WATER 101

Just the basics!

Diane Tate, CDR Associates
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Goals

- Gain familiarity with basic water terms and concepts
- Tailor this presentation to what YOU need to know
- Develop a list of further questions to cover at a future Advisory Committee session

Purpose: Background for work of the ESPA Advisory Committee

Outline

- Hydraulics
  - Units and Terms
  - Water Quality Parameters
  - Municipal Engineering
    - Water Treatment and Distribution
    - Wastewater Collection and Treatment
  - Groundwater and Aquifers
- Hydrology
- Water Storage
- On-Farm Water Use
- Models and Scenarios
- Discussion: Other possible topics

Engineer Fashion

Diane’s Circle of Water

Basic Hydraulics
Units and Terms

- Flow – CFS, MGD
- Volume – AC-FT, ft³
- Area – acre, hectare, square mile
- General
  - Topography, right-of-way, easement, GIS
- Terms explained in each section

Flow: One CFS fills 8 1/3 bathtubs in one minute

At a flow of one CFS, it would take 36 hours to fill an Olympic-size pool.

At a flow of one MGD, the same pool would fill in less than a day.

Boulder Creek at 900 cfs, May 28th, 2003

What is the flow now?

One cubic foot is equivalent to 7.5 gallons

Volume: One AC-FT is equivalent to three Olympic-size swimming pools
One acre is enough space to park 230 cars.

Basic Water Quality Parameters

- **Vocabulary**
  - Pathogens, TSS, TDS, precipitate, concentration, invasive species, contamination/pollution
- **Color and Clarity**
- **Temperature**
- **Current and Flow**
- **Dissolved Oxygen**
- **pH**
- **Pollutants**
- **Pathogens**

Main Entry: **pollute**
Function: *transitive verb*
1 *a*: to make ceremonially or morally impure: **DEFILE** *b*: **DEBASE**
2 *a*: to make physically impure or unclean: **BEFOUL, DIRTY** *b*: to contaminate (an environment) especially with man-made waste

Color, Clarity and Temperature

Current and Flow

- **USGS Real-time stream data**

Dissolved Oxygen and pH
Pollutants
- Petroleum Products
- Detergents
- Nitrate and Phosphate
- Heavy Metals
- Fecal Coliform

A plethora of pathogens

Water Quality Affects Plant and Animal Life
- Sediment
- Excess nutrients
- Low dissolved oxygen
- Bacteria and other pathogens
- Trash
- Hazardous waste

Not suitable for contact recreation

Municipal Engineering – Water Treatment
- Vocabulary
  - Flocculation, Non-revenue water
- Boulder’s Water Sources
- The Water Treatment Process
- Distribution Systems

Boulder’s Water Sources
- Seven Reservoirs in the Silver Lake/Lakewood Watershed (North Boulder Creek) – 40%
- Barker Reservoir (Middle Boulder Creek) – 40%
- Boulder Reservoir – 20%
The (Engineered) Water Treatment Process

- May include:
  - Sedimentation
  - Aeration
  - Mixing, flocculation, settling
  - Softening
  - Filtration
  - Adsorption
  - Disinfection
  - Storage

Water Distribution Systems

- Sizing Water Pipes
- Maintaining Water Pressure
- What happens to water in the pipes?

Municipal Engineering – Wastewater Treatment

- Vocabulary
  - Organic and non-organic; aerobic and anaerobic; BOD, COD, total coliform; primary, secondary and tertiary treatment; effluent

- What’s in the sewer?
  - Stages in wastewater treatment
  - Boulder’s Wastewater Treatment Facility
  - Collection systems
  - Septic Systems

What’s in the sewer?

- Dissolved and suspended solids
- High BOD
- High COD
- Nitrogen
- Phosphorus
- Grease
- Pathogens
- Heavy Metals

Stages in Wastewater Treatment

- Screening
- Settling
- Biological Treatment
- Disinfection
- Further Solids Removal
- Nutrient Removal
- Sludge Treatment and Disposal
Boulder’s Wastewater Treatment Facility

Septic Tanks

Wastewater Collection System
- Gravity lines
- Force mains
- Pump Stations
- Separation Distances
- Deep trunk sewers

Groundwater
- Vocabulary
  - Aquifer; rechargeable vs. non-rechargeable; drawdown; subsidence; intrusion; plume
- Mapping groundwater
- How a well works
- Subsidence and salt water intrusion
- Linkage with surface water
- Groundwater contamination

Vocabulary: rechargeable; drawdown; subsidence; intrusion; plume

Mapping groundwater

How a well works

Subsidence and salt water intrusion

Linkage with surface water

Groundwater contamination
How a Well Works

Edwards Aquifer and Recharge

Water Storage

- **Vocabulary**
  - Storage-area-elevation data, dead storage
- Reservoir Storage
- Sedimentation
- Evaporation
Sedimentation and Evaporation

- 45 cm of sediment per year – almost 1.5 feet
- Proportional to area: evaporation losses average 20% of reservoir inflows

Hydrology, Surface Drainage and Floodplains

- Vocabulary
  - Alluvium, ephemeral, sheet flow, infiltration, evaporation, transpiration, playa lake, impervious cover, rainfall, runoff, hydrograph, floodway, floodplain
- Rainfall/Runoff Relationships
- Statistical Floods

Runoff Hydrograph
Streamflow Hydrograph

South Boulder Creek
Flood Frequency Analysis

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<th>Return Period</th>
<th>Peak Flow Rate</th>
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<tr>
<td>2-Year</td>
<td>582 cfs</td>
</tr>
<tr>
<td>5-Year</td>
<td>990 cfs</td>
</tr>
<tr>
<td>10-Year</td>
<td>1350 cfs</td>
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<td>20-Year</td>
<td>1780 cfs</td>
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<td>3140 cfs</td>
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<td>3930 cfs</td>
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<tr>
<td>500-Year</td>
<td>5200 cfs</td>
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On-Farm Water Use

- Vocabulary
  - Evapotranspiration (ET)
- Brainstorm questions for the next background session

Models and Scenarios

- What is a model?
- What are scenarios?
- Brainstorm questions for a future Advisory Committee Meeting
What is a model?
- “a miniature representation of something”
- “a set of statements describing a system that incorporates physical and non-physical elements, and helps explore relationships among elements”
- Incorporates static and dynamic elements
- Deterministic vs. stochastic

What is a scenario?
- A particular set of inputs to the model structure designed to answer a specific question
- Examples and analogies

Other Possible Topics … What would you add?
- More on modeling and the ESPA Groundwater Model?
- More on agricultural water use?