Hydrology - The Odyessy of Water

1987 NPS Water Resources Course
16 - 24 July
Freeman M Smith

I. The Hydrologic Cycle

1. Precipitation

a) rain
b) snow
c) fog

2. Evapotranspiration

a) evaporation

b) transpiration

c) free-water evaporation

3. Runoff

a) overland flow

b) interflow

c) groundwater flow

4. Hydrologic and Climatic Data

a) units and measurement

b) instrumentation

II. The Water Balance

1. Spatial

a) global

b) regional

c) local

2. Temporal

a) annual

b) seasonal

c) daily

3. The Coupling between the Water Balance and the Energy Balance

III. Watersheds - A Hydrologic Unit

1. Geomorphic Evolution

a) slopes

b) channels

2. Descriptors of Watersheds and Stream Networks

a) size, shape, and relief

b) the order of stream networks and their watersheds

c) watershed behavior

IV. The Hydrologic System

1. Driving Variables

a) precipitation

b) the energy balance

2. Storage Components

a) the plant canopy

b) the surface

c) the soil

d) the aquifer

e) lakes

3. Processes and Controls

a) interception

b) snowmelt

c) infiltration

d) overland flow

e) interflow

f) groundwater flow

g) evaporation

f) evapotranspiration

V. Uncertainty in Hydrolgic Behavior

1. Nominal Behavior

2. World Records

3. Extreme Events

a) floods

1) rain

2) rain-on-snow

3) flash floods

b) doughts

1) global

2) regional

3) global

VI. Sources of Hydrologic and Climatic Information

1. National Weather Service

2. U.S. Geological Survey

3. U.S. Soil Conservation Service

4. State Records

5. World Meteorlogical Organization

PRESENTATION BY RAY HERRMANN

Principles of Groundwater

I. The Nature of Ground Waters

A. Introduction (an invisible yet important resource)

B. Some Important and Recurring Terms, Facts and Figures

C. The Hydrologic Cycle (Recharge, Discharge, Infiltration, Evapotransporation)

D. The Occurance of Underground Water

1. Water in Rocks and Sediments

a. Primary (Pore spaces and other voids)
   i. Sediments
   ii. Volcanics
b. Secondary (Fractures, solution cavities)
   i. Sedimentary (Clastic, Limestone)
   ii. Igneous (Volcanic, Intrusive)
   iii. Metamorphic

2. The Amount of Water in Rocks
   a. Porosity
   b. Permeability
   c. Specific Yield
   d. Specific Retention

E. Flow systems

1. The Free Water Table
2. Confined Aquifers
3. Multiple Flow Systems
   a. Surface - Subsurface Relationships
   b. Multiple Subsurface Systems

4. Artesian Systems
   a. Overburden Pressure
   b. Peizometric Surface

5. Hot Water Systems
6. Permafrost
7. Ghyben-Herzberg Relation

F. The Quality of Groundwater
   1. Origin of the Water
   2. Mineral and Chemical Nature of the Host Rock
   3. Time
   4. Distance (History of Travel)
   5. Heat
   6. pH

G. Conclusion

PRESENTATION BY WILLIAM WERRELL

II. PRINCIPLES /METHODS OF GROUND WATER STUDY

A. General Comment
B. Ground Water Contour Maps
C. Effects of Pumping Wells
D. Theory of Aquifer Tests
E. Ground Water Mounds
F. Boundary Effects
   Positive
   Negative
G. Multiple Wells
H. Models

III. "SPECIAL" GROUND WATER CONDITIONS/STUDIES

A. Salt Water Intrusion
B. Leaky Aquifers
C. Perched water
D. "Mining Water"

IV. COMMON MISCONCEPTIONS

A. Age of water denotes the length of time before impacts
B. Water flows downhill
C. "Artesian water" is pure
D. We are "running out of water".

V. CURRENT GROUND WATER CONCERNS/STUDIES

A. Groundwater depletion
B. Groundwater quality
C. Salt water intrusion
D. Land subsidence

VI. Summary

E:20708gr.mmi

WATER QUALITY: PHYSICAL CONSTITUENTS

Objective

Provide a broad overview of erosion and sedimentation processes, relationships to landforms, implications for watershed management, and considerations in water quality sampling and analyses.

Upon completion of this course section, the trainee should be able to:

1. Distinguish between erosional and depositional landscapes and identify primary sedimentation processes occurring on different landforms.

2. Identify the major variables influencing surface erosion and mass erosion.

3. Describe the role of stream channel features in relation to stream power, and describe accelerated erosion effects on stream channels.

4. Distinguish among sediment yield, sediment concentration, and turbidity, and describe common methods of suspended sampling and analysis.

Topic Outline

I. Overview: Sediment, Landscape, Climate Relationships
   - A. Processes and Landforms
   - B. Sediment Budgets
   - C. Good Mud and Bad Mud
     1. Accelerated vs. natural erosion rates
     2. Impacts and values

II. Upland Surface Erosion
   - A. Basic Concepts
   - B. Terms: Soil Loss, Sediment Yield
   - C. Influencing Factors
     1. Soil erodibility
     2. Rainfall energy
     3. Runoff
     4. Slope length and steepness
     5. Vegetation
   - D. Prediction: Universal Soil Loss Equation
   - E. Measurement
   - F. Management

III. Upland Mass Erosion
- A. Basic Concepts
- B. Classification
  1. Slump (rotational failure)
  2. Slump - earthflow
  3. Debris avalanche
  4. Creep
- C. Influencing Factors
  1. Soil properties
  2. Slopes
  3. Vegetation (roots)
  4. Drainage
- D. Management Considerations

IV. Instream Factors
- A. Stream Power
- B. Morphological Features
  1. Pools, riffles
  2. Floodplains
  3. Banks
  4. Bed Materials
- C. Bedload Transport
- D. Responses of Streams to Increased (or Decreased) Sediment Delivery

V. Suspended Sediment and Water Quality
- A. Concepts of Suspended Sediment Transport
- B. Measurement of Sediment Concentration
- C. Variations on Sediment Concentration with Depth
- D. Relationships between Sediment Concentration and Streamflow
- E. Turbidity
  1. A water quality parameter in its own right
  2. An index of suspended sediment
- F. Sampling and Monitoring Considerations

WATER QUALITY MONITORING AND CHEMICAL CONSTITUENTS

SAM KUNKLE & MARK FLORA
WATER RESOURCES DIVISION
NATIONAL PARK SERVICE
FORT COLLINS, CO 80523
(303) 491-5607

I. - UNITS

- DEFINITIONS

- WATER QUALITY INSTRUMENTATION

II. - WATER QUALITY IMPACTS IN THE NATIONAL PARK SYSTEM

- Mineral Extraction

- Watershed Disturbance

- Recreational Water Quality

III. - POINT SOURCE AND NON-POINT SOURCE POLLUTION

- SAMPLING METHODOLOGY

IV. - STRATEGIES FOR WATER QUALITY MONITORING

- Common Sources and Impacts

- Parameter Selection

- Implementation Alternatives

MICROBIOLOGY: BACTERIAL PATHOGENS, VIRAL PATHOGENS, PARASITES, AND INDICATOR ORGANISMS

Kirke L. Martin
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Natural Resources Management Trainee Course, July 1987

Floodplain Guidelines

PRESENTATION BY WILLIAM WERRELL

I. Introduction

II. Probable Maximum Flood

A. Historical Dam Building by "Engineers Estimates" For Spillway Design

B. Major Floods in 1930's, Dam Losses

C. Present Day Need for Better Prediction

1. Rainfall Data
2. Hydrograph Concept - Unit Hydrograph
3. Probable Maximum Hydrograph
4. Probable Maximum Flood (PMF)

D. Defination of PMF

III. National Flood Insurance Act (NFIA)

A. Conditions Prior to Act
B. Federal Emergency Management Agency (FEMA)
C. Voluntary Agreement Between Government and Communities
1. Agreement - Mapping, Insurance
2. No Agreement - No Federal Aid
D. Insurance
1. Insurance Rates Based Upon Hydrology
2. Insurance Sales by Private Companies
E. Participation/Benefits - Some States Have Adopted NFIA Program
F. "Fairness" of the Act

IV. El Dorado Wash Flood at Lake Mead NRA

V. Executive Order 11988 (Floods)

A. Broad Objectives - Protect Lives and Property
B. Specific Objectives
C. Application
D. Requirements - Allows for Floodproofing
E. 500-year Floodplain/Critical Actions
1. Jails, Hospitals
2. Irreplaceable Historical Items
F. Signs
G. Tsunamis

VI. Executive Order 11990 (Wetlands)
- A. Defination of Wetlands
- B. Factors to be Considered
  1. Public Health, Water Supply, Sediment
  2. Ecosystems
  3. Recreation, Scientific, Cultural

VII. NPS Floodplain Guidelines
- A. Prepared as Directed by Execitive Orders
- B. Extension of Executive Order Standards
- C. "High Hazard Areas"
  1. Defination
  2. Probable Maximum Flood Protection Required
- D. Other Provisions

VIII. Practical Applications to Comply With NPS Guidelines
- A. Basic Determinations/Studies
- B. Practical Application of Study Results
- C. "Floodproofing" or Mitigation

IX. Summary

OUTLINE

WATER QUALITY LEGISLATION & REGULATIONS

Dan B. Kimball
Chief, Policy, Planning & Evaluation Branch
Water Resources Division
Denver, CO
(303-236-8765;FTS 776-8765)

I. Introduction (Compliance/Tools for protection)

A. Clean Water Act

B. Safe Drinking Water Act

C. Other Acts

1. Resource Conservation & Recovery Act (RCRA)

2. Comprehensive Environmental Response, Compensation, & Liability Act (CERCLA or "Superfund")

3. National Wild & Scenic Rivers Act (NWSRA)

4. Toxic Substances/Pesticide Control Acts

5. Surface Mining Control & Reclamation Act (SMCRA)

6. Nuclear Waste Policy Act (NWPA)

7. Coastal Zone Management Act (CZMA)

8. Marine Protection, Research, and Sanctuaries Act (MPRSA)

9. National Environmental Policy Act (NEPA)

D. Other Programs

1. EPA Ground-Water Protection Strategy

2. Boundary Waters Treaties

3. Biosphere Reserves/World Heritage Sites

E. Applicability and examples for NPS waters

F. Jurisdiction/Compliance Issue (Attachment)

II. Clean Water Act

A. Definitions (Attachment)

1. Water Quality Criteria

2. Water Quality Standards

3. Point v. Non-point Source Discharges

4. Effluent limitations

5. Best management practices

B. Significant Sections

1. Sec. 101 (Goals: "fishable/swimmable"; eliminate all discharges by 1985)

2. Sec. 201 (Municipal sewage treatment plant funding)

3. Sec. 208 (Areawide water quality management planning)

4. Secs. 301 & 306 (Permits required for point source discharges; effluent limitations)

5. Sec. 303 (Water quality standards/stream classification/anti-degradation policy/outstanding national resource waters)

6. Sec. 304 (EPA water quality criteria guidance)

7. Sec. 311 (oil spill requirements; SPCC - NPS maintenance)

8. Sec. 402 (National pollutant discharge elimination system (NPDES))

9. Sec. 404 (Dredge & fill permits; Corps of Engineers/EPA; NPS Wetlands Protection Guidelines)

C. Implementation highlights

1. NPDES permitting (State primacy, effluent limitations)

2. State stream classification (Outstanding National Resource Water Program)

3. 208 planning (new emphasis - BMPs)

III. Safe Drinking Water Act

A. Significant Sections

1. Sec. 1412 (National Drinking Water Regulations)

2. Part C (Protection of Underground Sources of Drinking Water - Sole Source Aquifer Designation and Underground Injection Control Programs)

B. Implementation highlights

1. Federal drinking water standards (toxics?)

2. Underground injection control program (State primacy)

IV. Other Acts

A. RCRA ("cradle to grave" standards for hazardous wastes; leaking underground storage tank program)

B. CERCLA (Superfund/Natural Resource Damage Claims)

C. NWSRA (preserve free flowing condition)

D. Toxic Substances/Pesticide Control Acts

E. SMCRA (Performance standards / AML)

F. NWPA (HLNW siting; EPA/NRC regs)

G. CZMA (State planning and Federal "consistency")

H. MPRSA (Ocean dumping controls)

I. NEPA (cumulative impacts and alternative analyses)

V. Other Programs

A. EPA Ground-Water Protection Strategy (Federal v. State role, classification guidelines)

B. Boundary Waters Treaties (Canada/Mexico)

C. Biosphere Reserves/World Heritage Sites

VI. Upcoming Legislation

A. Ground-Water Protection (Research?)

B. Acid precipitation controls?

Attachments

1. Federal Facilities Compliance

2. Clean Water Act Definitions

CLEAN WATER ACT DEFINITIONS

Water Quality Criteria:

Descriptions of certain maximum or minimum physical, chemical, and biological characteristics of water (usually expressed as consitutuent concentrations) which reflect tolerances and requirements of aquatic biota, human health, and aesthetics which will protect defined uses of the nation's waters with an adequate degree of saftey. (Not enforceable/ EPA criteria guidance or site-specific criteria)

Water Quality Standards:

A rule or law comprised of the use or uses to be made of a water body or segment and the water quality criteria necessary to protect that use or uses. (Enforceable/take into account social, legal, economic, & institutional considerations)

Standards serve the following functions:

(1) Establish water quality goals for a specific water body; and

(2) Serve as the basis for water quality based treatment controls.

Point v. Non-Point Source Discharges:

Point Source Discharge: Any discernible, confined, or discrete conveyance from which pollutants are or may be discharged. (Pipe)

Non-Point Source Discharge: urban/agricultural/mining/ construction runoff. (Diffuse)

Effluent Limitations:

With respect to point source dishcarges to the nation's waters, physical, chemical, and biologic limits which are based on control technology or are necessary to meet water quality standards in receiving waters.

Best Management Practices:

With respect to non-point source discharges to the nation's waters, recommended water pollution control practices (e.g., erosion control for agriculture & reclamation for mine sites)

OUTLINE

AN OVERVIEW OF WATER RESOURCES MANAGEMENT PLANNING IN THE NATIONAL PARK SERVICE

Dan B. Kimball
Chief, Policy, Planning & Evaluation Branch
Water Resources Division
Denver, CO
(303-236-8765;FTS 776-8765)

I. Introduction to Water Resources Planning Section of Course

A. Overview - Dan Kimball

B. Case Study - Chuck Wood, Glen Canyon National Recreation Area

C. Class Exercise - Bill Werrell

D. Budgeting related to planning - Bill Reed

II. Relation of Water Resources Management Plans (WRMPs) to NPS Planning Process (component of Natural Resources Management Plans: part of NRMP or separate plan) (Attachment)

III. WRMP: Defines course of action based upon law and NPS policy for the protection, conservation, use, and management of park water resources. (WRMP = action plan for addressing water resources matters facing NPS units; DOI/EPA MOU under Clean Water Act - development of Water Quality Management Plans by NPS)

IV. Basic objectives of WRMPs

A. Address park-specific issues (broad range of issues-surface water, ground water, quantity & quality, floodplains, water rights, threatened & endangered species, aquatic resources, external threats, etc.) with a planning horizon of 5 - 10 years

B. Tool for management (to make decisions)

C. Vehicle to obtain funds

V. Basic steps in preparing WRMPs (NPS Instructions for Preparation of WRMPs - currently being updated by WRD)

A. Collection of background hydrologic data and related information

B. Identification of water resources objectives for unit

C. Identification of water resources issues (scoping)

D. Special studies/investigations (short-term)

E. Development of water resources management program (to include monitoring, research, and management actions to address identified issues)

1. Develop and evaluate alternatives (to assure NEPA compliance and provide options for management) and identify preferred alternative(s)

2. Draft project statements (10-23Bs identifying funding requirements, implementation priority, scheduling, etc.) for implementation of WRMP

F. Public participation

VI. Relation of Park, Region, and WRD in work effort

VII. Other important considerations

A. Preparation of a work plan/task directive

B. Timing of WRMP (plan does not have to "solve" all problems - but identify "approach(es)" to solve problems)

C. Coordination with other agencies (e.g., 208 areawide planning organizations; Coastal Zone Management Act entities; etc.)

D. WRMP = issue-oriented (not simply compilation of hydrologic data but management document focusing on issues)

E. WRMP = Dynamic document (responsive to changes in water quality conditions, results of implementation activities, new regulations, changes in technology, etc.)

VIII. Examples of WRMPs

A. Cape Cod NS (1981)

B. Sequoia-Kings Canyon NP (1984)

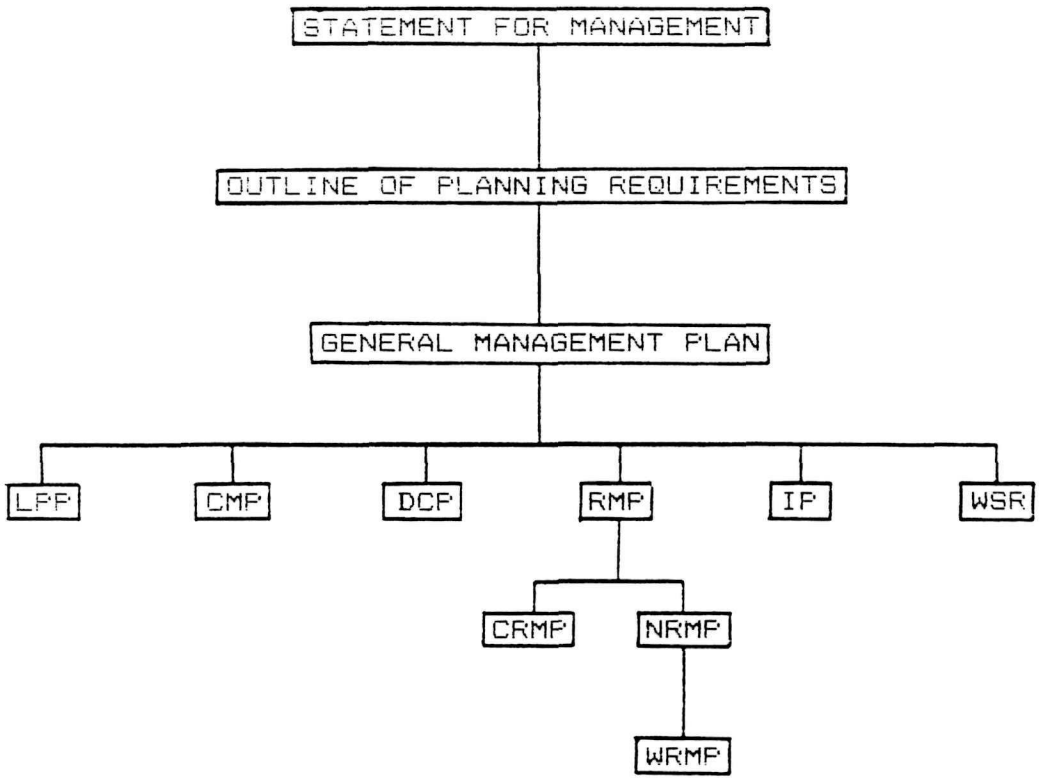
C. Grand Canyon NP (1984)

D. Santa Monica Mountains NRA (1984)

E. Redwood NP (1985)

F. Glen Canyon NRA (1987)

NPS PLANNING DOCUMENTS



Legend:

LPP: Land Protection Plan

CMP: Concessions Management Plan

DCP: Development Concept Plan

RMP: Resource Management Plan

IP: Interpretive Plan

WSR: Wilderness Suitability Review

CRMP: Cultural Resource Management Plan

NRMP: Natural Resources Management Plan

WRMP: Water Resources Management Plan

COURSE OBJECTIVES

FRESHWATER ECOSYSTEMS

The purpose of this segment is to provide participants with a broad overview of the diversity and significance of freshwater ecosystems contained within the national parks. Topics include classification schemes for describing aquatic systems, basic principals of limnology, aquatic food webs, representative aquatic and riparian communities, selected species assemblages, and an introduction to freshwater fisheries. The segment will conclude with suggestions for additional sources of technical assistance and selected references will be recommended. Limited time will be alloted for questions and discussion.

COURSE OUTLINE

FRESHWATER ECOSYSTEMS

I. Classification Schemes for Aquatic Environments

A. Physical environments

1. Standing waters (lakes, reservoirs, ponds, bogs, etc.)

2. Flowing waters (riverine environments)

(a) Permanent vs. intermittent flows
(b) Natural vs. regulated flows

B. Classifications based on productivity (natural lakes) and succession processes

1. Oligotrophic systems
2. Mesotrophic systems
3. Eutrophic systems

C. Community classifications (typically defined by type of fishery)

1. Cold water ecosystems
2. Cool water ecosystems
3. Warm water ecosystems

II. Examples and Characteristics of Representative Aquatic Systems in the National Parks

III. Anatomy of a Freshwater Ecosystem

A. Generalized model of an aquatic system

B. Basic limnology (thermal stratification, light transmission, nutrient cycles, biotic zones, etc)

B. Trophic dynamics, energy pathways, food webs (Analysis of energy transfers from primary production through top predators)

C. Relationships between aquatic ecosystems and terrestrial/riparian communities

1. Energy transfers
2. Critical habitats for terrestrial species
3. Microhabitats

IV. Selected Aquatic Communities (emphasis on elements not covered elsewhere during the course)

A. Aquatic flora (Species diversity and factors influencing distribution and abundance)

1. Phytoplankton communities (algae)
2. Aquatic macrophytes (rooted aquatics)
3. Riparian (shoreline) vegetation

B. Zooplankton - population dynamics

V. National Park Fishery Resources (commercial fisheries excluded from consideration)

A. Native fisheries -- characteristics of pristine ichthyofaunas (a scarce commodity)

B. Invasion or introduction of non-native fishes (The "Johnny Appleseed" syndrome -- dilemma of the Natural Area Parks)

1. Genetic consequences from hybridization

2. Ecological perturbations to natural processes

(a) impacts on native fisheries
(b) alteration of indigenous microbiotas

C. Fish parasites -- A problem or a blessing?

VI. Summary amd Conclusion

A. Significance of aquatic resources in the national parks
B. Available sources of technical assistance
C. Suggested references for further reading (handout)
D. Questions and discussion

WETLAND SYSTEMS OF THE UNITED STATES--AN OVERVIEW

I. Definition of wetlands

   A. General comprehensive definition (all inclusive)

   B. Other definitions

II. Examples of wetland systems (U.S. Fish and Wildlife Service Classification System)

   A. Palustrine (typical marshes)

   B. Riverine (channel habitat)

   C. Lacustrine (lakes)

   D. Estuarine (brackish waters influenced by ocean salts)

   E. Marine (saline ocean areas)

III. Values of wetland systems

   A. Fish and wildlife

   B. Recreation

   C. Flood control

   D. Water quality restoration

   E. Soil stabilization

   F. Grazing

   G. Ground water recharge

   H. Human water source

   I. Commercial food source

IV. Impact of man's activities on wetland systems

   A. Water quality degradation

   B. Drainage

   C. Water diversions

D. Channelization

E. Grazing

F. Filling

G. Timber harvest

H. Land conversion

I. Irrigation return flows

V. Management of wetland systems

A. Rivers and streams

B. Pothole marshes

C. Springs

D. Estuaries

E. Intertidal ocean shorelines

VI. Wetland systems in the future

A. Effects of their loss

B. Effects of their restoration and maintenance

VII. What can you do to ensure proper management of wetland systems in the future?

Resources Management Trainee Course

July 16-27, 1987

Potential Impacts to Water Resources from Oil and Gas Development

I. Phase of Field Development

1. Preliminary Investigation
2. Exploration
3. Development
4. Production
5. Abandonment

II. Potential Water Resource Impacts from Exploratory Operations

1. Sedimentation from overland heavy vehicles

2. Potential groundwater contaminants from explosive geophysical exploration

3. Damage to wells and springs from seismic vibrations

III. Potential Water Resource Impacts from Drilling Operations

1. Sedimentation from road and site construction

2. Contamination from drill cuttings and fluids, and flows from formations

3. Brine or oil contamination from blowouts

4. Groundwater and or surface water contamination from improper plugging operations

IV. Potential Environmental Impacts Associated with Production Operations

1. Sedimentation due to road and site use, and erosion of poorly designed pads and berms

2. Water quality deterioration from produced water disposal

3. Contamination from pesticide use around production facilities

4. Contamination from chemicals utilized for tertiary recovery

Resources Management Trainee Course

July 16-27, 1987

Wastewater Treatment and National Purification of Organic Waste

A. Wastewater Treatment

I. Definition of Wastewater Treatment

Conventional wastewater treatment is a combination of physical and biological processes designed to remove organic matter from solution

II. Design Standards

1. Plant designed to accommodate both hydraulic and organic loading

a. Hydraulic quantity for sizing basin is average workday flow during that season of the year when discharge is greatest

b. Design organic loading exposed in average pounds per week day (see Figure 1)

2. Design should consider type of wastwater influence. Industrial wastes usually have higher BOD loadings than domestic wastes. (See Figure 2 & 3)

3. Effluent Quality

EPA standards for secondary treatment (See Figure 4)

III. Wastewater treatment schemes

1. Conventional municipal (See Figure 5)

2. Small wastewater flows

a. Biological processing without primary sedimentation (Figure 6)

b. Stabilization ponds (Figure 7)

IV. Conventional Treatment: 3 stages - preliminary treatment, clarification (sedimentation) and biological filtration

1. Preliminary treatment

a. Screens and shredders - remove objects 1 inch and larger in size, and shred to about 1/4 inch

b. Grit Chambers - Grit includes sand and other heavy particulate matter such as seeds and coffee grounds. Grit chambers usually designed to remove particles equivalent to a fine sand (.2 mm)

c. Flow monitoring - usually done with parshall flumes or weirs

2. Sedimentation

1. Clarification is performed in rectangullar or circular basins. Allows for further removal of particulate solids before biological treatment

3. Biological Filtration - Consists of spreading wastewater so that it will come in contact with microbial growth attacned to the surface of supporting media (Fig 8)

1. Trickling Filter - most common municipal treatment system. The most common supporting media is crushed rock, slag or field stone. Biological films consist primarily of bacteria, protozoa and fungi

2. Wastewater may be sent for final clarification before being discharges to the environment

V. Small Extended aeration plants

Very popular in treating small flows from schools, subdivisions, trailor parks and villages (Fig. 9)

VI. Stabilization Pads - Still used in rural communities (about 3,500 in United States)

1. Facultative ponds - most common. Utilized both aerobic and anaerobic decompositive (Fig. 10)

2. Aerated Lagoons

3. Anaerobic Lagoons

VII. Septic Systems

Underground concrete box sized for a detention time of approximately two days. Effluent is discharged to an absorption field where most of the biological stabilization occurs (Fig. 11)

VIII. Sludges and Wastewater Effluents

B. Natural Purification of Organic Pollutants

I. Generalized effect of organic pollution on a receiving stream (Fig. 12)

1. Zone of degradation

a. Progressive reduction of dissolved oxygen utilized in satisfying BOD

2. Zone of Active Decomposition

a. Exhibits characteristics of significant pollutants

b. Dissolved oxygen is at a minimum

c. Anaerobic decomposition of bottom muds results in offensive ordors

d. Little or no bilogical diversity. Fish may find zone undesirable

e. Bacteria and fungi thrive

3. Zone of recovery

a. reaeration exceeds rate of deoxygenation

b. Dissolved oxygen increases slowly

c. Ammonia nitrogen is converted to nitrate

d. Biological diversity increases

4. Zone of clean water

a. D.O. returns to pre-pollution values

b. Supports a wide variety of plant and animals

c. Permanent changes include increase in inorganic compounds (nitrate, phosphate and dissolved salts). May also exhibit higher algal population

5. Factors affecting BOD utilization and oxygen recovery

a. Hydraulic and organic loadings. Hign organic loadings in relation to stream may cause extended anaerobic conditions

b. BOD removal - BOD is eliminated from receiving streams by two processes, deoxygenation and physical removal

Deoxygenation consists of chemical and biochemical processes by which organic materials are oxidized to stable end products by utilizing soluable oxygen

Removal is a process which occurs as temporary suspended organics settle along the bottom of a stream, forming sludge layers

c. Reaeration - Physical process which describes the replenishment of oxygen previously depleted by organic decoy. Reaeration is usually discribed ass a tuntion of stream velocity and stream depth

d. Temperature - temperature affects the solubility of oxygen and can alter the rate of reaction mechanism for each of the substances undergoing chemical or biochemical alteration

e. Benthic demand - Sludge deposits downstream of a sewage outfall undergo reaction which deplete stream oxygen levels

f. Respiration and Photosynthesis - sewage discharges usually createmore ideal environments for algal communities which produce surplus oxygen during daylight hours through photosynthesis, and consume oxygen at night during respiration, thus causing diurnal fluctuations in dissolved oxygen content

II. Models and wasteload allocation

1. Use of mathematical models to simulate D.O. concentration below sewage outfalls

WATER RESOURCE TRAINING
FT. COLLINS, CO - 1987

INSTRUCTOR: Paul Rose
Santa Monica Mts. NRA

URBAN HYDROLOGY - WATER RESOURCE PROGRAM, SANTA MONICA MOUNTAINS NATIONAL RECREATION AREA

I. INTRODUCTION

II. SANTA MONICA MOUNTAINS

A. Urban Park Concepts
B. Natural Resource Values
C. Cooperative Resource Approaches
   1). jurisdictions
   2). land ownership
   3). land protection strategies
      a). fee
      b). less than fee
      c). direct ownership
D. Resource Management Objectives
   1) geographic planning units
   2) land classification
   3) land ownership

III. WATER RESOURCE MANAGEMENT

A. Water Resource Management Plan
B. Objectives of Water Resource Program
   1) establishment of monitoring program
   2) determine impact of development actions
      a) resources
      b) recreation
   3) determine extent of water quality and quantity degradation
   4) monitor effects of visitor use on water resources
   5) classify water resources for present and proposed uses and recreation potential
C. Water Resources Issues and Concerns
   1) water quality degradation
   2) water quantity impacts
   3) mitigation of external/internal impacts associated with development
   4) sewage impacts
   5) floodplain alterations
   6) sedimentation
   7) acid rain

IV. SANTA MONICA MOUNTAINS WATER RESOURCE PROGRAM

A. Acquisition of Base Line Data
   1) NPS
   2) Federal
   3) State
   4) County/Local

B. Cooperative USGS Water Resources Program
   1) Water Quality Monitoring (seasonal variance)
      a. monitoring sites
         1). undisturbed watersheds
         2). moderately impacted watersheds
         3). developed watersheds
      b. parameters monitored
         1). physical
         2). biological
      c. detection of impacted surface waters
         1). toxic heavy metals
         2). pesticides
         3). chemical shifts in constituents associated with development actions
   2. Water Quantity
      a. discharge monitoring
      b. integration with long-term monitoring programs
      c. network design
      d. crest/stage gauges

C. NPS MONITORING ACTIVITIES
   1. Bacteriological (fecal coliform) Contamination
   2. Hydrologic Inputs
   3. Physical
      a. specific conductance
      b. pH
      c. temperature
   4. Stream Discharge

V. FUTURE WATER RESOURCE ACTIVITIES and PROGRAM DEVELOPMENT

WATER RESOURCES RESEARCH

Jill Baron

A. Riparian/Hydrological Studies and Assessments

B. Pollutant Monitoring Techniques

   1. Water Quality in Parks (Bio indicators)

   2. Water Quality in Parks (Toxic contaminant fate analysis)

C. Methods for Assessing Deterioration of Park Water Resources

   1. Application of Modeling to Park Water Resource Problems

   2. Techniques for Analyzing Ground Water Parameters

   3. Application of State of the Art Techniques (Computer analysis and multiobjective analysis)

D. Geothermal Studies

E. Acid Precipitation Research and Monitoring