Water and Wastewater System Planning
CE 431

Under "Planning" we will cover the following elements which guide most of our design-level decisions:

- Population forecasting and related elements
- Water Supply planning criteria
- Wastewater planning criteria

1. Service Life/Design Period/Population Forecasting

We size and design infrastructure to accommodate growth, **not** based on current needs.

Service Life versus Design Period

- Service Life = expected useable life of infrastructure
  - Mechanical systems - 25 years
  - Piping (e.g. sanitary sewer systems; water distribution systems) - 50 to 100 years
  - Structures (water tanks, wastewater treatment structures) - 50 to 100 years
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- Design Period = population planning period for designing/sizing infrastructure
  - Typically work on 25 year minimum planning periods
  - Also need to consider build-out populations
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  - What drives the 25 year timeframe?

- Sometimes the two overlap; sometimes not
  - e.g.: collection system wastewater pumping station - mechanical vs structural

Population Data

- Historical population data
  - U.S. Census - decennial counts (e.g. 10 year intervals)
  - State, local, other - annual estimates
- Contrast with similar cities
- School enrollments
- Utility connections
- Land use data
- Latter three require population factor estimate
  - e.g.: 3:1 for typical utilities
  - socio-economically influenced
  - residential/commercial/industrially influenced

Population Forecasting

- More of an art than science
- Relies on experience and understanding of local socio-economic conditions
- Factor in potential "build-out" boundaries and build-able lands inventory
- Ultimately may need to coordinate population with the State
    - e.g.: Oregon

Population Forecasting Models

- Constant Percentage Method
    - Linear on semi-log paper

- Linear Model
    - Constant rate of growth
    - Linear on arithmetic paper

- Curvilinear method

- Which model is most appropriate?

2. Wastewater System Planning

Wastewater Flows

- Commercial, Industrial - rely on such information as fixture units, use-specific data as provided by your client or obtained from similar facilities, and the various general references.
- Municipal - typically base our design flow analyses on actual treatment plant data
- Sources of municipal wastewater
    - Domestic
    - Infiltration
    - Inflow
- Similar diurnal pattern to water usage
- Pertinent flow factors - see Oregon DEQ handout
    - Average Daily Flow
    - Peak Day
    - Peak Hour
    - Maximum and Minimum Month
    - Minimum Day
    - What is the relevance of each?

<u>Wastewater Constituents</u> - see also the example NPDES permit on the course web site

- Physical

- Inorganics

- Metals

- Organics/oxygen demand

- Microorganisms

3. Water System Planning

Water Demands

- Design flows are based on the type of usage associated with the facility being constructed
- Need to consider public, municipal, industrial, and commercial usage
- Municipal Planning - need to identify top users
- Consider average, minimum, maximum, and peak flow conditions
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- Also consider un-accounted for water
    - Leaks
    - Pipeline breaks
    - Unauthorized service connections
    - Improperly operating meters
    - Recommended to be less than 15%
    - In estimating, best to account for as much usage as possible
        - Separate out unmetered but known usage
- Forecasting - need to incorporate more efficient use of water in the future
- What are some "typical" average water usage numbers and max/min factors?

- How do we develop this data for our specific situation (e.g. City, commercial building, apartment complex)?

- General Design Factors:
  - Sizing raw water and finished water supplies, including transmission and treatment
    - Maximum Day Demand (MDD)
    - Often provide some level of reliability/redundancy, plus some excess capacity in individual units

  - Storage sizing
    - One general approach
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    - Ground level versus Elevated tanks - critical to understand hydraulics and necessary appurtenances to provide required flow.
    - Each State/jurisdiction may have their own storage sizing criteria
      - Washington

  - Distribution system
    - PHF + fire flow

Water Quality

- Common Contaminants - raw water
    - Surface Water

    - Ground Water

- Common Contaminants - finished water (see drinking water MCLs on course web site)

- Bulk Parameters
  - Physical
    - Turbidity
    - Color
    - Taste/Odor
    - Temperature
    - pH
  - Chemical