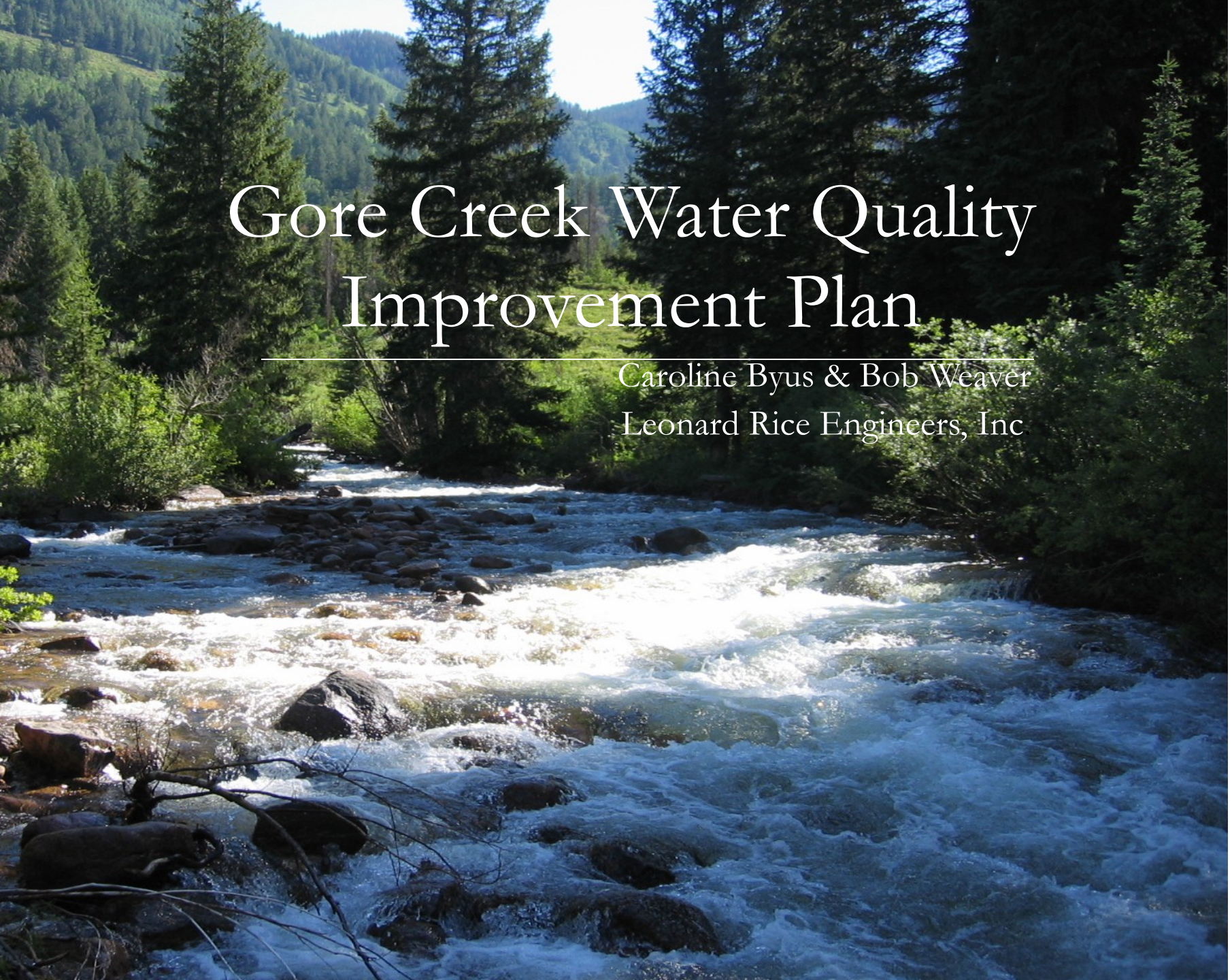
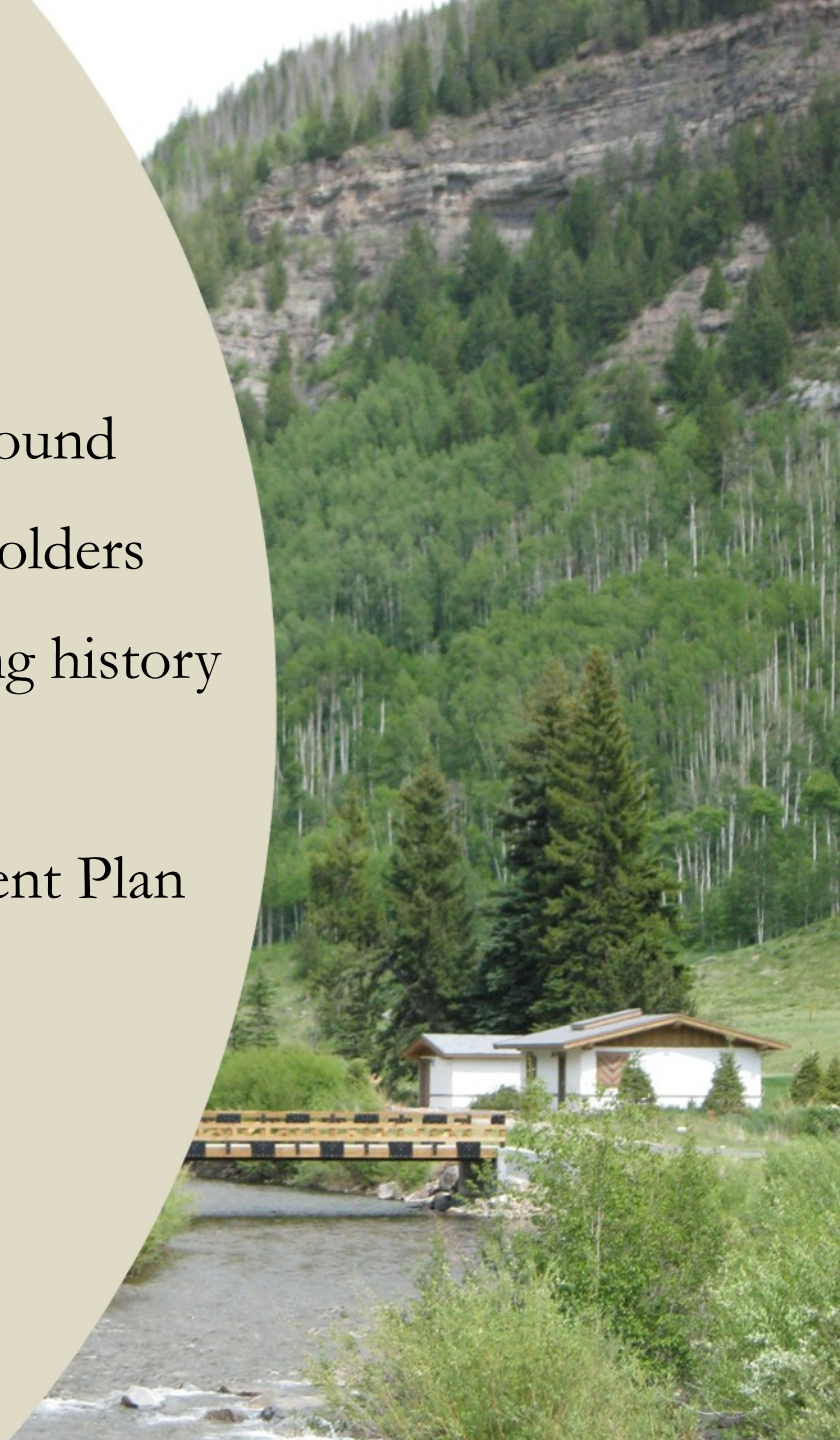


Gore Creek Water Quality Improvement Plan

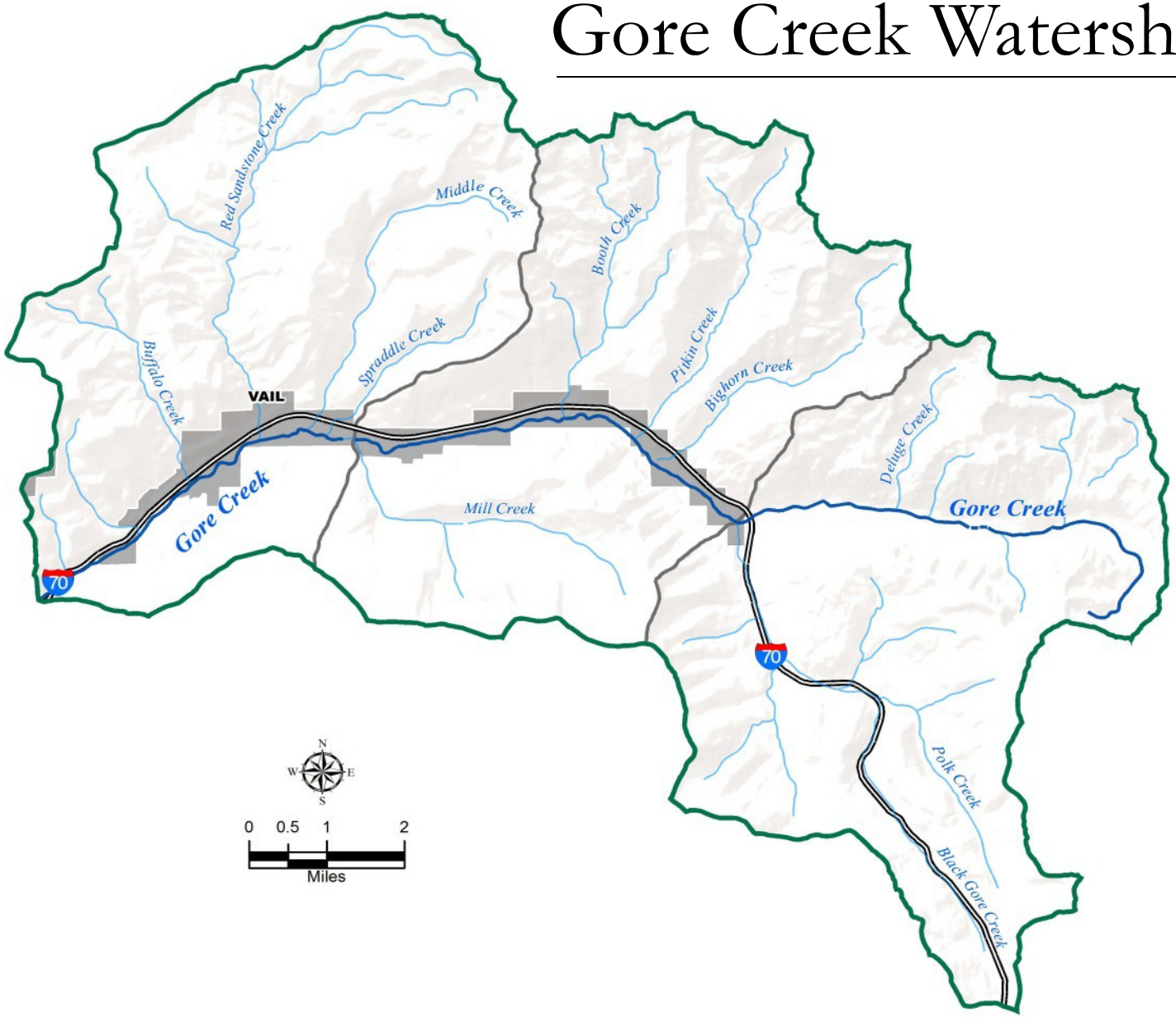
Caroline Byus & Bob Weaver
Leonard Rice Engineers, Inc

Presentation Summary

- Geographical Orientation and Background
- Gore Creek/Eagle River Basin Stakeholders
- Water quality and biological monitoring history
- Regulatory Context
- Gore Creek Water Quality Improvement Plan (WQIP) Development Process
- Next Steps

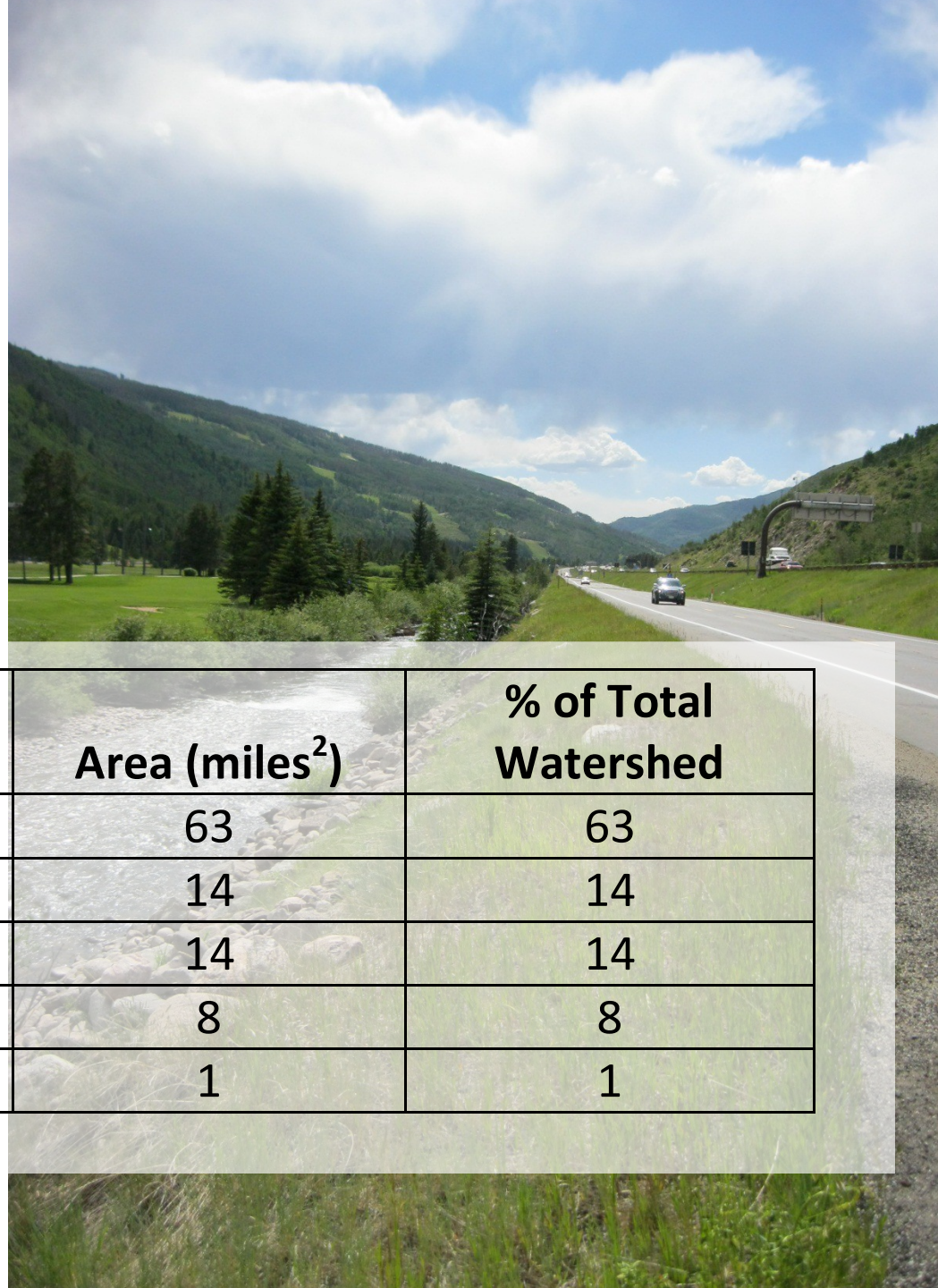


Gore Creek Watershed



Land Use

Gore Creek Watershed Land Use/Land Cover



Land use/cover	Area (miles^2)	% of Total Watershed
Forested land	63	63
Shrub-brushland	14	14
Tundra and exposed rock	14	14
Urban	8	8
Other	1	1

- Click to edit Master text styles
  - Second level
    - Third level
      - Fourth level
        - Fifth level

Photo Source: History of Vail Video Series (1962-1973) http://www.vail.com/lodging-and-dining/explore-town/history.aspx?page=viewall

Photograph courtesy of Ken Neubecker

Watershed Urbanization

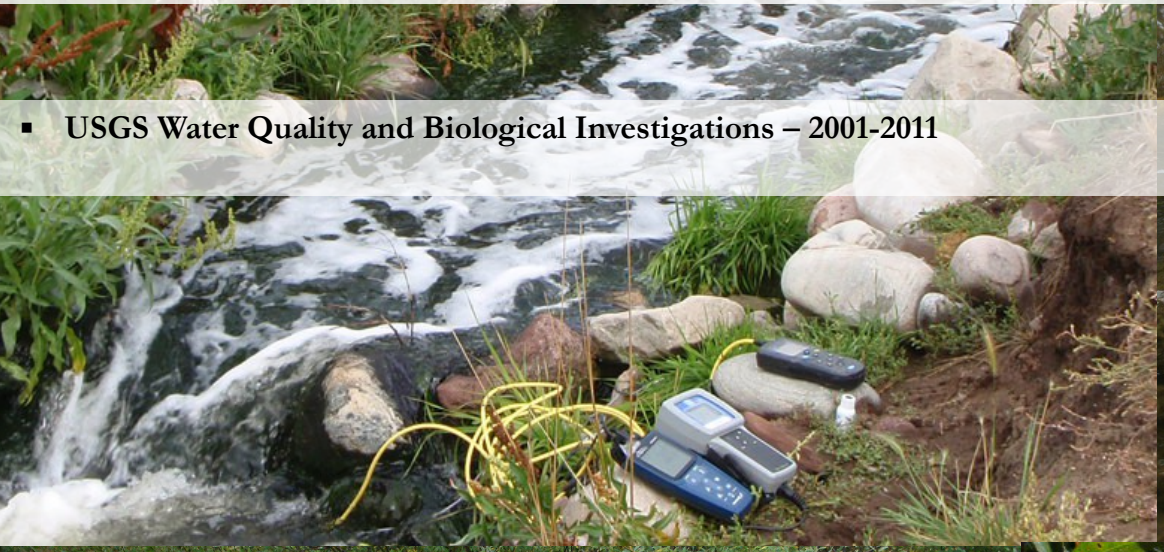
"the transformation of land from rural land uses, such as agriculture to urban land uses, such as housing"

Gore Creek/Eagle River Stakeholders

- Water Quality Monitoring Partnership – formed in 1995
  - Original focus – Development of a Gore Creek Watershed Management Program/Eagle Mine Superfund Site
  - Expanded focus – Eagle River Basin
  - Participants
  - Local Agencies – Eagle County, Town of Vail, Town of Avon,
  - State Agencies – CDOT, CPW, CDPHE
  - Federal Agencies – US Forest Service, USGS
  - Utilities – Eagle River Water & Sanitation District, Upper Eagle Regional Water Authority, Aurora Water, Colorado Springs Utilities
  - Business – Vail Resorts, Eagle Park Reservoir Company
  - NGOs – Eagle River Watershed Council

Water quality and biological monitoring history

- USGS Water Quality and Biological Investigations – 2001-2011



- ERWSD – Water Quality and Macroinvertebrate Studies
- Town of Vail – Stormwater and Wetlands studies

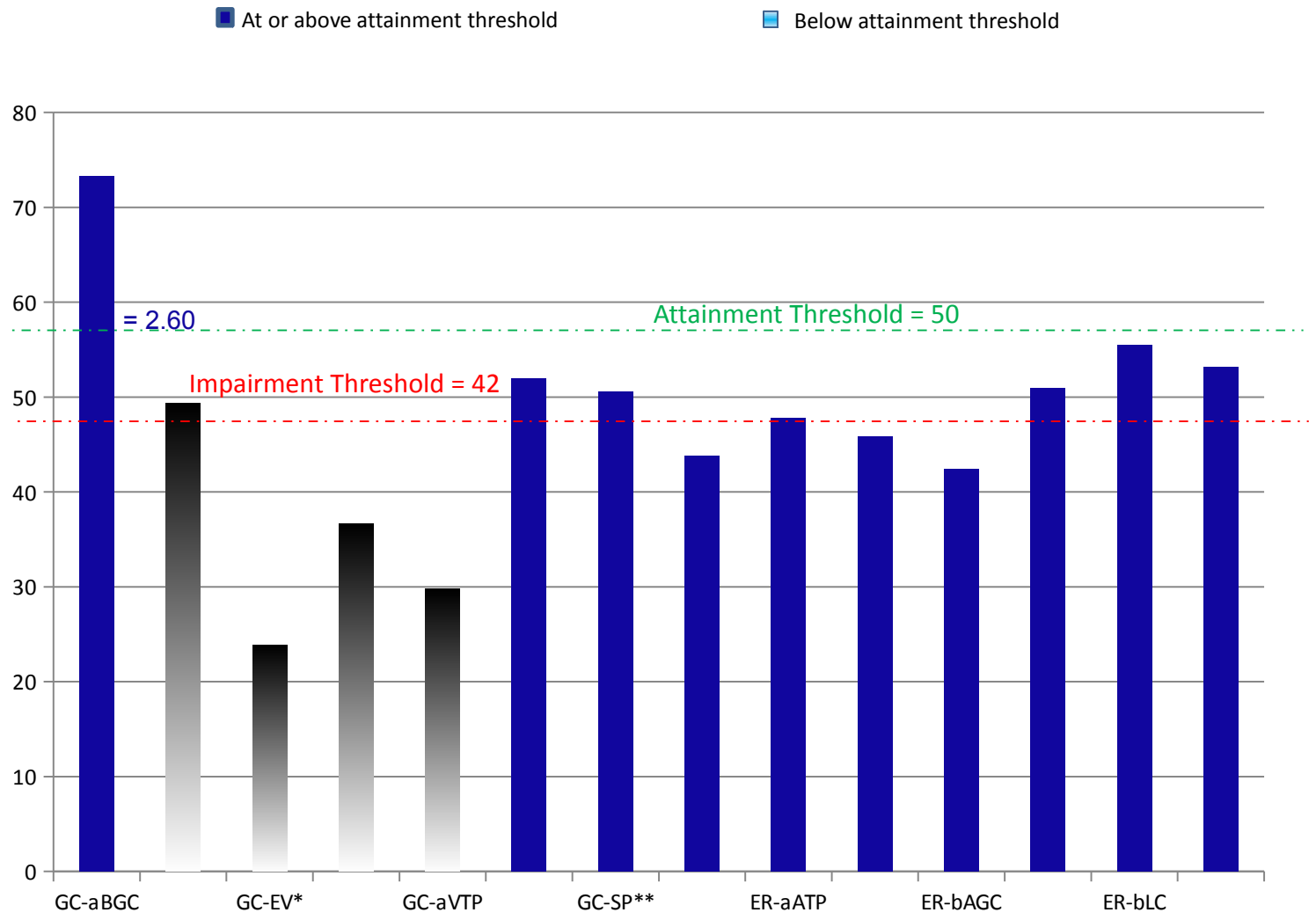
- US Forest Service – Macroinvertebrate studies
- CPW fish surveys

Regulatory Context

- Water quality and biological benchmarks
  - Water Quality Standards
  - WQCC Policy 2010-1 – Aquatic Life Use Attainment
  - Multimetric Index (MMI) thresholds defined for determining attainment/impairment

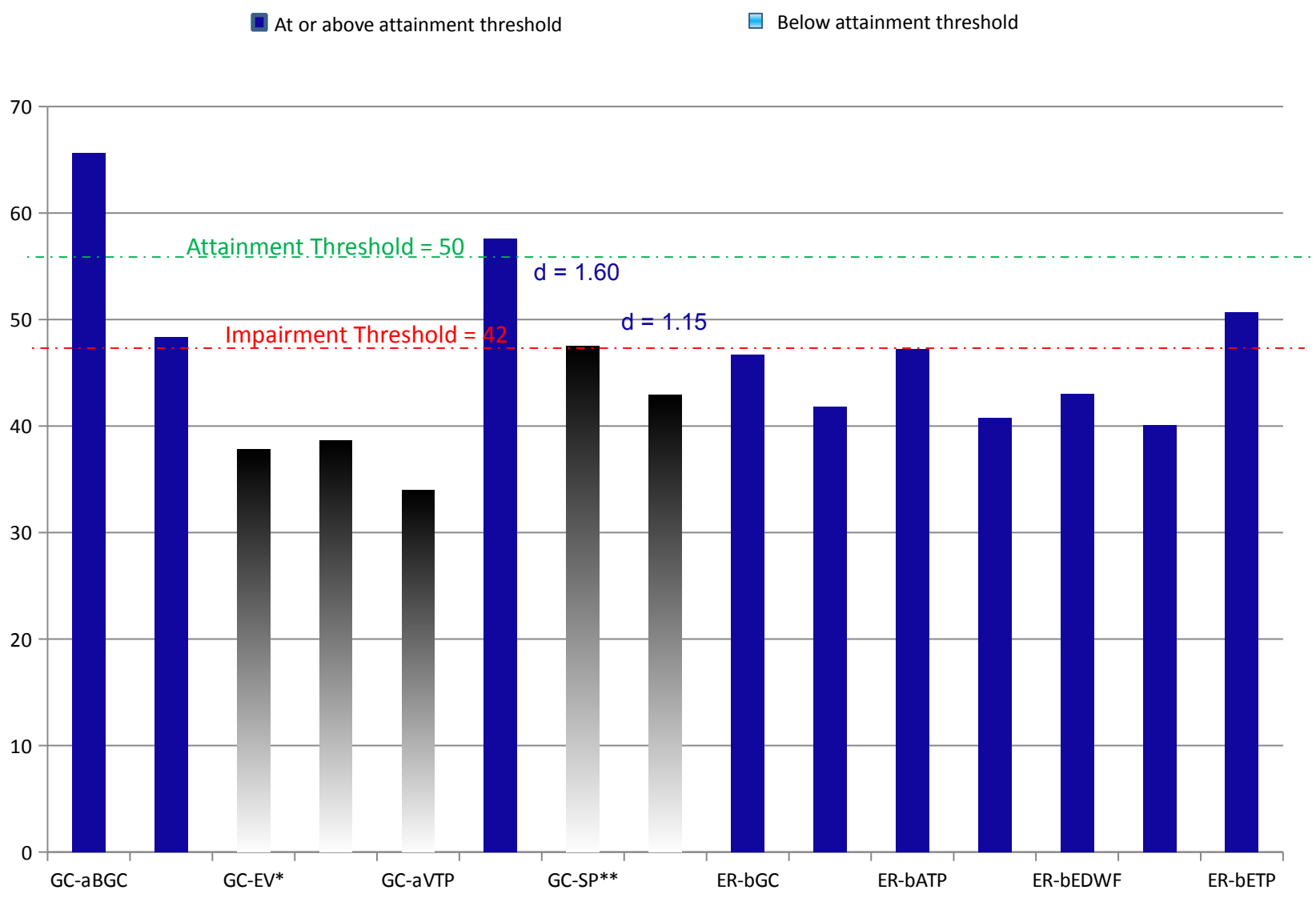
MMI Scores Gore Creek & Eagle River (Fall 2009)

Biotype 2: Mountains



Source: Information provided by David E. Rees, Timberline Aquatics, Inc.

MMI Scores Gore Creek & Eagle River(Fall 2010)



Source: Information provided by David E. Rees, Timberline Aquatics, Inc.

Regulation 93 – 2012
303(d) List of Impaired Waters Requiring TMDLs

- Gore Creek –Listed for Aquatic Life Use Impairment

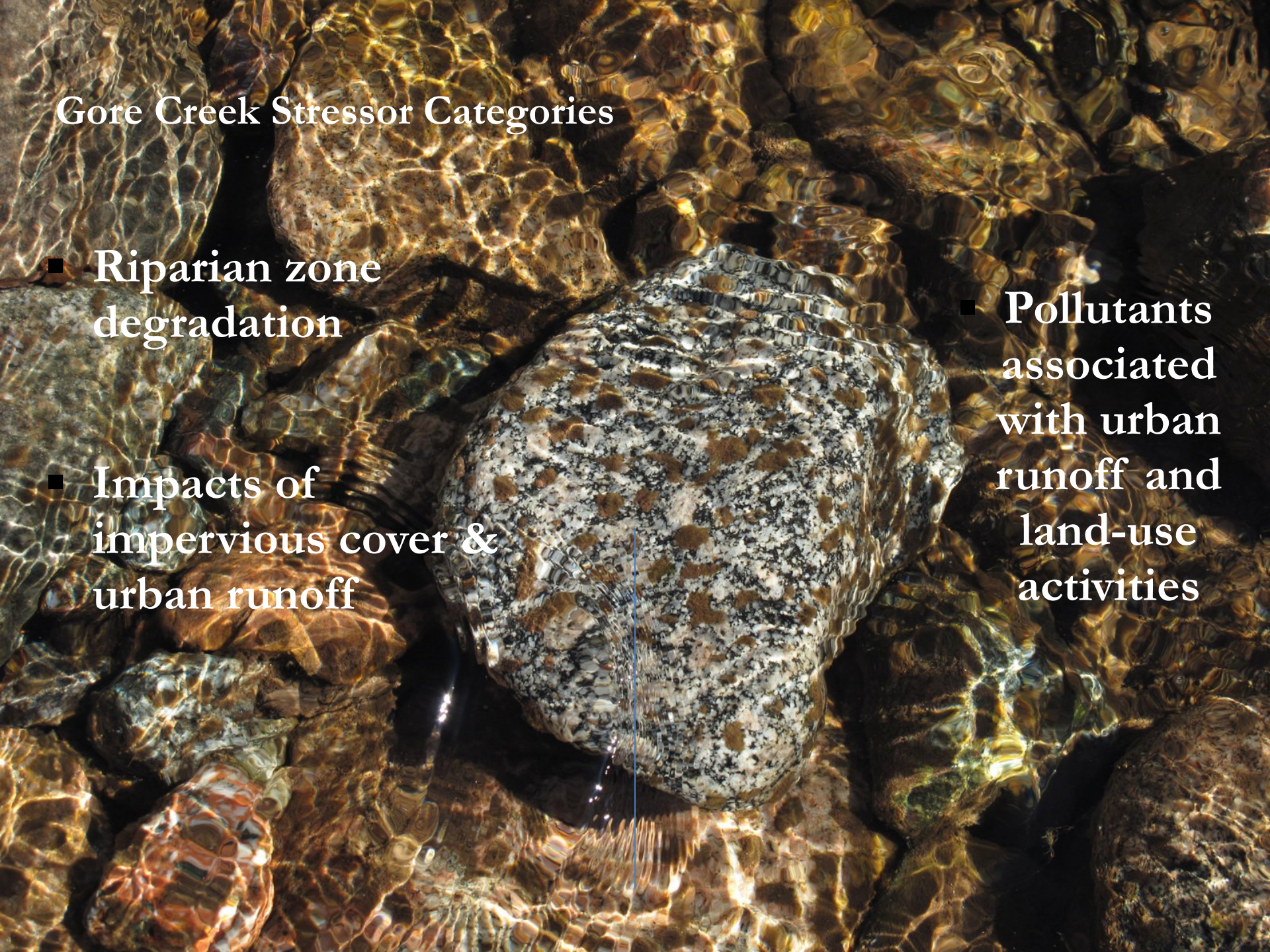
- "Provisional" status – cause of impairment unknown

Photo courtesy of Timberline Aquatics, Inc.

Gore Creek Water Quality Improvement Plan

Study Design/Plan Development Process

- Compilation and analysis of current available water chemistry and biological data
- Review of scientific literature/studies;
- Reach characterization –habitat assessment;
- Identification of stressors;
- Identification of appropriate corrective actions; and,
- Development of an implementation plan

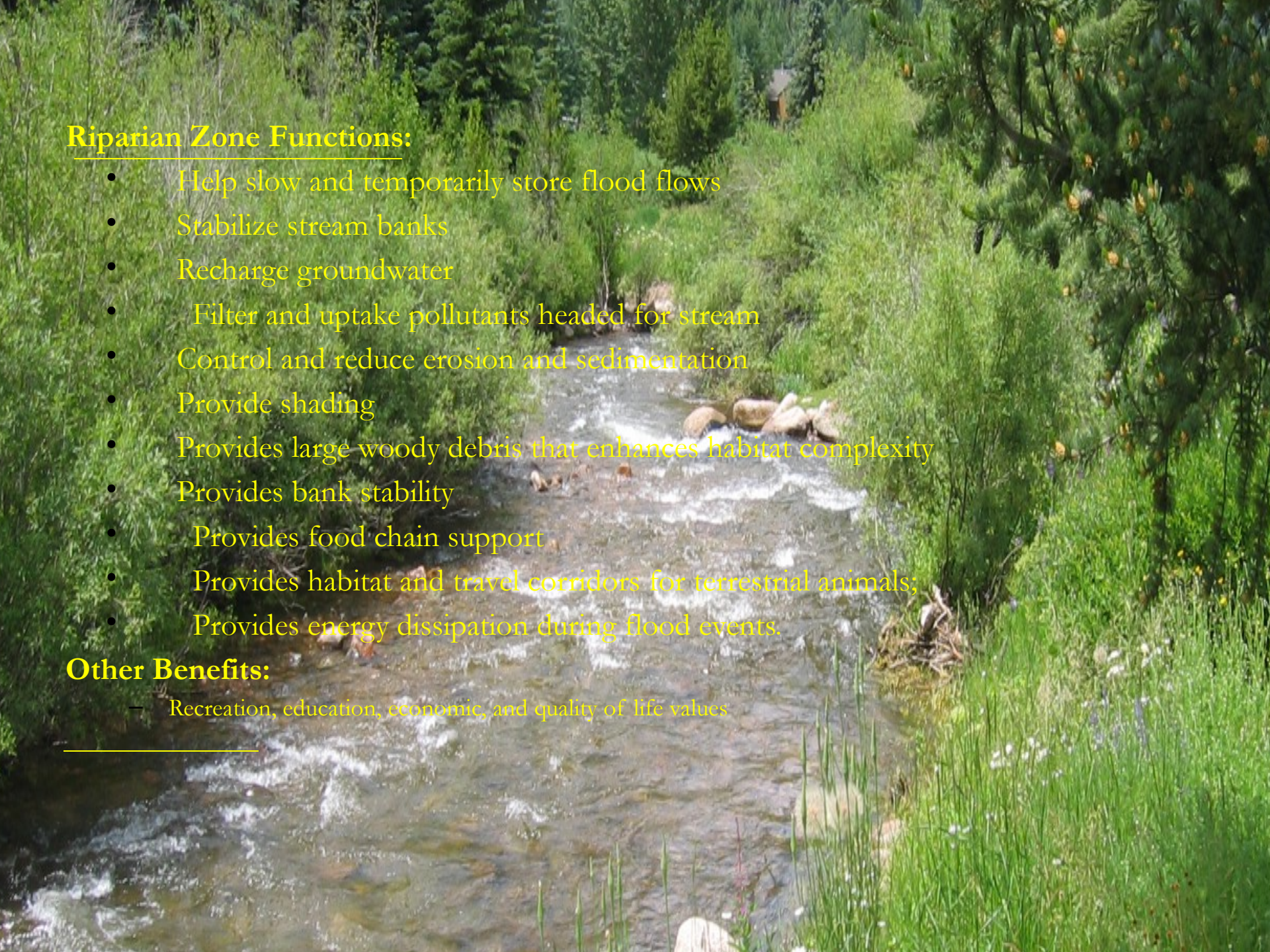


Gore Creek Stressor Categories

- Riparian zone degradation
- Impacts of impervious cover & urban runoff
- Pollutants associated with urban runoff and land-use activities

Riparian zone degradation

Healthy riparian areas are critical to water quality and biological health of streams



Riparian Zone Functions:

- Help slow and temporarily store flood flows
- Stabilize stream banks
- Recharge groundwater
- Filter and uptake pollutants headed for stream
- Control and reduce erosion and sedimentation
- Provide shading
- Provides large woody debris that enhances habitat complexity
- Provides bank stability
- Provides food chain support
- Provides habitat and travel corridors for terrestrial animals;
- Provides energy dissipation during flood events.

Other Benefits:

- Recreation, education, economic, and quality of life values

Riparian zone degradation

Recommended Corrective Actions

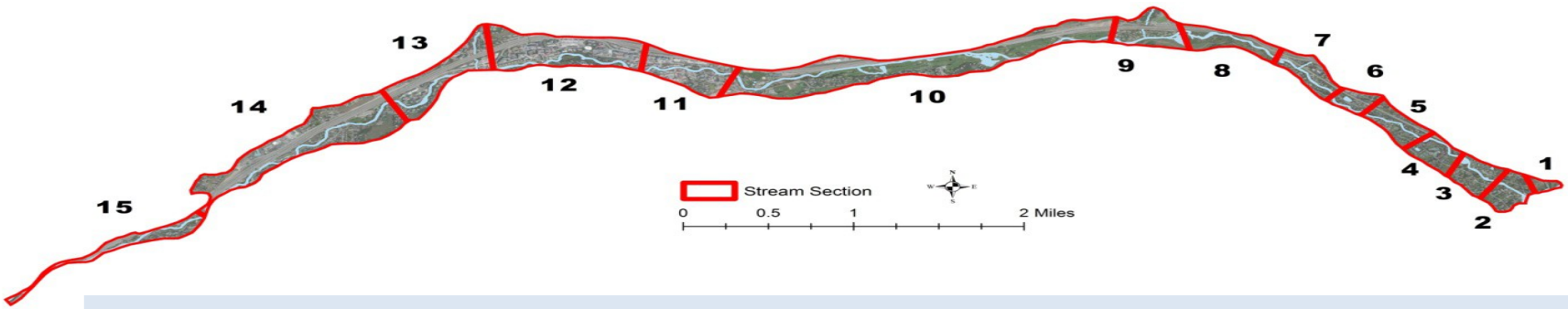
Physical: improve riparian zone quality/restore function

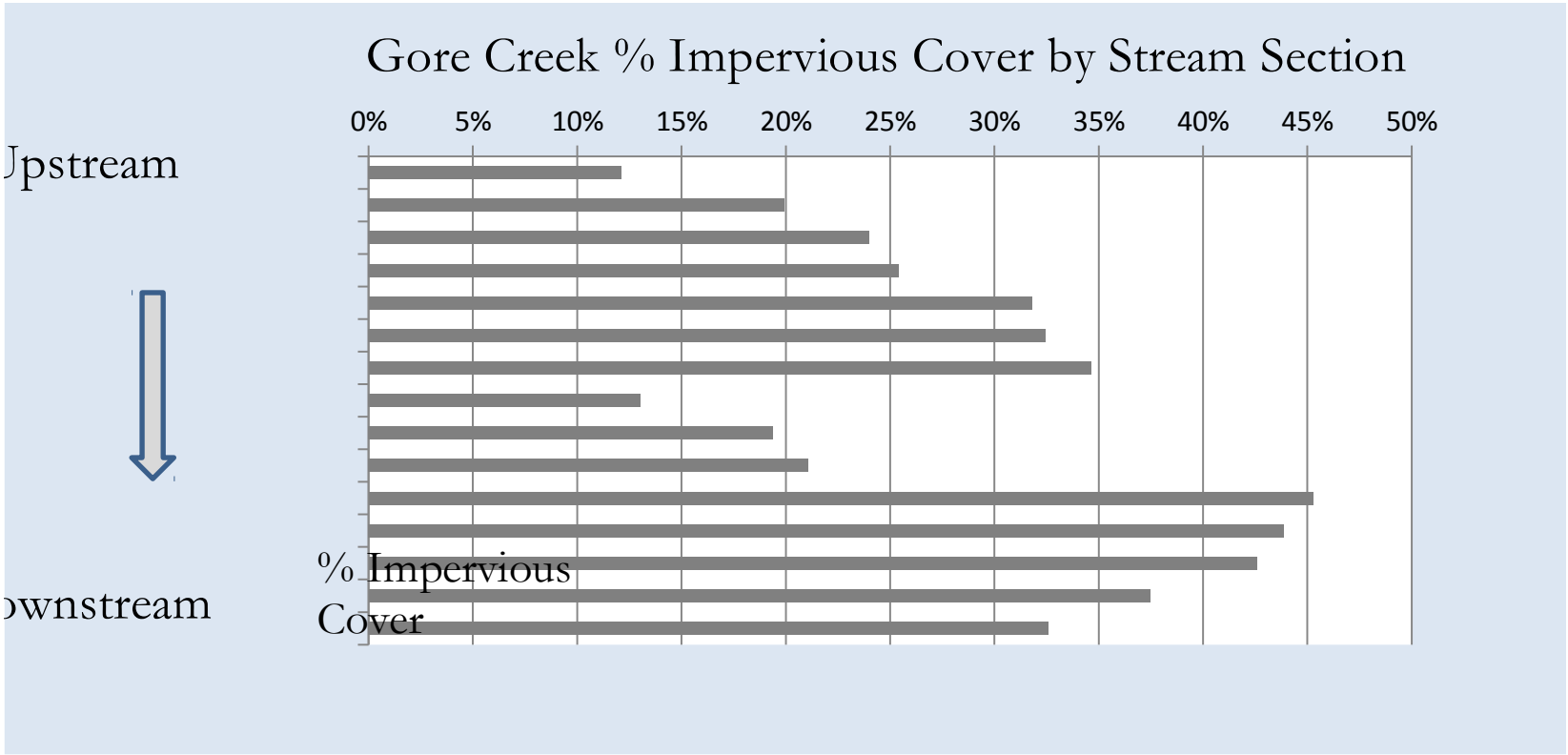
Regulatory: zoning setbacks

Voluntary: educational and monetary incentives

Impacts of Impervious Cover & Urban Runoff

Gore Creek % Impervious Cover by Stream Section

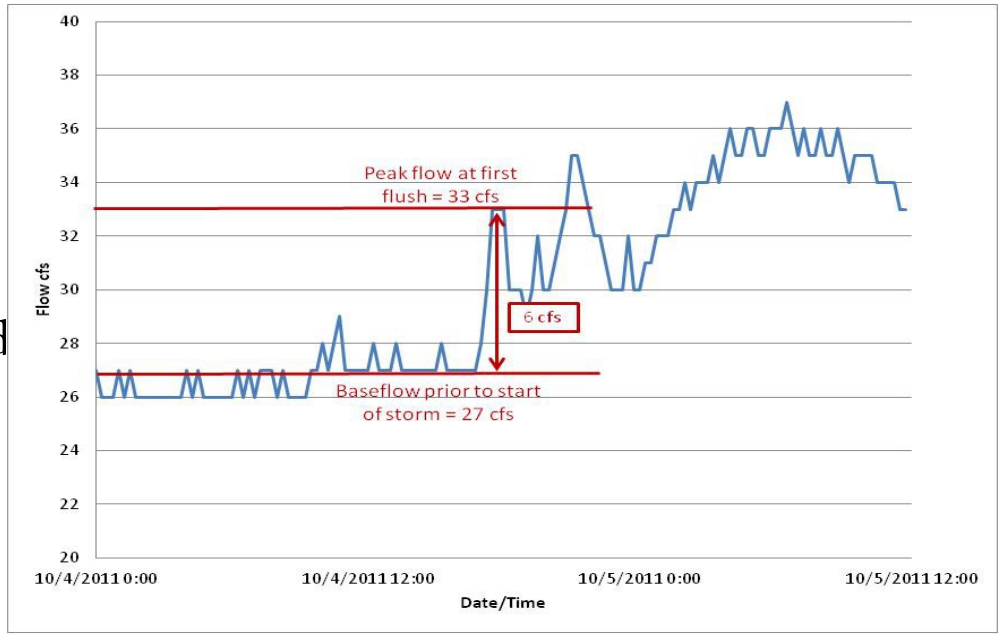




Stream Hydrograph at USGS Gage 09066325, Gore Creek Abv. Red Sandstone Creek During October 4, 2011 Rainfall Event

The Problem of Imperviousness

- "First Flush" – pulses of concentrated contaminants in stormwater delivered to stream;
- Significant negative correlation between % IC within 100 feet of stream and diversity, abundance, and composition of benthic macroinvertebrates; and,
- Impervious cover within riparian buffers (surrogate for disturbance) strongly correlates to aquatic life degradation.



Stream Hydrograph at USGS Gage 09066325, Gore Creek Abv. Red Sandstone Creek During October 4, 2011 Rainfall Event

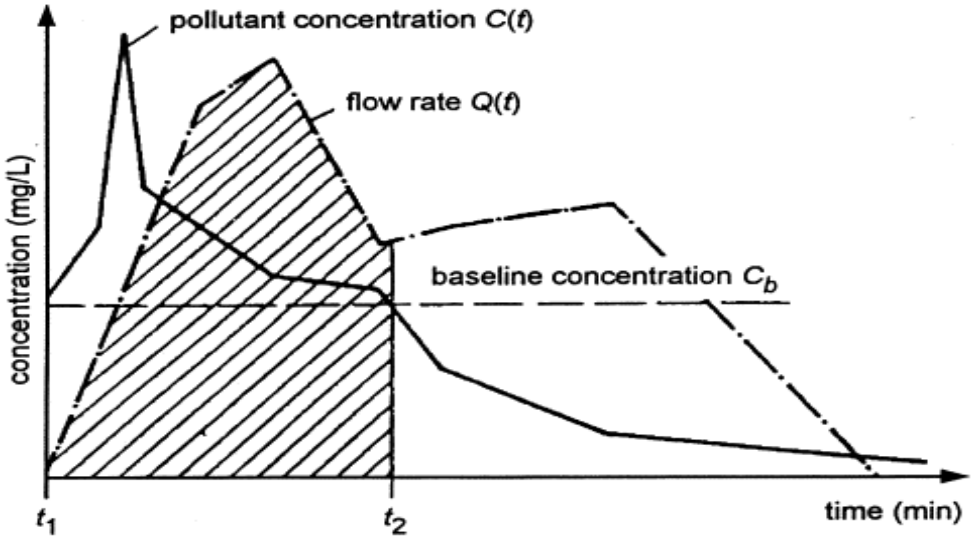


Diagram illustrating "First Flush" of pollutants during storm event

Impacts of Impervious Cover & Urban Runoff
Recommended Corrective Actions

Portions of urban Vail have up to 45% impervious area cover (within the alluvial aquifer boundary) adjacent to Gore Creek

Reduce influence of impervious surfaces on water quality and ecosystem health:

1.) Re-establish natural hydrological pathways where practical and/or necessary:

Adopt and implement Low impact development and green infrastructure practices;

2.) Improve efficiency (replace or retrofit) of existing stormwater treatment structures to gain better pollutant reductions; and,

3.) Improve BMPs for stormwater infrastructure maintenance activities where possible.

Key Pollutants of Concern

- Pesticides (insecticides, herbicides, fungicides, etc.)
- De-icers – Magnesium chloride, sodium chloride
- Hydrocarbons (PAHs)
- "Heavy" metals
- Nutrients
- Hazardous chemicals (spills, illegal dumping)

Sources of Contaminants in Urban Stormwater Runoff

Contaminant	Contaminant Sources
Sediment and Floatables	Streets, lawns, driveways, roads, construction activities, atmospheric deposition, drainage channel erosion
Pesticides and Herbicides	Residential lawns and gardens, roadsides, utility right-of-ways, public, commercial and industrial landscaped areas, soil wash off
Organic Materials	Residential lawns and gardens, public and commercial landscaping, animal wastes
Metals	Automobiles, bridges, atmospheric deposition, industrial areas, soil erosion, corroding metal surfaces, combustion processes
Oils and Grease/Hydrocarbons	Highways, roads, driveways, parking lots, vehicle maintenance areas, gas stations, illicit dumping to storm drains
Bacteria and Viruses	Lawns roads, leaky sanitary sewer lines, sanitary sewer cross-connections, animal waste, septic systems
Nitrogen and Phosphorus	Lawn fertilizers, atmospheric deposition, automobile exhaust, soil erosion, animal waste, detergents

Source: EPA, 1999. Preliminary Data Summary of Urban Storm Water Best Management Practices

Recommended Corrective Actions

Reduce input of toxic pollutants associated with urban land-use activities by:

- Use of alternative strategies for pesticide control (Integrative Pest Management Program);
- Use alternative management strategies to maintain roads, reduce input of de-icers;
- Adopt water quality protection ordinances and regulations to restrict or ban certain pesticide use near waterways;
- Upgrade WWTFs to meet nutrient regulations
- Physical removal of pollutants from paved surfaces (increased frequency of street sweeping); and,
- Improve BMPs for stormwater infrastructure maintenance where possible.

Next Steps

- Stakeholder Review Process
- WQIP Finalization
- Implementation Plan Development
  - Program Prioritization
  - Educational Programs
  - Regulatory Programs
  - Monitoring and maintenance programs
  - Project Prioritization
  - Budgeting and funding sources
  - Institutional arrangements (who does what)
- Plan Implementation