APES Ch. 19 Notes ~ Hazardous Chemicals: Pollution and Prevention

19.1 Notes

I. Toxicology and Chemical Hazards

A. Background info.

1) **toxicology**—the study of the harmful effects of substances on humans or animals and the environment
2) **carcinogenic—***causing cancer*
3) *NTP: National Toxicology Program* http://ntp-server.niehs.nih.gov
   a) part of the Department of Health and Human Services
   b) develops and carries out tests to predict whether a chemical will cause harm to humans
4) IRIS: Integrated Risk Information System www.epa.gov/iris/intro.htm

B. Dose Response and Threshold

1) **dose response**—*the relationship between the amount of exposure (dose) to a substance and the resulting changes in body function or health (response)*
2) **exposure**—*contact with a substance by swallowing, breathing, or touching the skin or eyes*
   a) **acute**—*occurring over a short time*
      - *acute exposure*—contact with a substance that occurs once or for only a short time (up to 14 days)
   b) *intermediate duration exposure*—contact with a substance that occurs for more than 14 days and less than a year
   c) **chronic**—*occurring over a long time*
      - *chronic exposure*—contact with a substance that occurs over a long time (more than 1 year)
3) threshold
   a) **threshold**—the dose or exposure level below which a significant adverse effect is not expected
   b) **threshold level**—time-weighted average pollutant concentration values, *exposure beyond which is likely to adversely affect human health*

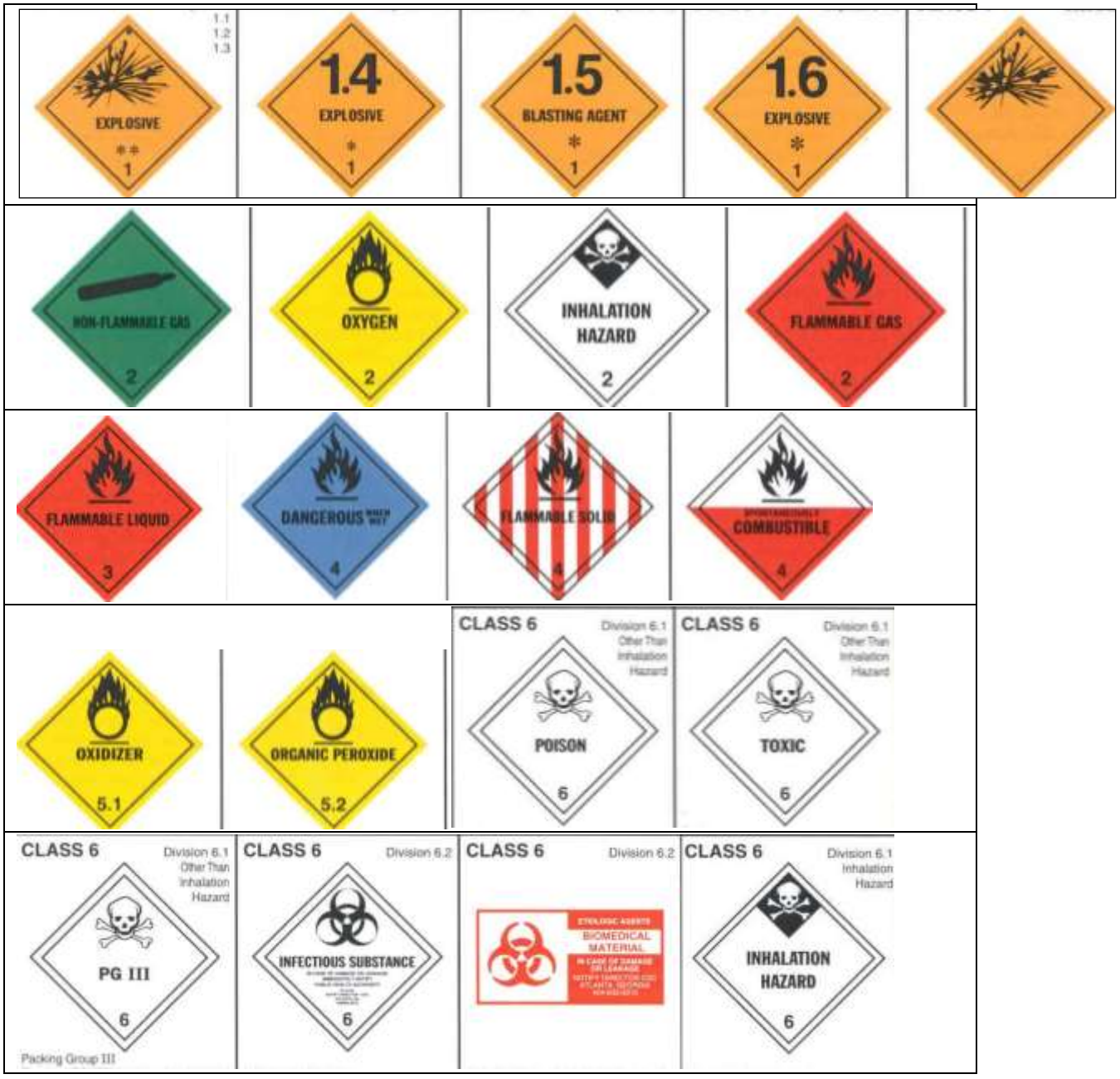
C. The Nature of Chemical Hazards: HAZMATs

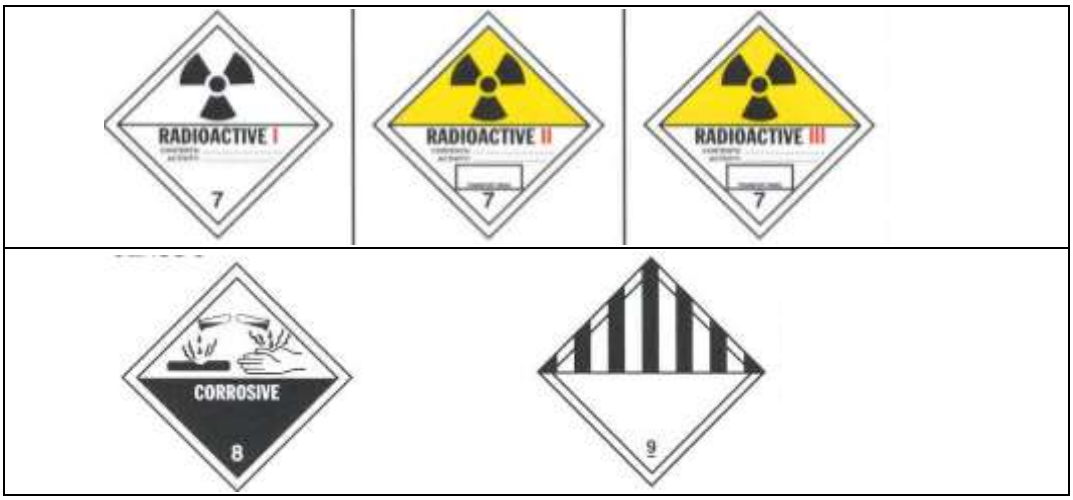
1) **HAZMAT—hazardous material**
2) properties of classification
   a) **ignitability—***catch fire easily*
   b) **corrosivity—***eat away skin, storage tanks, or equipment*
   c) **reactivity—***chemically unstable; potentially explosive or fume-producing*
   d) **toxicity—***poisonous when consumed*
3) nine classifications from http://safety.science.tamu.edu/dot.html

- Class 1: *Explosives*—mass explosion hazards, projection hazards, fire hazards, no significant blast hazards, very insensitive explosives, extremely insensitive explosive articles
- Class 2: *Gases*—flammable, nonflammable, poisonous, corrosive
- Class 3: *Flammable liquids*

- Class 4: *Flammable solids; spontaneously combustible materials; and materials that are dangerous when wet*
- Class 5: *Oxidizers and organic peroxides*
- Class 6: *Poisons and etiologic (infectious) materials*
- Class 7: *Radioactive materials*
- Class 8: *Corrosives*
- Class 9: *Miscellaneous*
- *ORM-D: Other regulated material (*presents a limited hazard during transportation due to its form, quantity and packaging)

PLACARDS (SIGNS) USED FOR HAZMATS from www.fau.edu/divdept/envhs/DOT.html





D. Sources of Chemicals Entering the Environment
   1) **total product life cycle**—the existence of the product from its raw materials stage to its disposal
   2) *methods of introduction into the environment*
      a) *accidental spills, explosions, etc.*
      b) *mining process*
      c) *refining process*
      d) *deliberate application: example— pesticides and fertilizers*
      e) *chemical and industrial byproducts*
      f) *evaporation of volatile materials*
      g) *particulate matter from combustion*
      h) *landfill leachate*
      i) *businesses like drycleaners and gas stations*
      j) *household chemicals* (**HHW—household hazardous waste**)

General categories of household hazardous waste (HHW) from http://muextension.missouri.edu/xplor/wasteman/wm6003.htm
1) *Automotive products*
Examples: gasoline, motor oil, antifreeze, windshield wiper fluid, car wax and cleaners, lead-acid batteries, brake fluid, transmission fluid
2) *Home improvement products*
Examples: paint, varnish, stain, paint thinner, paint stripper, caulk, adhesives
3) *Pesticides*
Examples: insecticide and insect repellent, weed killer, rat and mouse poison, pet spray and dip, flea collars, mothballs, disinfectant, wood preservative
4) *Household cleaners*
Examples: furniture polish and wax, drain opener, oven cleaner, tub and tile cleaner, toilet bowl cleaner, spot remover, bleach, ammonia
5) Other
Examples: household batteries, cosmetics, pool chemicals, shoe polish, lighter fluid, prescription medicines, arts and crafts materials

3) **Toxics Release Inventory (TRI)** http://www.epa.gov/tri/

a) definition

"*The Toxics Release Inventory (TRI) is a publicly available EPA database that contains information on toxic chemical releases and other waste management activities reported annually by certain covered industry groups as well as federal facilities.* This inventory was established under the **Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA**) and expanded by the Pollution Prevention Act of 1990."

b) Toxics Release Inventory Reporting Categories
from http://www.scorecard.org/general/tri/tri_desc.html

Air Releases Stack Air Releases Fugitive Air Releases Water Releases Land Releases RCRA Subtitle C Landfills Other On-site Landfills Land Treatment / Application Farming Surface Impoundments Other Land Disposal	Underground Injection Class I Injection Wells Injection Wells Class II-V Total Environmental Releases Total Off-Site Transfers Publicly Owned Treatment Works Disposal Energy Recovery Recycling Treatment	Total Production-Related Waste Released On- Off-Site Energy Recovery On-Site Energy Recovery Off-Site Recycling On-Site Recycling Off-Site Treated On-Site Treated Off-Site

E. The Threat from Toxic Chemicals

1) heavy metals

Aluminum, Al	Antimony, Sb	*Arsenic, As*	Beryllium, Be
Cadmium, Cd	*Chromium, Cr*	Cobalt, Co	*Copper, Cu*
Iron, Fe	*Lead, Pb*	Manganese, Mn	*Mercury, Hg*
Molybdenum, Mo	Nickel, Ni	Selenium, Se	Silver, Ag
Tin, Sn	Vanadium, V	*Zinc, Zn*	

a) industrial use
b) some used in pesticides
c) some used in paints, inks, and dyes
d) may cause birth defects, retardation, and other harmful effects

2) organic compounds

a) **POP—persistent organic pollutants**

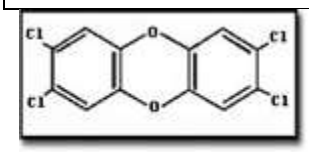
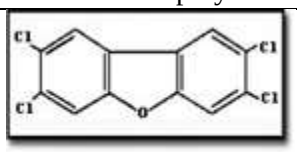
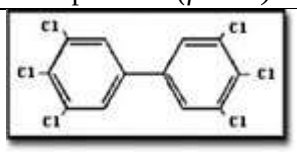
- definition from the EPA:

"*POPs are a set of chemicals that are toxic, persist in the environment for long periods of time, and biomagnify as they move up through the food chain.* POPs have been linked to adverse effects on human health and animals, such as *cancer, damage to the nervous system, reproductive disorders, and disruption of the immune system*. Because *they circulate globally via the atmosphere, oceans, and other pathways*, POPs released in one part of the world can travel to regions far from their source of origin."

- examples of POPs from the EPA:

The "Dirty Dozen"	([1] Pesticide	[2] Industrial Chemical	[3] Byproduct)
aldrin[1]	*chlordane*[1]	*dieldrin*[1]	
hexachlorobenzene[1,2,3]	*mirex*[1]	polychlorinated dibenzo-p-dioxins *(dioxins)*[3]	
DDT[1]	*toxaphene*[1]	*polychlorinated biphenyls (PCBs)*[2,3]	

endrin[1] *heptachlor*[1] polychlorinated dibenzo-p-furans *(furans)*[3]

2,3,7,8-Tetrachlorodibenzo-p-dioxin (*TCDD)*

2,3,7,8-Tetrachlorodibenzofuran 3,3',4,4',5,5'-Hexachlorobiphenyl

b) **dioxins**

From the EPA:

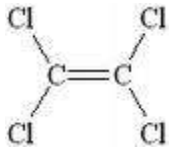
" '*Dioxins*' refers to a group of chemical compounds that share certain chemical structures and biological characteristics. Several hundred of these compounds exist and are *members of three closely related families: the chlorinated dibenzo-p-dioxins (CDDs), chlorinated dibenzofurans (CDFs) and certain polychlorinated biphenyls (PCBs)*. Sometimes the term dioxin is also used to refer to the most studied and one of the most toxic dioxins, 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). CDDs and CDFs are not created intentionally, but are produced inadvertently by a number of human activities. Natural processes also produce CDDs and CDFs. PCBs are manufactured products, but they are no longer produced in the United States…

It is important to note that dioxin levels in the United States environment have been declining for the last 30 years due to reductions in [human]made sources. However, dioxins break down so slowly that some of the dioxins from past releases will still be in the environment many years from now."

c) **halogenated hydrocarbons**

(especially **chlorinated hydrocarbons**)

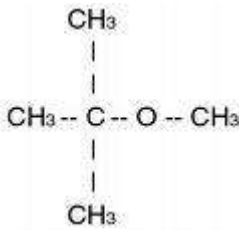
- *halogens: F, Cl, Br, I, At (astatine)*
- see the "dirty dozen" for examples
- specific textbook examples
  - PERC (perchloroethylene)



PERC

http://www.dhs.ca.gov/ohb/HESIS/perc.htm

  - MTBE (methyl tert-butyl ether)



MTBE

F. Involvement with food chains

1) **bioaccumulation**—*increase in concentration of a pollutant from the environment to the first organism in a food chain*
2) **biomagnification**—*increase in concentration of a pollutant from one link in a food chain to another*
3) examples
   - *DDT* (see Ch. 16 notes)
   - **methylmercury (CH_3Hg^+ ion)** poisoning in Minamata, Japan
   - **Love Canal (Niagra Falls, NY)**

- Pre-1910 Wm. T. Love planned to build a small three-block community
- 1920 Love Canal designated a municipal and industrial dumping site
- 1942-1953 Hooker Chemicals and Plastics dumped chemical wastes into the love canal
- 1953 Hooker Chemical filled the canal and sold it to the city for $1.00, warning them not to disturb the clay cap covering the

wastes

- Late 1950s Area developed with 100 homes and a school
- ~1978 Chemical leaching observed; development of the area causes a "bathtub" effect that released harmful contaminates.
- Many health problems resulted: skin lesions, birth defects, etc.
- The company was sued for damages

19.2 Notes

II. History of Mismanagement

A. Legislation

1) **Clean Water Act (CWA)**

from the EPA: "*The Act made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions*."

2) **Clean Air Act (CAA)** deals with air pollution prevention and control

3) Conclusion: land disposal was the easier option, and was not regulated in the 1970s as it is now.

B. *methods of land disposal*

1) **deep-well injection**

(info from http://www.frtr.gov/matrix2/section4/4-54.html)

a) synonyms: subsurface injection, underground injection, Class I injection wells

"Deep well injection is a *liquid waste disposal technology*. This alternative uses injection wells to place treated or untreated liquid waste into geologic formations that have no potential to allow migration of contaminants into potential potable water aquifers."

b) target chemicals: *VOCs (volatile organic chemicals), SVOCs (semivolatile organic compounds)*, fuels, explosives, pesticides

c) setup

"A typical injection well consists of *concentric pipes*, which extend several thousand feet down from the surface level into highly saline, permeable injection zones that are confined vertically by impermeable strata. *The outermost pipe or surface casing, extends below the base of any underground sources of drinking water (USDW) and is cemented back to the surface to prevent contamination of the USDW*. Directly inside the surface casing is a long string casing that extends to and sometimes into the injection zone. This casing is filled in with cement all the way back to the surface in order to seal off the injected waste from the formations above the injection zone back to the surface. The casing provides a seal between the wastes in the injection zone and the upper formations. The waste is injected through the injection tubing inside the long string casing either through perforations in the long string or in the open hole below the bottom of the long string. The space between the string casing and the injection tube, called the annulus, is filled with an inert, pressurized fluid, and is sealed at the bottom by a removable packer preventing injected wastewater from backing up into the annulus."

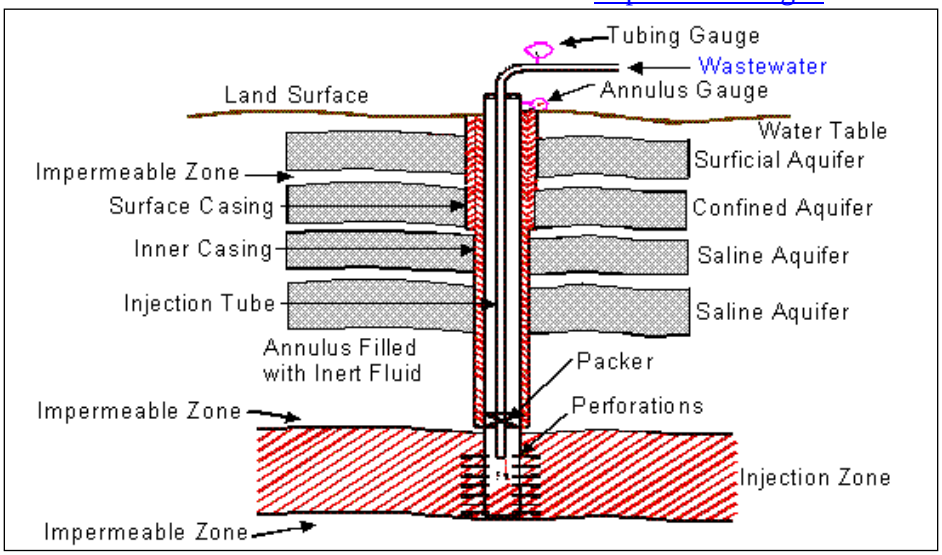
d) limitations

- possibility of seismic activity
- injected wastes must be compatible with the injection well system
- high concentrations of suspended solids (typically >2 ppm) can lead to blockage
- corrosion of the injection well components

- high iron concentrations may result in fouling when conditions convert soluble to insoluble products
- rapid population growth of indigenous or injected bacteria from organic carbon
- waste streams saturated with organic contaminants may require pretreatment
- extensive assessments prior to approval

e) locations: Louisiana, Texas, Ohio, Oklahoma

DEEP-WELL INJECTION from http://www.frtr.gov



f) *classes of injection wells* www.epa.gov

- *"Class I wells* are technologically sophisticated and inject hazardous and non-hazardous wastes below the lowermost underground source of drinking water (USDW).
- *Class II wells* are oil and gas production brine disposal and other related wells.
- *Class III wells* are wells that inject super-heated steam, water, or other fluids into formations in order to extract minerals. More than 50 percent of the salt and 80 percent of the uranium extraction in the U.S. is produced this way.
- *Class IV* wells inject hazardous or radioactive wastes into or above underground sources of drinking water. These wells are banned under the UIC program because they directly threaten public health.
- *Class V* wells are injection wells that are not included in the other classes. Some Class V wells are technologically advanced wastewater disposal systems used by industry, but most are "low-tech" wells, such as septic systems and cesspools. Generally, they are shallow and depend upon gravity to drain or "inject" liquid waste into the ground above or into underground sources of drinking water. Their simple construction provides little or no protection against possible ground water contamination, so it is important to control what goes into them."

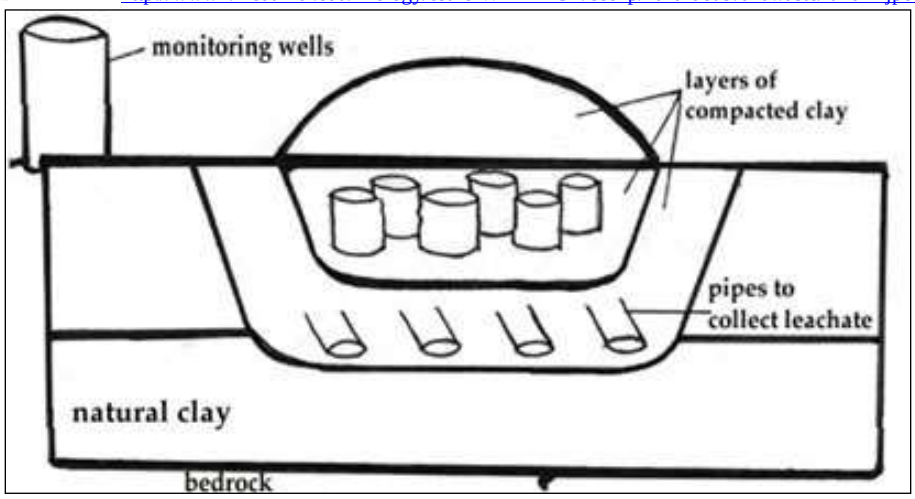
2) **surface impoundments**
http://www.epa.gov/superfund/training/hrstrain/htmain/glossmz.htm

"*A topographic depression, excavation, or diked area, primarily formed from earthen materials* (lined or unlined) and designed to hold accumulated liquid wastes, wastes containing free liquids, or sludges that were not backfilled or otherwise covered during periods of deposition… structures

that may be more specifically described as *lagoon, pond, aeration pit, settling pond, tailings pond, sludge pit,* etc."

3) **secure landfills**
   a) four critical elements:
      - stable hydrogeologic site
      - bottom liner
        - two impermeable liners: often a clay liner backed up by a plastic liner
        - can be clay, plastic, or composite
        - state-of-the-art plastic (HDPE) landfill liners are 1/10 of an inch thick!
      - leachate collection system
      - cover or cap (clay dike and clay cap)
   b) at least 10 ft. from bottom liner to water table
   c) careful groundwater monitoring by wells

SECURE LENDFILL http://www2.mcdaniel.edu/Biology/estherWEBPAGE/ccehp/hazardous%20waste/landfilljpeffinal



4) **midnight dumping** and **orphan sites**
   a) how to curtail **midnight dumping** (from the EPA)
      - cleanup efforts
      - community outreach and involvement
      - targeted enforcement
      - tracking and evaluation
   b) **orphan sites** from www.deq.state.or.us
      - definition

"Orphans are sites contaminated by a release of hazardous substances that poses serious threats to human health or the environment, where the parties responsible for the contamination are either unknown -- or unable or unwilling -- to pay for needed remedial actions."

- typical orphan sites

"A typical Orphan Site is a property with soil and/or groundwater contamination, where the party responsible for the contamination has gone out of business, and may also have left behind hazardous substances in tanks or drums. Sometimes a company is still operating, but is too small to afford the cleanup. Another type of orphan project is an areawide site where drinking-water wells have been contaminated, but the source of the contamination is unknown."

C. scope of the mismanagement problem
    1) cleaning up the messes, especially those which compromise water quality
    2) regulation of waste handling and disposal
    3) future solutions, such as source reduction

19.3 Notes

III. Cleaning up the mess
A. assuring safe drinking water
1) **(SDWA) Safe Drinking Water Act of 1974**
a) protection of drinking water supplied by public water systems (those serving more than 25 people)
b) establishes primary regulations for the protection of the public health and secondary regulations relating to the taste, odor, and appearance of drinking water
2) EPA-listed contaminants in water: *Microorganisms, Disinfectants, Disinfection Byproducts, Inorganic Chemicals, Organic Chemicals, Radionuclides*

B. **groundwater remediation**
1) *In Situ (in place) Physical/Chemical Treatment*

Air sparging (dry distillation)	In situ flushing
Blast-enhanced fracturing	In situ stabilization/solidification
Directional wells	Permeable reactive barriers
Hydraulic and pneumatic fracturing	Thermal enhancements
Ground-water recirculation wells	Treatment train

2) *Biological Treatment*
a) bioslurping
b) intrinsic bioremediation
c) monitored natural attenuation
d) phytoremediation
e) treatment train
3) *Electrokinetics*—a process in which a low-voltage direct-current electric field is applied across a section of contaminated soil

C. Superfund for toxic sites
a) **The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)**, commonly known as **Superfund**, was enacted by Congress on December 11, *1980*.
b) provisions
a) *"established prohibitions & requirements concerning closed & abandoned hazardous waste sites*
b) *provided for liability of persons responsible for releases of hazardous waste at these sites*
c) *established a trust fund to provide for cleanup when no responsible party could be identified*"

3) *Superfund sites*—areas of high, propriety-level pollution
   a) old factories where chemicals were dumped on the ground
   b) landfills where HAZMATs were dumped
   c) remote places where people secretly dumped HAZMATs
   d) old mines
   e) search for sites: http://cfpub.epa.gov/supercpad/cursites/srchsites.cfm

From http://scorecard.org/env-releases/land/us.tcl#trends and http://www.epa.gov/region4/waste/sf/state/fl.html :
As of March 2014: **1322 Superfund sites across the U.S. on the National Priority List;**
1 in Pinellas County listed as a priority on the final NPL (presently being cleaned up)

EPA's RCRA/Superfund Hotline (800) 424-9346

4) setting priorities
   a) *identify sites*
      - test groundwater and waste present
   b) *take immediate protective measures, if necessary*
      - isolation through recapping, installing concrete dikes, or digging trenches
   c) most threatening sites are placed on the **NPL** (**National Priorities List**)

5) cleanup technology
   a) soil incineration (*kiln heating*) to burn off volatile chemicals
   b) flushing with water/detergent through injection wells
   c) **bioremediation—***oxygen and aerobic bacteria are injected into the contaminated areas*
      - *benefits* of bioremediation
      - *treating contamination in place*
      - *harnessing natural processes*
      - *reducing environmental stress*
   d) **phytoremediation**

From http://ewr.cee.vt.edu/environmental/teach/gwprimer/phyto/phyto.html#plant
"Phytoremediation uses one basic concept: *the plant takes the pollutant through the roots. The pollutant can be stored in the plant (phytoextraction), volatized by the plant (phytovolatization), metabolized by the plant (phytodegradation),* or any combination...
…"Certain plant species—known as *metal hyperaccumulators*—have the ability to extract elements from the soil and concentrate them in the easily harvested plant stems, shoots, and leaves. These plant tissues can be collected, reduced in volume, and stored for later use."

- *prevent erosion*
- *stabilize the soil*
- *extraction of heavy metals through the roots of plants*

Table 1. Partial listing of plants and chemicals they can remediate

Plant	Chemicals
1) Arabidopsis	Mercury
2) Bladder campion	Zinc, Copper

3) *Brassica* family (Indian Mustard & Broccoli)	Selenium, Sulfur, Lead, Cadmium, Chromium, Nickel, Zinc, Copper, Cesium, Strontium
4) *Buxaceae* (boxwood)	Nickel
5) *Compositae* family	Cesium, Strontium
6) *Euphorbiaceae*	Nickel
7) Tomato plant	Lead, Zinc, Copper
8) Trees in the *Populus* genus (Poplar, Cottonwood)	Pesticides, Atrazine, Trichloroethylene (TCE), Carbon tetrachloride, Nitrogen compounds, 2,4,6-trinitrotoluene (TNT), hexahydro-1,3,5-trinitro-1,3,5 triazine (RDX)
9) Pennycress	Zinc, Cadmium
10) Sunflower	Cesium, Strontium, Uranium
11) genus *Lemna* (Duckweed)	Explosives wastes
12) Parrot feather	Explosives wastes
13) Pondweed, arrowroot, coontail	TNT, RDX
14) Perennial rye grass	Polychlorinatedphenyls (PCP's), polyaromatichydrocarbons (PAH's)

6) evaluating Superfund
   a) superfund reforms page www.epa.gov/superfund/programs/reforms/
   b) three rounds of reforms (1993-1995), addressing the areas of
      - enforcement
      - cleanup
      - risk assessment
      - public involvement
      - environmental justice
      - economic redevelopment
      - innovative technology
      - state and tribal empowerment

from http://www.epa.gov/superfund/programs/reforms/faqs.htm#how

"How have the Superfund Reforms changed the Superfund program?

The Superfund program is fundamentally different as a result of the reforms. Since 1993, when EPA announced the first round of reforms, the program has changed in response to stakeholders' concerns. Through the commitment of EPA, State and Tribal site managers, other federal agencies, private sector representatives, and involved communities, EPA has achieved real results in protecting public health and the environment while experimenting with and instituting changes to the cleanup process. EPA's cleanups address real threats to public health and the environment and, where possible, return sites to productive reuse. The reforms are now integrated into the base program, resulting in a faster, fairer, and more efficient Superfund.

   c) *NPL Statuses:*
      - *Currently on the Final NPL*
      - *Deleted from the Final NPL*
      - *Proposed for NPL*

7) **Brownfields**

From http://www.epa.gov/swerosps/bf/

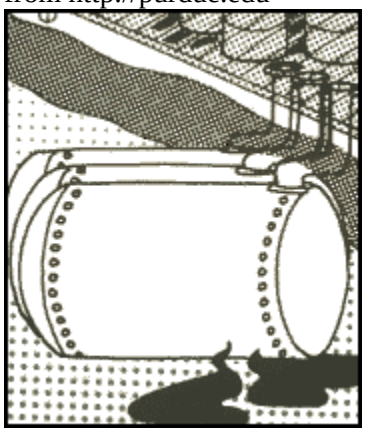
"A brownfield is defined as '*a real property where expansion or redevelopment is complicated by actual or perceived environmental contamination.*' Every city and county, rural and urban, has vacant, underused, and potentially contaminated properties. Many programs are available to assist with the redevelopment of such properties… Cleaning up and reinvesting in

these properties takes development pressures off of undeveloped, open land, and both improves and protects the environment…"

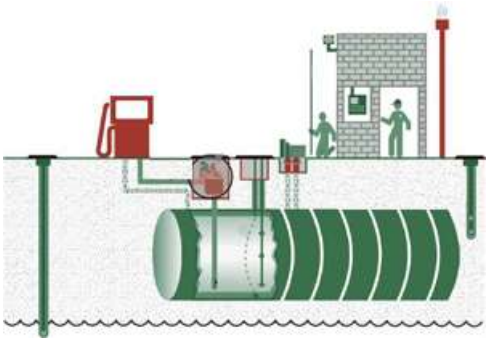
a) provides incentives for developers
b) rehabilitates unused, unsightly facilities— often in low-income areas

8) Leaking Underground Storage Tanks
   a) EPA Office of Underground Storage Tanks: http://www.epa.gov/OUST/
   b) UST regulations are part of RCRA
   c) Energy Policy Act of 2005 UST provisions: http://www.epa.gov/OUST/fedlaws/epact_05.htm

LEAKING TANK from http://purdue.edu



UST from www.nwetc.org



19.4 Notes

IV. Managing Current Hazardous Wastes
   A. The **Clean Air Act (CAA)** and **Clean Water Act (CWA)** – see 19.2 notes
      1) Clean Air Act
         a) Background info:

The Clean Air Act (CAA) of 1970 *requires the EPA to develop and enforce regulations to protect the general public from exposure to airborne contaminants* that are known to be hazardous to human health. Title I of the 1990 CAA Amendments had the EPA establish **New Source Performance Standards (NSPS)** and **National Emissions Standards for Hazardous Air Pollutants (NESHAP)** to protect the public. The Clean Air Act was the first U.S. major environmental law to include a provision for citizen suits.

         b) About NSPS:

From http://www.cdphe.state.co.us/ap/nsps.html

"New Source Performance Standards (NSPS) are federal standards adopted by the U.S. EPA to regulate air emissions by many types of industrial facilities. They can be found in 40 Code of Federal Regulations (CFR) Part 60.

All industries subject to NSPS must meet certain general requirements, such as monitoring and record keeping. In addition, certain specific requirements apply to each type of industry subject to NSPS. Each NSPS defines the facilities subject to it and prescribes emission limits for specified pollutants, compliance requirements, monitoring requirements, and test methods and

procedures. Air emission permits issued by the State typically reference NSPS requirements where applicable to the source."

c) Selected NESHAP – extensive list at http://www.epa.gov/ttn/atw/mactfnlalph.html

2) Clean Water Act: People cannot discharge any pollutant from a point source into navigable waters, unless a **discharge permit** or **National Pollutant Discharge Elimination System (NPDES) permit** is granted.

B. **Resource Conservation and Recovery Act (RCRA) of 1976**

From http://www.epa.gov/lawsregs/laws/rcra.html

1) background info

"**RCRA** *gave EPA the authority to control* hazardous waste from the 'cradle-to-grave.' This includes the *generation, transportation, treatment, storage, and disposal of hazardous waste*. RCRA also set forth a framework for the management of non-hazardous wastes. The 1986 amendments to RCRA enabled EPA to address environmental problems that could result from underground tanks storing petroleum and other hazardous substances. RCRA focuses only on active and future facilities and does not address abandoned or historical sites (see CERCLA)."

2) additional RCRA requirements:

- *Land Disposal Restrictions (LDRs)*
- *Used Oil Management Standards*
- *Tanks and Containers* used to store hazardous waste with a high volatile organic concentration must meet RCRA emission standards
- *Boilers and Industrial Furnaces (BIFs)* that use or burn fuel containing hazardous waste must comply with strict design and operating standards
- *Transportation of Hazardous Waste* within a facility boundary (e.g., for the sake of consolidation) is exempt from specific RCRA requirements, but must comply with regulations established by the U.S. Department of Transportation under the Hazardous Materials Transportation Act
- *Solid Waste Management* … there is increasing attention being paid to the environmental impacts of industrial solid waste, and an increasing likelihood that RCRA may be amended to address this waste

C. **Federal Hazardous and Solid Waste Amendments (HSWA) of 1984**

1) background info

"**HSWA**—*The Federal Hazardous and Solid Waste Amendments are the 1984 amendments to RCRA that required phasing out land disposal of hazardous waste*. Some of the other mandates of this strict law include increased enforcement authority for EPA, more stringent hazardous waste management standards, and a comprehensive underground storage tank program."

2) "prohibits the continued land disposal of untreated wastes beyond specified dates unless the EPA determines the prohibition of certain disposal methods is not required to protect human health and the environment

3) To continue injecting hazardous wastes under these regulations, operators must

a) treat the wastes below the EPA specified contaminant levels (referred to as treatment standards), or
b) submit a petition demonstrating that there is no migration of hazardous constituents from the injection zone.

D. Reduction of accidents and accidental exposure

1) leaking **underground storage tanks**: **UST** legislation

From http://www.epa.gov/OUST/fedlaws/nrg05_01.htm

"On August 8, 2005, President Bush signed the *Energy Policy Act of 2005*. Title XV, Subtitle B of this act (entitled the *Underground Storage Tank Compliance Act of 2005*) contains amendments to Subtitle I of the Resource Conservation and Recovery Act - the original legislation that created the underground storage tank (UST) program. This new law significantly affects federal and state underground storage tank programs, will require major changes to the programs, and will go a long way toward keeping our nation's land and water safe from underground storage tank releases. Gas station owners and operators, as well as other non-marketers who own underground storage tanks, will be impacted by the changes EPA and states make in their tank programs as a result of the law."

2) **Department of Transportation Regulations (DOT Regs)**
   a) restrict types of containers
   b) regulate packing methods and materials
   c) placards must be displayed (see 19.1 notes)

3) worker protection: **OSHA Act** and "**Right to Know**"
   a) **Occupational Safety & Health Act of 1970 (OSH or OSHA Act)**
   b) *OSHA: Occupational Safety & Health Administration*

From http://www.osha.gov

"*OSHA's mission is to assure the safety and health of America's workers by setting and enforcing standards; providing training, outreach, and education; establishing partnerships; and encouraging continual improvement in workplace safety and health.*

OSHA and its state partners have approximately 2100 inspectors, plus complaint discrimination investigators, engineers, physicians, educators, standards writers, and other technical and support personnel spread over more than 200 offices throughout the country. This staff establishes protective standards, enforces those standards, and reaches out to employers and employees through technical assistance and consultation programs."

   c) "**Worker's right to know**" example: every year, school faculty and staff members view a mandatory video about chemicals; lists are available to check chemicals on campus
   d) **MSDS (material safety data sheets)**

- SECTION I – IDENTITY OF THE PRODUCT, EMERGENCY TELEPHONE NUMBER, INFORMATION TELEPHONE NUMBER, NAME OF THE MANUFACTURER OR IMPORTER, ADDRESS OF THE MANUFACTURER, DATE PREPARED, SIGNATURE OF THE PREPARER (OPTIONAL).
- SECTION II – HAZARDOUS INGREDIENTS/IDENTITY INFORMATION
- SECTION III – PHYSICAL/CHEMICAL CHARACTERISTICS
- SECTION IV – FIRE AND EXPLOSION HAZARD DATA
- SECTION V – REACTIVITY DATA
- SECTION VI – HEALTH HAZARD DATA
- SECTION VII – PRECAUTIONS FOR SAFE HANDLING AND USE
- SECTION VIII – CONTROL MEASURES

4) Community Protection and Emergency Preparedness (from the EPA)

a) **SARA** overview

"The **Superfund Amendments and Reauthorization Act (SARA)** amended the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) on October 17, 1986…

- *stressed the importance of permanent remedies and innovative treatment technologies in cleaning up hazardous waste sites*
- required Superfund actions to consider the standards and requirements found in other State and Federal environmental laws and regulations
- provided new enforcement authorities and settlement tools
- increased State involvement in every phase of the Superfund program
- increased the focus on human health problems posed by hazardous waste sites
- encouraged greater citizen participation in making decisions on how sites should be cleaned
- increased the size of the trust fund to $8.5 billion"

b) **SARA, Title III: The Emergency Planning and Community Right-to-Know Act (EPCRA)**

From http://www.michigan.gov/deq/0,1607,7-135-3307_3667_4137-11426--,00.html

- Why it was established

"In response to continuing community concern regarding hazardous materials and chemical release tragedies, a reauthorization and expansion of Superfund was signed into law in 1986. It is known as the *Superfund Amendments and Reauthorization Act (SARA)*…"

- What it does

"SARA Title III *establishes requirements for* Federal, State and local governments, Indian Tribes, and industry regarding *emergency planning and 'Community Right-to-Know' reporting on hazardous and toxic chemicals*. The Community Right-to-Know provisions help increase the public's knowledge and access to information on chemicals at individual facilities, their uses, and releases into the environment. States and communities, working with facilities, can use the information to improve chemical safety and protect public health and the environment."

- Four major components:
  - *Emergency planning*
  - *Emergency release notification*
  - *Hazardous chemical inventory*
  - *Toxic chemical release inventory*

c) **Toxic Substances Control Act of 1976 (TSCA)**

From http://www.epa.gov/lawsregs/laws/tsca.html

"The Toxic Substances Control Act (TSCA) of 1976 was enacted by Congress to give EPA the ability to *track the 75,000 industrial chemicals currently produced or imported into the United States. EPA repeatedly screens these chemicals and can require reporting or testing of those that may pose an environmental or human-health hazard*. EPA can ban the manufacture and import of those chemicals that pose an unreasonable risk. Also, EPA has mechanisms in place to track the thousands of new chemicals that industry develops each year with either

unknown or dangerous characteristics. EPA then can control these chemicals as necessary to protect human health and the environment."

19.5 Notes

V. Broader Issues

A. Environmental Justice and Hazardous Wastes

1) Areas of concern:

a) legally permitted discharge

b) < 100 kg HAZMAT / month = company exemptions

c) disposal of inappropriate trash in regular landfills (pesticides, paints, some batteries, etc.)

d) "**midnight dumping**"

2) **Environmental Justice (EJ)**

from http://www.epa.gov/compliance/environmentaljustice/

"Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies… It will be achieved when everyone enjoys the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work." Fair treatment = no one group should bear a disproportionate amount of negative environmental impact.

4) Basel Convention

From http://www.basel.int/

"The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal is the most comprehensive global environmental agreement on hazardous and other wastes. The Convention has 169 Parties and aims to protect human health and the environment against the adverse effects resulting from the generation, management, transboundary movements and disposal of hazardous and other wastes. The Basel Convention came into force in 1992."

B. Pollution prevention for a sustainable society:
getting citizens, businesses, and government working together responsibly

1) **pollution control**

a) air, land, water pollution

b) filtration, chemical treatment, air filters, water purifiers, etc.

2) **pollution avoidance**

a) *changing the production process*

- better materials management, less waste
- minimizing or elimination of pollution

b) *substitution of nonhazardous materials for HAZMATs*

- **wet cleaning** vs. using organic solvents

c) *reuse*—clean up and reuse industrial solvents and lubricants

3) *the EPA's P2: pollution prevention (avoidance)*

a) definition from http://www.epa.gov/p2/

"*Pollution Prevention (P2) means 'source reduction,'* as defined under the Pollution Prevention Act, and other practices that reduce or eliminate the creation of pollutants."

b) *Pollution Prevention Act of 1990* Policy:

"The Congress hereby declares it to be the national policy of the United States that pollution should be prevented or reduced at the source whenever feasible; pollution that cannot be prevented should be recycled in an environmentally safe manner, whenever feasible; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner."

4) Responsible Care Program http://www.responsiblecare.org

"*Responsible Care is a global chemical industry performance initiative that is implemented in the United States through the American Chemistry Council*. In the U.S., Responsible Care has resulted in reduced emissions by 75 percent and an employee safety record that is four and a half times better than the average of the U.S. manufacturing sector. Responsible Care helps America's leading chemical companies go above and beyond government requirements and openly communicate their results to the public."

5) *EPA's Design for the Environment (DfE)* http://www.epa.gov/dfe/

"…*Informing businesses in the design or redesign of products and processes that are cleaner, more cost-effective, and safer for workers and the public*. The DfE process promotes *voluntary* environmental improvement by addressing industries' need for key information on how to incorporate environmental concerns into business decisions."

6) **green products**
   a) Products Made with Salvaged, Recycled, or Agricultural Waste Content
   b) Products That Conserve Natural Resources
   c) Products That Avoid Toxic or Other Emissions
   d) Products That Save Energy or Water
   e) Products That Contribute to a Safe, Healthy Built Environment

7) summary of chemical pollution options for sustainability:
   a) *pollution prevention*
   b) *recycling*
   c) *treatment (breaking down)*
   d) *safe disposal*