Introduction

Environmental engineering is the development and implementation of processes for the supply of water, disposal of waste, and the control of pollution of all kinds.

Environmental engineering protects public health by prevention of disease transmission; it protects public resources ("the environment") by averting contamination and degradation of air, water & land resources.

Typical "projects"

Capture, treatment, and distribution of drinking water
Collection, treatment, and discharge of waste water
Characterization, control, and reduction of air pollutants
Characterization, control, and reduction of noise pollution
Characterization, control, and reduction of thermal pollution
Collection, treatment, and storage of solid waste
Collection, treatment, and storage of hazardous waste
Restoration (clean-up) of contaminated soil, water, and air
Preparation, monitoring, and compliance of discharge permits
Assessment, audits, and impact studies

"Mass"	"Energy"
• chemical pollution of soil, air, water	• thermal pollution of soil, air, water
	• noise pollution of air, soil water

History of Environmental Engineering in USA

1830's USA design of water supply systems – private water companies replaced by public water systems

1820's — storm sewer design
sanitary sewer systems — separate systems
combined systems

1800 - 1850 "hydraulic engineering"

1850 — water pollution by sanitary seners
— new raw watr sources by moving intake
outfalls

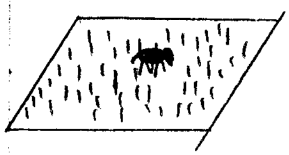
U.S. Civil War

1870 — sanitary chemistry
1890 — sand filtration; trickling filters — <u>treatment</u>
1891 — epidimology (statistical study of disease outbreak) typhoid
1893 — sedimentation <u>treatment</u>
1900 — activated sludge <u>treatment</u>
1901 — U.S. PHS Hygenic Laboratory (evolved into CDC)
1913 — U.S. PHS Cincinnati Laboratory (oxygen demanding waste etc.)
WWI
1918 — activated sludge, Houston TX (first large scale implementation)
1923 — chlorine disinfection
WWII
1944 — Donora, Pennsylvania — first major air pollution event in USA
Korea Conflict
1948 — Water Pollution Control Act (WPCA); 1955 Air Pollution Control Act
1964 — "Silent Spring" Rachaal Carson
U.S. Troops in Vietnam
1969 — National Environmental Protection Act (NEPA)
1970 — Earth Day
1970 — Environmental Protection Agency (EPA)
1972 — Clean Water Act (CWA)
1976 — Resource Conservation and Recovery Act (RCRA)
1980 — Comprehensive Environmental Response, Compensation & Liability Act (CERCL
1990 — Clean Air Act Amendments (CAA)

Legislation

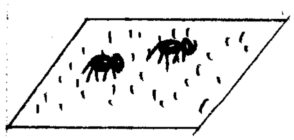
Why is legislation so important in environmental engineering? Because the environment is a shared resource.

Concept of "commons"



"common" pasture – open to all

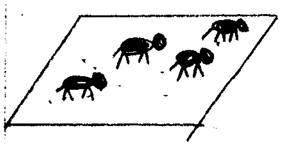
"rational" herdsman. • since proceeds from sale of animal go to owner, adding another cow add a positive utility of almost +1



• since all herdsmen share in reduced grass cover equally, adding another cow produces a negative utility as a fraction of −1

Net utility of adding one cow: $+1 - f = 1 - f > 0$

∴ Rational choice is to add an animal.



But **every** user reaches same conclusion – eventually the pasture is so overgrazed that it cannot support any cattle.

This "incentive" to oversubscribe to a resource is called the "tragedy of the commons" – it is fundamental to understanding why environmental laws exist. Water, air & soil are to some extent shared (common) resources that must be managed so there will be enough resource (environmental quality) for all the cows (people) to survive.

Legislation "allocates" resources by various methods: auction (wealth); permits (merit & wealth); lottery (chance); first-come, first-served etc.

Development of legislation

U.S. congress writes laws.

Lawmakers must percieve that environmental regulation benefits society and their re-election campain.

Once passed into law, congress directs the appropriate agency to develop and publish regulations to Implement the laws.

Laws are typically reactive: Hazardous materials in 1940's were not closely regulated until the 1970's when their effects became apparent.

U.S. EPA

Created in 1970. Multiple missions: establish standards protective of the environment and consistent with U.S. goals; conduct research on pollutant effects and treatments; provide financial & technical assistance; assist the CEQ in recomendations to president regarding environmental policy.

State Agencies

Modeled on EPA. Enforces state laws. Enforces federal laws if state laws are equal to or more strict than federal laws.

Enforcement methods

Various. Majority is self-reporting. Different from governmental monitoring and risk of aprehension. Primarily economic reasons for this model. Governmental & citizen monitoring does have impact. and helps ensure compliance.

Regulation Methods

Effluent standard | Receiving medium standard

Effluent - based on quality of material released into environment (end-of-pipe). Easy to monitor. Consistent: polluter must comply with specific allowable levels of pollutants masses & volumes

Receiving medium - based on quality of medium receiving pollutants. A discharger can release any amount that does not cause receiving medium to drop below certain established minimums

Allows for flexible discharge patterns to take advantage of natural variations in assimilative capacity.

Enforcement is difficult. Dischargers must have highly trained personnel and effective real-time monitoring to take advantage of this type of standard

In most cases, effluent standards are the norm for polluters. Receiving medium standards are specified and monitored to determine if unregulated pollution is in progress.