Nutrient Study Presentation Topics

• **Introduction and Background**
  – Nutrient fundamentals – sources and impacts
  – WQCD approach to nutrient criteria

• **Monitoring Goals and Objectives**
  – Overview of sampling plan

• **Monitoring Results and Data Interpretation**
  – Water chemistry sampling results
  – Macroinvertebrate sampling results

• **Next Steps**
  – Potential near-term control strategies
  – Potential long-term strategies
  – Continued data collection and analysis
Nutrient Fundamentals

• **Phosphorus (P) and Nitrogen (N)**
  – related to excessive plant growth
  – Not directly toxic to fish and macroinvertebrates

• **Excessive Plant Growth (e.g. algae) impacts**
  – Physical aquatic environment
  – Dissolved oxygen
  – Aesthetic impacts

• **Other environmental variables also influence plant growth**
  – Sunlight, water velocity, flow patterns (scouring), sedimentation, temperature, and other factors

• **Water Quality Standards**
  – Colorado - No numeric standards in place for P and N
  – WQCD Target date – June 2011
  – Upper Colorado River Basin – June 2014
Nutrient Mechanics

**Sources:**
- Human Waste & Detergent Use
- Animal Waste
- Fertilizers
- Soil Erosion
- Atmosphere

**Treatment/Reductions:**
- ISDS
- WWTP
- BMPs
- BMPs
- BMPs

**Stream:**

**Availability for Growth:**
- Readily Available
- Fairly Readily Available
- Readily Available (Designed for Growth)
- Needs to Convert
- Needs to Convert

Preliminary Results - Not for Attribution
WQCD Approach

- Numeric water quality criteria for N and P are to be based on levels necessary to protect aquatic life use
- Aquatic life use attainment – based on macroinvertebrate community health as measured by the Multimetric Index (MMI)
- Assumes that MMI scores decline as concentrations of N and P increase
- Relationships between MMI and nutrients based on statistical analyses (quantile regression) to derive numeric standards
- Continuing debate – how to differentiate nutrients from other stressors

Preliminary Results - Not for Attribution
Monitoring Objectives

• Participate in WQCD data collection and nutrient criteria process
• Characterize reference (natural) vs. impacted conditions
• Bracket and assess potential point and non-point sources
• Understand relationships between macroinvertebrates and nutrients
• Understand conditions unique to Gore Creek and the Eagle River
• Determine impacts of proposed nutrient criteria on the community and the District’s wastewater treatment facilities
• Identify potential management strategies
Gore Creek Sampling Sites
Gore Creek – Streamflow & Phosphorus Concentrations

Upstream  
Eagles Nest Wilderness  
Black Gore Cr.  
E. Vail Urban  
Vail Golf Club  
Mill Cr. & Vail Village  
Vail WWTP  
Red Sandstone Cr.  
W. Vail

Downstream

Proposed Phosphorus Criteria - 90 µg/L

Distance from Reference Site (Above Black Gore Creek confluence) (miles)

- Total P - Sept. 2008
- Total P - Sept. 2009
- Total P - ND 2008
- Total P - ND 2009
- Streamflow - 2008
- Streamflow - 2009
Gore Creek – Streamflow & Nitrogen Concentrations

**Upstream**

- Eagles Nest Wilderness
- Black Gore Cr.
- E. Vail Urban
- Vail Golf Club
- Mill Cr. & Vail Village
- Vail WWTP
- Red Sandstone Cr.
- W. Vail

**Downstream**

**Proposed Nitrogen Criteria**
- 824 µg/L

**Graph Details**

- **Y-axis**: Concentration (µg/L)
- **X-axis**: Distance from Reference Site (Above Black Gore Creek confluence) (miles)

**Data Points**

- **2008**
  - Total N - Sept. 2008
  - Total N - Sept. 2009
  - Total N - ND 2008

- **2009**
  - Streamflow

**Legend**

- [Blue Circle] Total N - Sept. 2009
- [Orange Triangle] Total N - ND 2008
- [Black Line] Streamflow 2008
- [Red Line] Streamflow 2009

**Preliminary Results** - Not for Attribution
Eagle River – Streamflow & Phosphorus Concentrations

Upstream

Downstream

Gore Creek Minturn

Eagle-Vail, Avon, Beaver Cr.

Avon WWTP Arrowhead Golf Course Edwards Lake Cr. Edwards WWTP

0 20 40 60 80 100 120 140

Streamflow (ft³/sec)

0 20 40 60 80 100 120 140 160 180 200

Concentration (µg/L)

Proposed Phosphorus Criteria - 90 µg/L

ERBGC ERAATP ERBATP

ERBAGC ERBEDWF ERBLEC


Distance from Gore Creek / Eagle River Confluence (miles)

Preliminary Results - Not for Attribution
Gore Creek – Total Phosphorus Loads (lbs/day)

Upstream

- Eagles Nest Wilderness
- Black Gore Cr.
- East Vail Urban
- Vail Golf Club
- Mill Cr. & Vail Village
- Vail WWTP
- Red Sandstone Cr.
- W. Vail

Downstream

2009 Point Source
2009 Non-Point Source
2008 Point Source
2008 Non-Point Source

Sample Site ID

Preliminary Results - Not for Attribution
Gore Creek – Total Nitrogen Loads (lbs/day)

**Upstream**
- Eagles Nest Wilderness
- Black Gore Cr.
- East Vail Urban
- Vail Golf Club
- Mill Cr. & Vail Village
- Vail WWTP
- Red Sandstone Cr.

**Downstream**
- W. Vail

**Sample Site ID**
- GCABGC
- GBP
- GCEV
- GCFP
- GCAVTP
- GCBYTP
- GCSP
- GCAER

**Preliminary Results - Not for Attribution**
Eagle River - Total Nitrogen Loads (lbs/day)

Upstream
- Gore Creek
- Minturn
- Eagle-Vail, Avon, Beaver Cr.
- Avon WWTP
- Arrowhead Golf Course
- Edwards
- Lake Cr.
- Edwards WWTP

Downstream

Load (lbs/day)

2009 Point Source
2009 Non-Point Source
2008 Point Source
2008 Non-Point Source

Sample Site ID

Preliminary Results - Not for Attribution
Gore Creek Nitrogen Concentrations Above & Below the Vail WWTP

Preliminary Results - Not for Attribution
Gore Creek Phosphorus Concentrations Above & Below the Vail WWTP

Proposed Phosphorus Criteria - 90 µg/L

Preliminary Results - Not for Attribution
Gore Creek Phosphorus Concentrations Above & Below the Vail WWTP

Proposed Phosphorus Criteria - 90 μg/L
Eagle River Phosphorus Concentrations Above & Below the Avon WWTP

Proposed Phosphorus Criteria - 90 μg/L
Eagle River Nitrogen Concentrations Above & Below the Avon WWTP

Proposed Nitrogen Criteria - 824 μg/L

Concentration (μg/L)

2008 Upstream
2008 Downstream
2009 Upstream
2009 Downstream

Preliminary Results - Not for Attribution
Eagle River Phosphorus Concentrations Above and Below the Edwards WWTP

- **Proposed Phosphorus Criteria**: 90 μg/L

**Preliminary Results** - Not for Attribution
Eagle River Phosphorus Loads Above & Below the Edwards WWTP

Preliminary Results - Not for Attribution
Eagle River Nitrogen Concentrations Above & Below the Edwards WWTP

Proposed Nitrogen Criteria - 824 μg/L

Preliminary Results - Not for Attribution
Eagle River Nitrogen Loads Above & Below the Edwards WWTP

- 2008 Upstream
- 2008 Downstream
- 2009 Upstream
- 2009 Downstream

Load (lbs/day)

Preliminary Results - Not for Attribution
Next Steps

• Continue data collection and analysis
• Continue Nutrient Criteria Work Group involvement and communication with the WQCD
• Investigate and implement point source control strategies
  – Reduction of phosphorus loading sources to WWTPs
  – Investigate treatment process refinements
  – Investigate Advanced Wastewater Treatment strategies
• Investigate and implement non-point source control strategies
  – Urban and construction stormwater BMPs
  – Riparian corridor restoration
  – I-70/Black Gore Creek sediment control
• Public education – inform the community about water quality issues and ongoing efforts of the District and others