The emphasis is on managing *our* activities and tracking their impact on the physical and biological world on which we depend.

River channel form, function and ecologic attributes are a product of the sediment, carbon, nutrients and water discharge supplied by the watershed.

Human actions and habits greatly affect the amount, timing and delivery of those elements.



Typical Management Process

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Changing Conditions

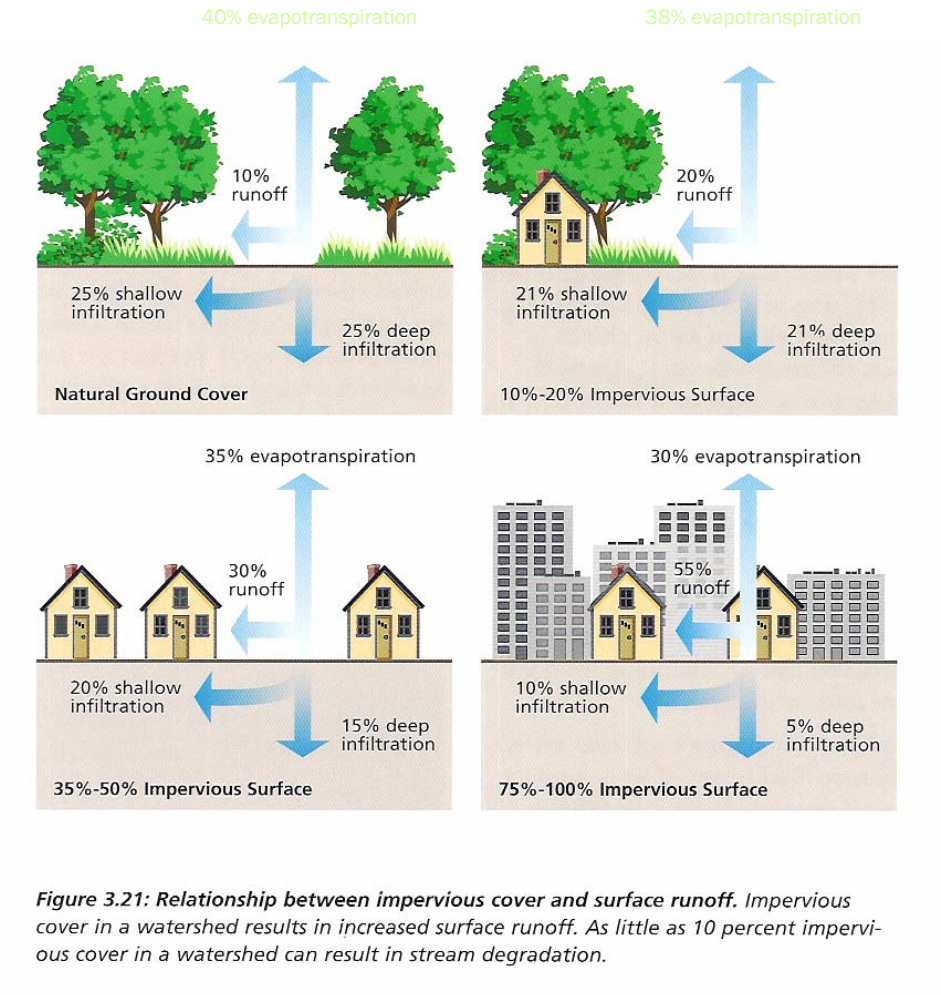

Figure 3.21: Relationship between impervious cover and surface runoff. *Impervious cover in a watershed results in increased surface runoff. As little as 10 percent impervious cover in a watershed can result in stream degradation.*

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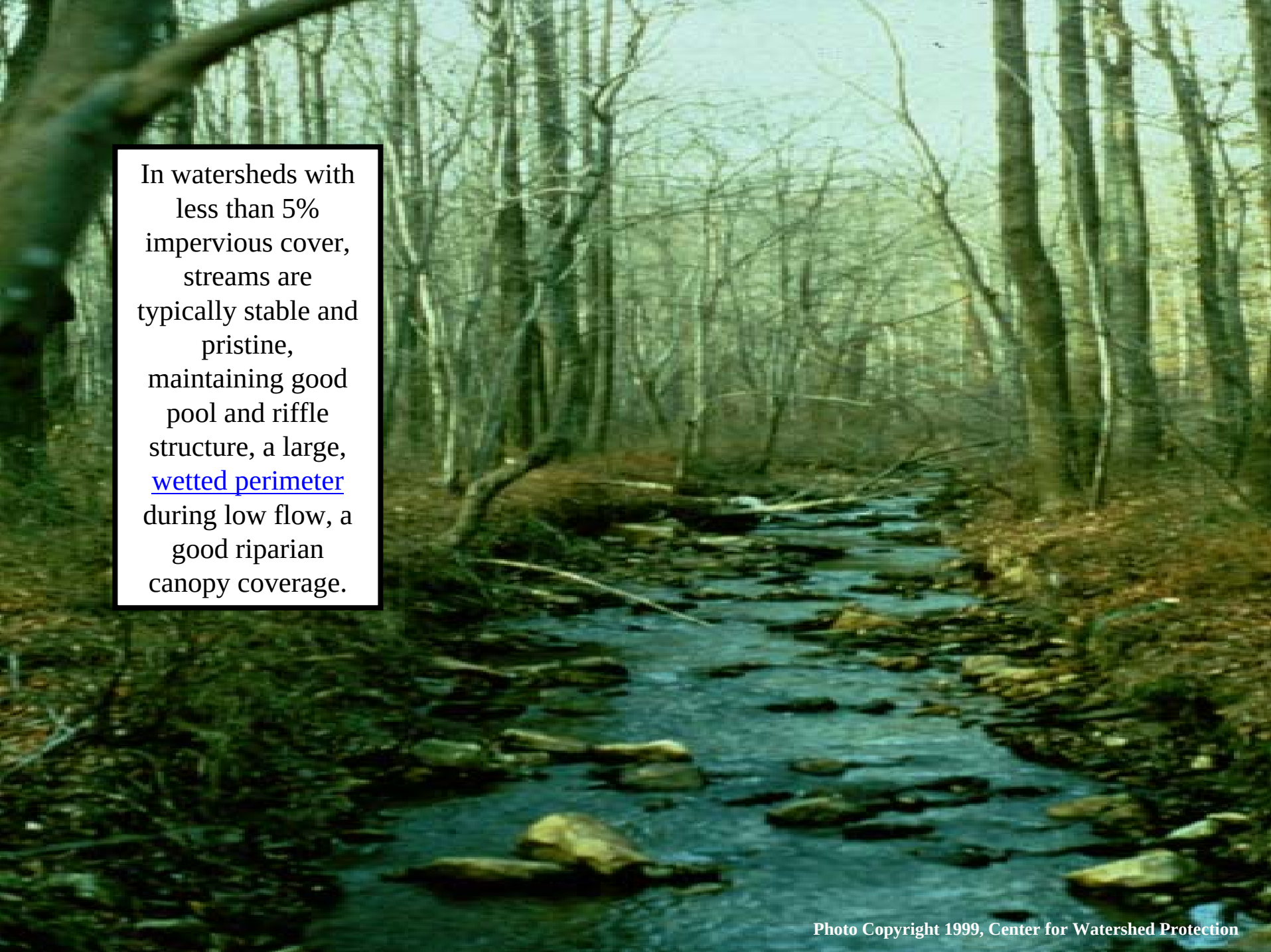
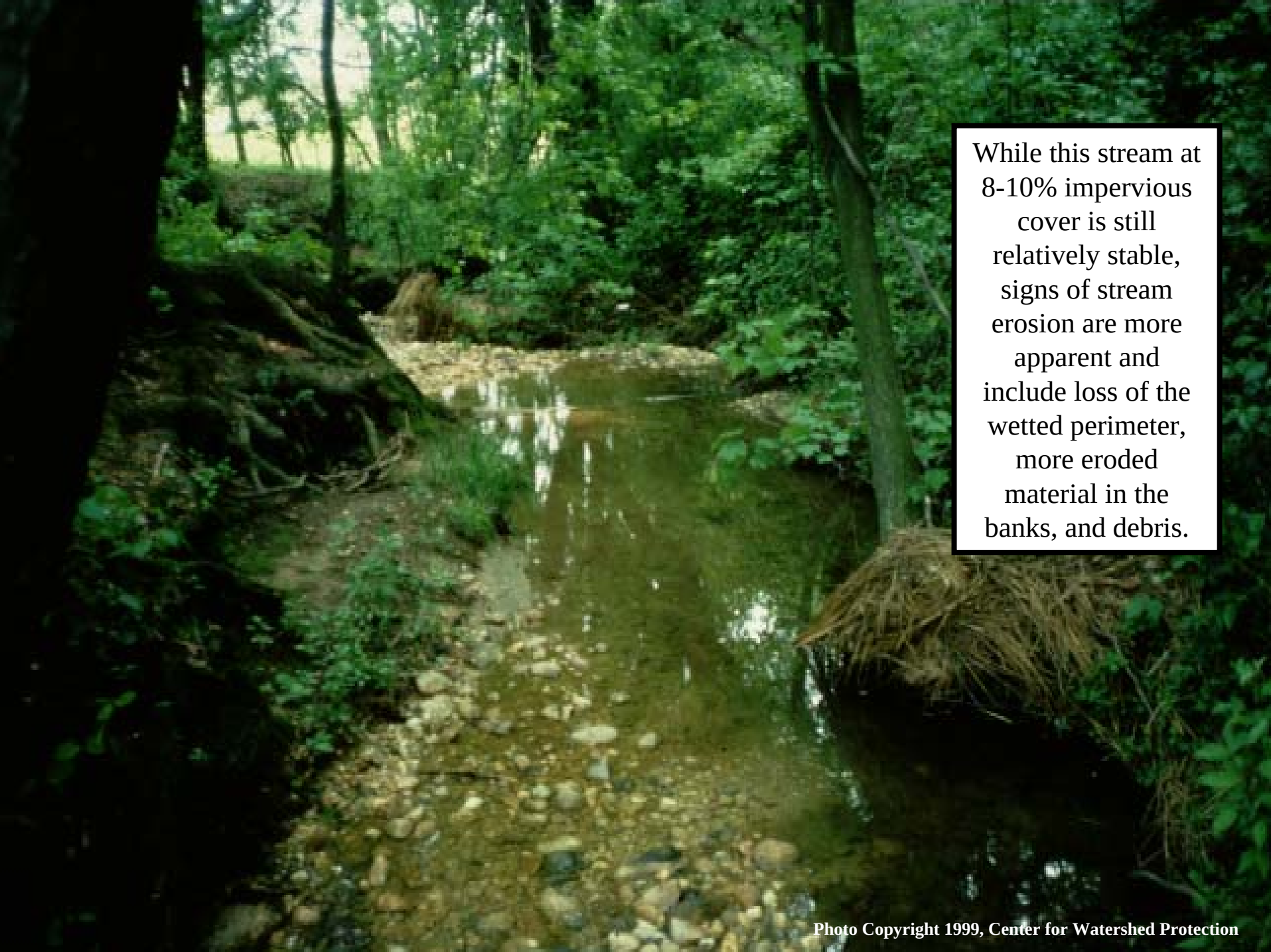
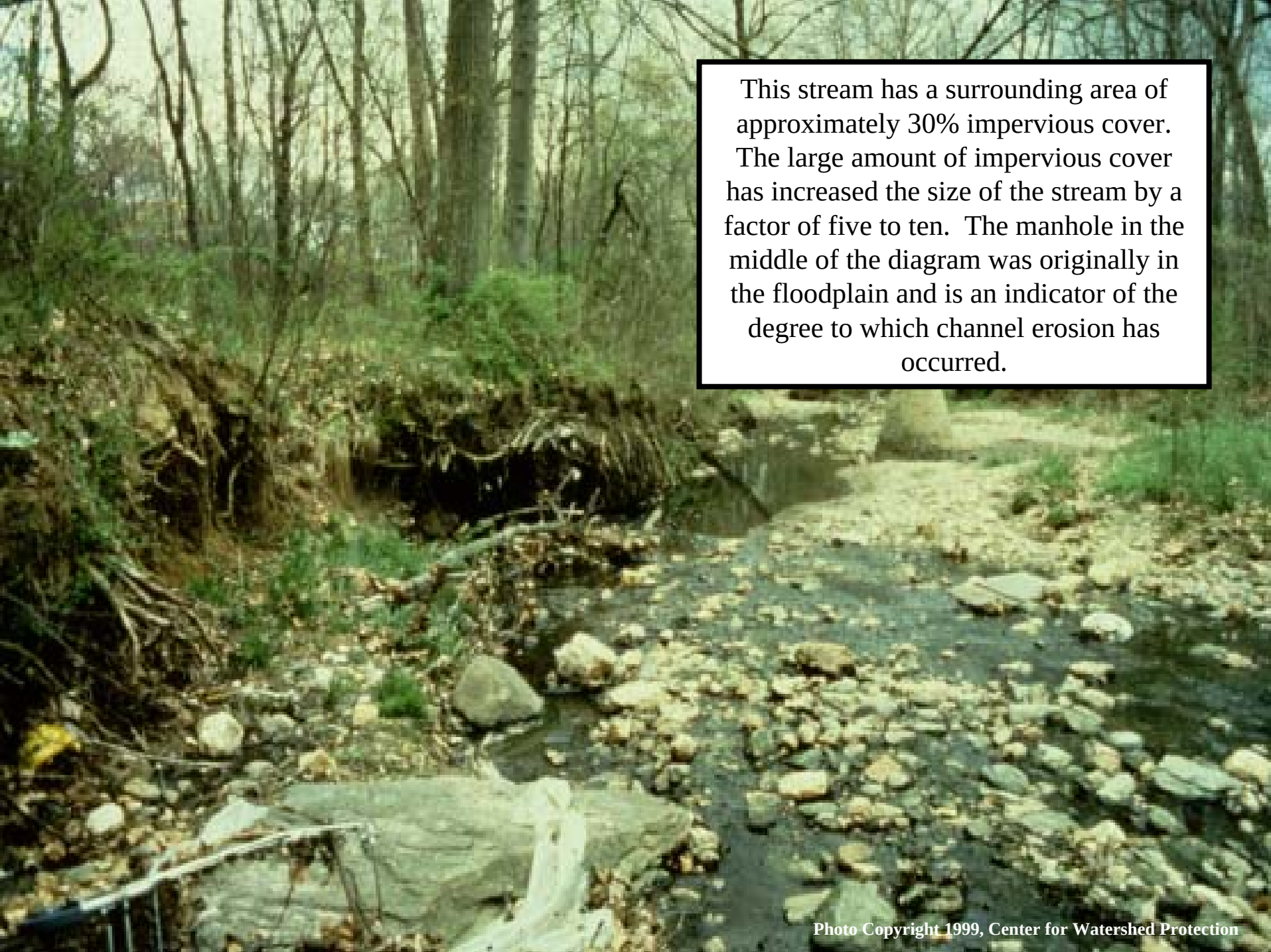


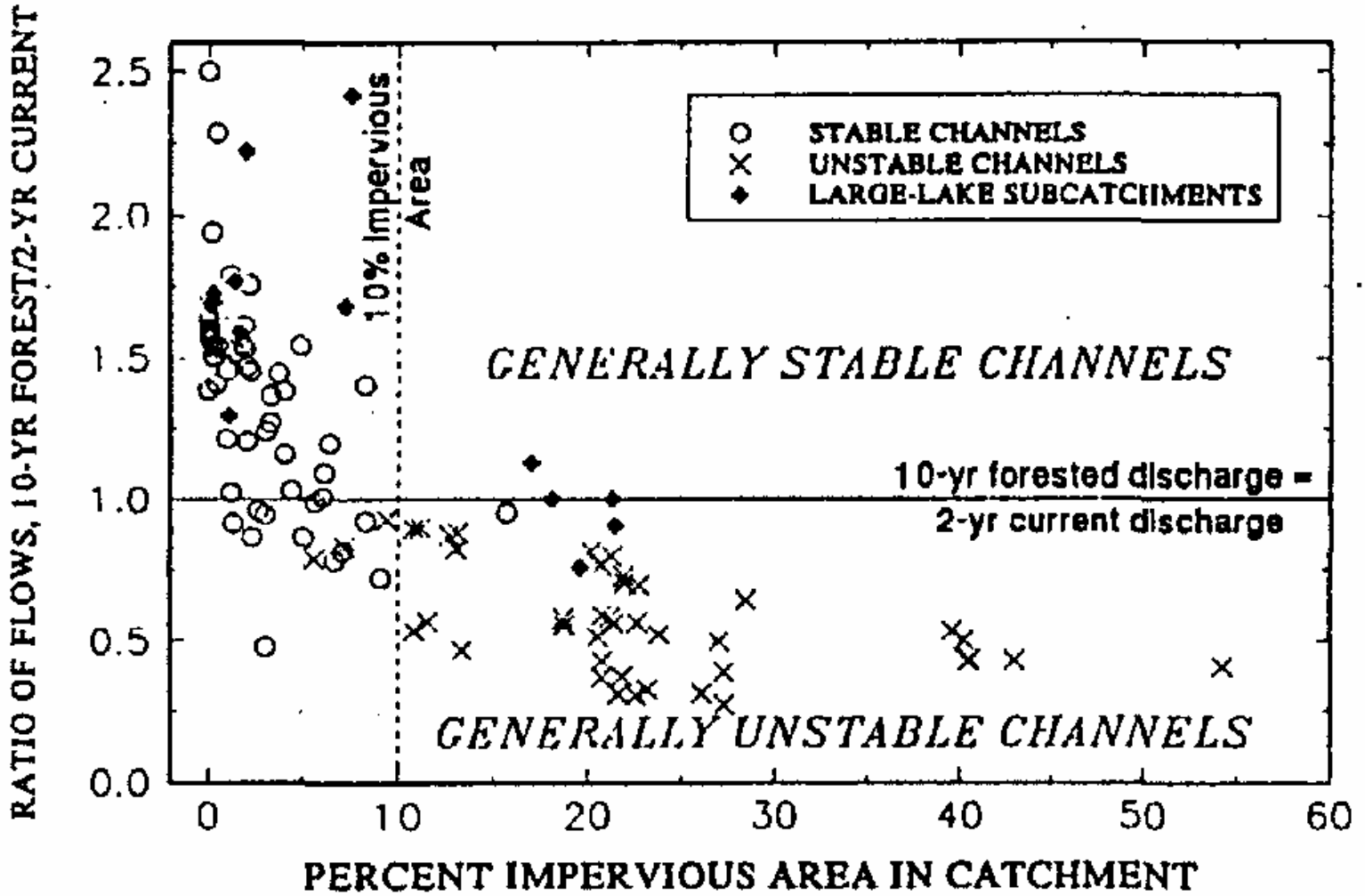


The surrounding area of this stream is also approximately 20% impervious cover and shows stream erosion that is much worse than in the previous slide due to an absence of vegetation to hold together bank structure.

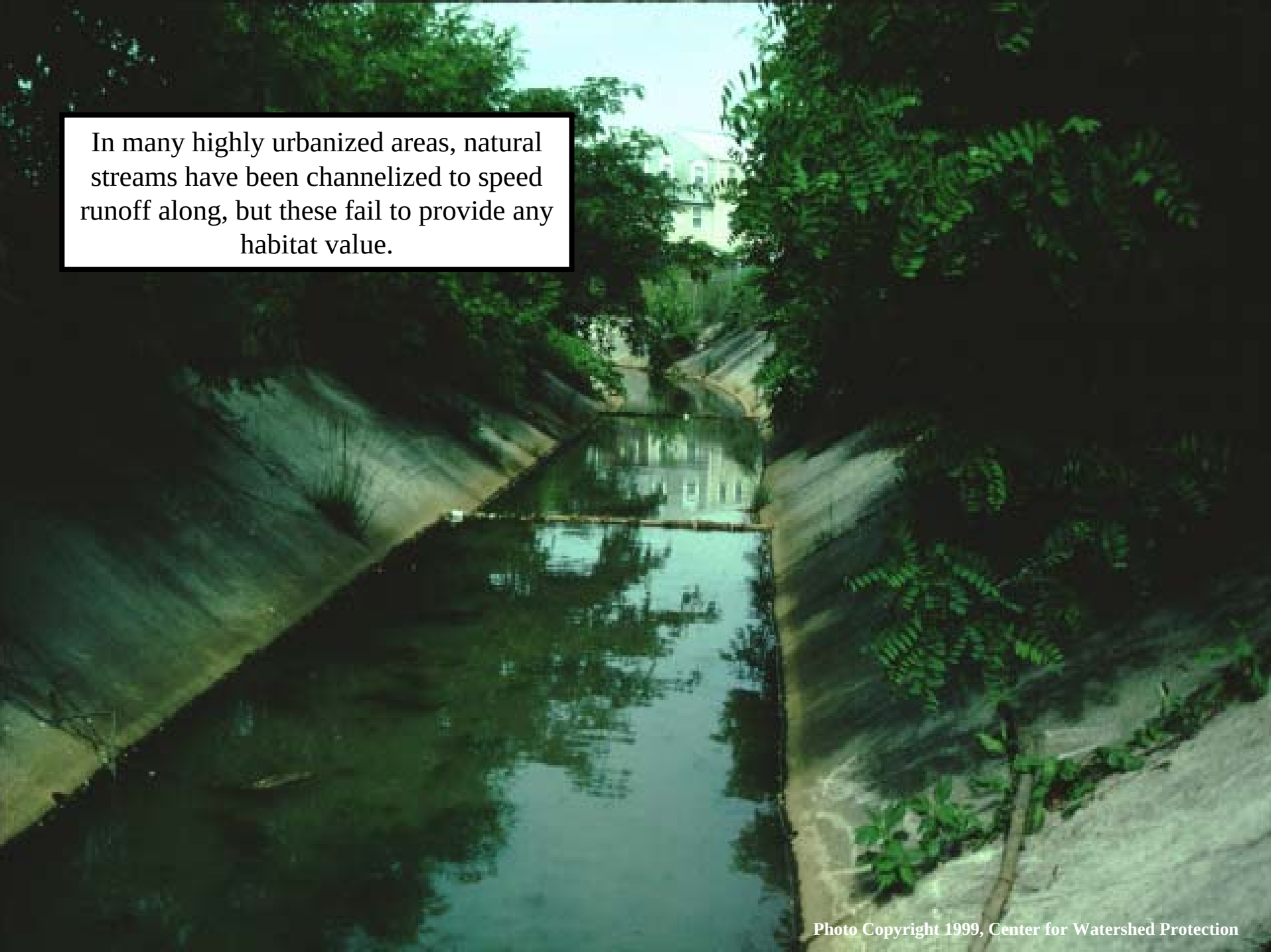


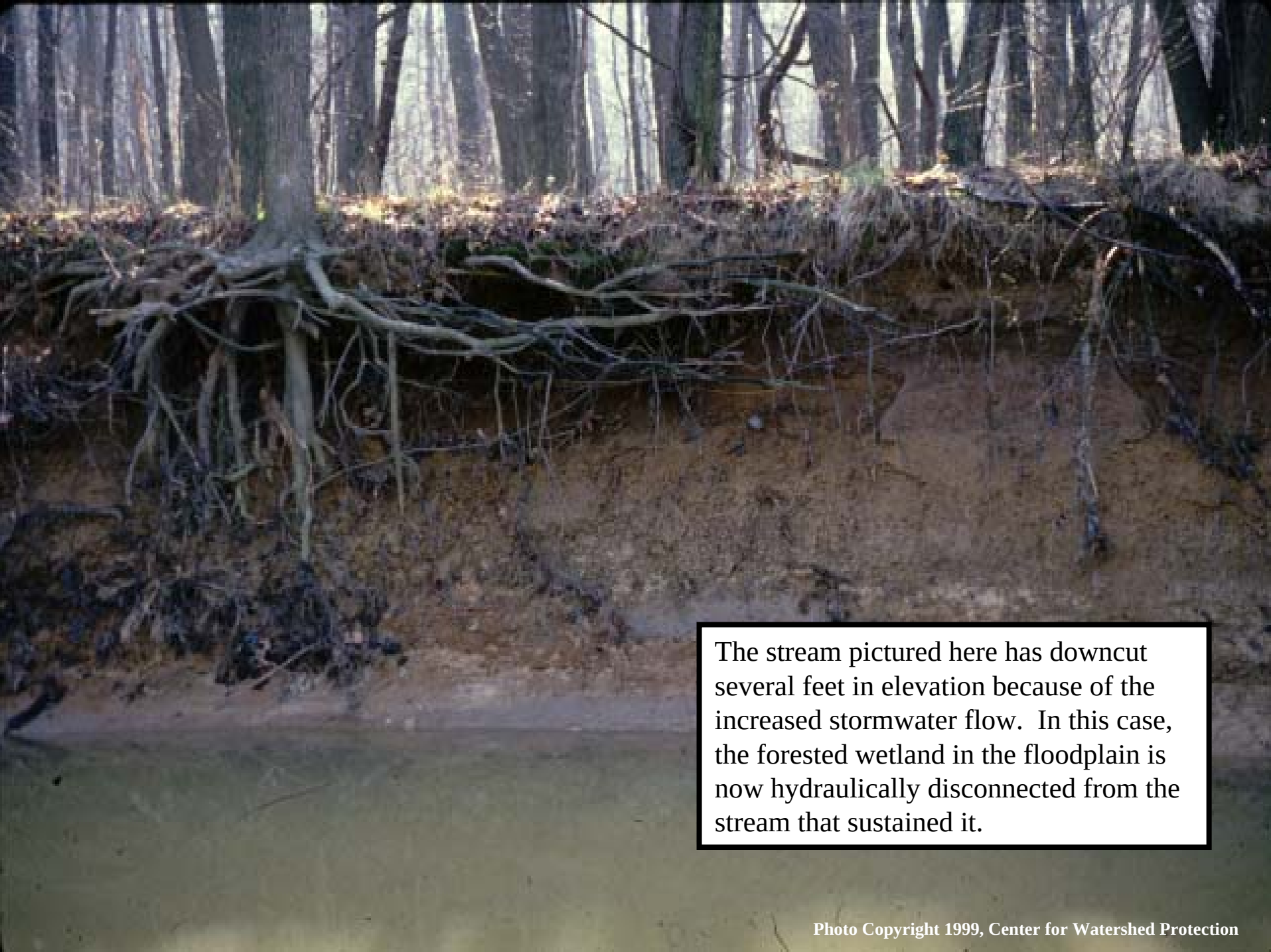
This stream has a surrounding area of approximately 30% impervious cover. The large amount of impervious cover has increased the size of the stream by a factor of five to ten. The manhole in the middle of the diagram was originally in the floodplain and is an indicator of the degree to which channel erosion has occurred.

Channel stability as a function of imperviousness
(Booth and Reinelt, 1993)

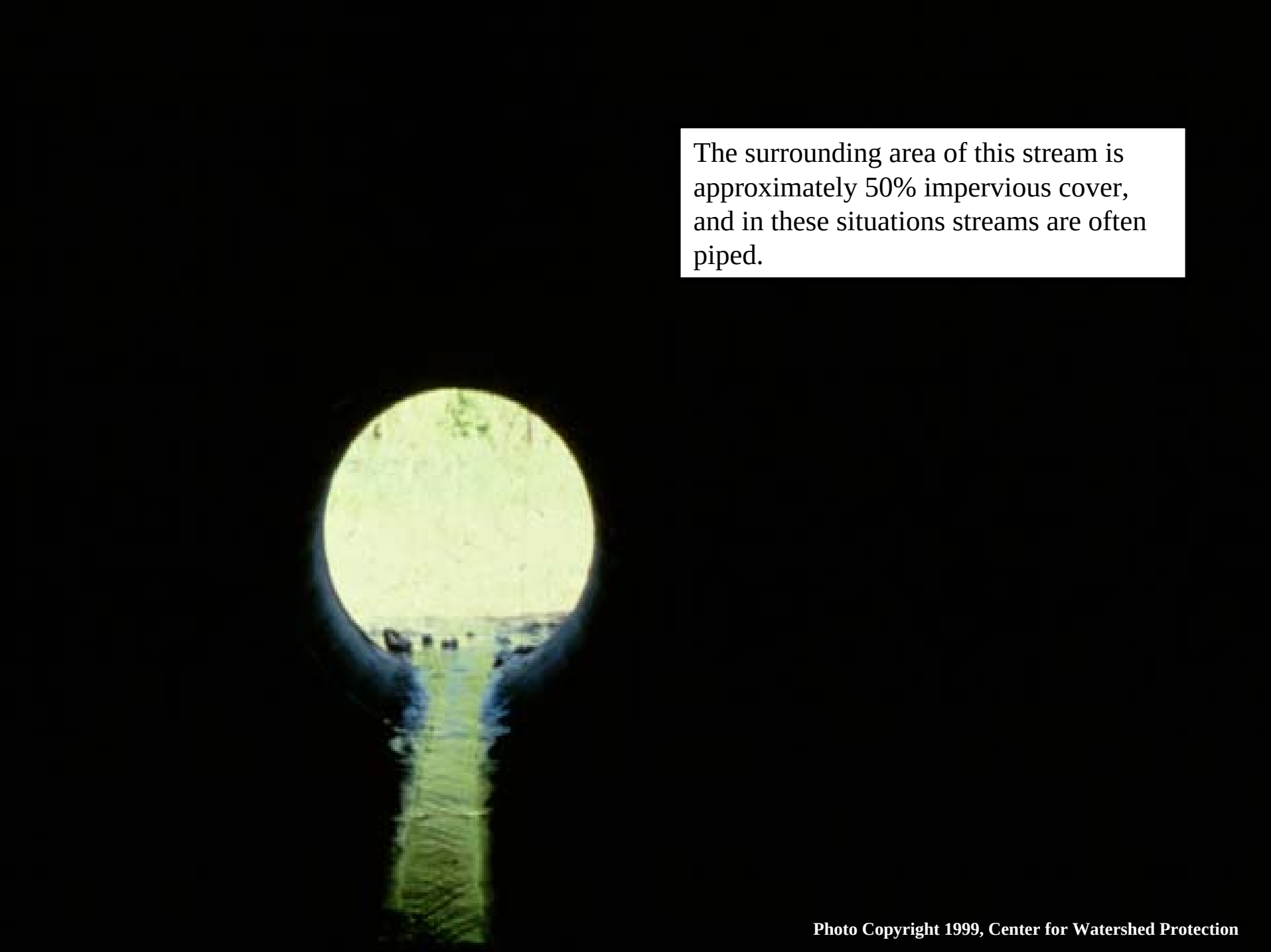


In a study conducted by Booth and Reinholt (1993), documented changes in channel stability occurred as impervious cover passed the 10% threshold.





The stream pictured here has downcut several feet in elevation because of the increased stormwater flow. In this case, the forested wetland in the floodplain is now hydraulically disconnected from the stream that sustained it.



The surrounding area of this stream is approximately 50% impervious cover, and in these situations streams are often piped.

Challenges

- Management decisions made in the context of political boundaries. Jurisdictional and property lines are frequently along the bottom of waterways, not the ridges
- Available information is not readily related to watershed boundaries
- Individual programs and mandates usually are focused on single issues

Stimulus for Change

- Statewide pressure on water supplies
- Water quality concerns
- Population growth and development
- Changing climate
- Integrating priorities at multiple scales
- Open space, housing, recreation needs
- Increased demands for goods and services from the environment

Watershed System Products, Goods & Services

- **Water Supplies – reliable quantity, quality, and distribution through time**
  - water purification, waste treatment
  - aquifer protection and groundwater recharge
  - appropriate flows for ecological life cycles

- **Food, Fiber and Fuel**
  - primary soil production
  - agricultural production
  - timber harvest
  - energy production – hydrologic, bio-fuel, wind

Watershed System Products, Goods & Services

- **Climate and Weather Attenuation**
  - **storm effects attenuation and buffering**
  - **water cycling and local cooling through evapo-transpiration**
  - **micro-climate generation from vegetation structure and distribution**
  - **drought attenuation and mitigation**
  - **carbon sequestration**

Watershed System Products, Goods & Services

- **Biodiversity Maintenance**
  - diverse assemblages of species
  - provision of aquatic and terrestrial habitats
  - nutrient and mineral cycling
- **Public Health & Safety**
  - flood and flow attenuation
  - fire ecology
  - disease suppression
  - recreation and open space
  - air filtration

Major Issues in Watershed Management

- **Land use effects on:**
  - runoff characteristics
  - infiltration rates to groundwater
  - flow hydrograph
  - soil erosion and sediment balance
  - biological diversity
  - channel and hillslope stability

Major Issues in Watershed Management

- Water, Nutrient and Mineral Cycling
  - change in rates, timing and distribution of nutrients, minerals, and carbon
  - change in residence time of water
  - changes in pollutant loads
  - redistribution and simplification of biological diversity

Major Issues in Watershed Management

- Public Health and Safety
  - Developing flood and fire ecological processes that provide environmental benefits, and that also provide:
    - flood damage reduction
    - fire loss reduction
  - Maintaining sufficient biological diversity to:
    - Attenuate disease
    - Provide pollination services
    - Maintain system resiliency

Adaptive Management

- **Experimentalism (Aldo Leopold):**
  - Managers respond to uncertainty by undertaking reversible actions and studying outcomes to reduce uncertainty at the next decision point
- **Multi-Scalar Modeling:**
  - Managers model environmental problems within multi-scaled (“hierarchical”) space-time systems
- **Place-Orientation:**
  - Managers address environmental problems from a “place” embedded in local natural and political contexts

Policy Recommendations

- Establish performance based, adaptive management
- Clearly define the products, goods, services and values important to the State
- Establish scientifically valid means for tracking change over time, by watershed
- Coordinate funding and other support by watershed
- Provide a means to obtain access to useful information from multiple sources that will enhance and better inform resource management decisions
- Conduct present business and agency activities with reference to watershed dynamics and responses

Strategic Practices

- Promote and support integration among Forest Management, Ecosystem Restoration, Agricultural Stewardship, and Urban Stormwater strategies on a watershed basis
- Promote and support installation of best management practices to reduce water use and demand, and to increase stormwater infiltration
- Restore wetlands within watersheds to increase habitat, increase residence time of water within the watersheds, attenuate flood flows, and increase abvailability of water
- Increase permeability within watersheds through Low Impact Development (LID), retrofitting impervious surfaces, and expanding dendritic drainage patterns
- Increase the number of stream gauges by watershed to obtain more complete records as the climate changes
- Promote vegetation management and forest practices that slow the loss pf winter snowpack
- Increase the use of watersheds as a reference for land use planning