Water Lesson Plan

1. Definitions and procedures:

• Signal #1: When I ask you a yes or no question, show me thumbs up for yes and thumbs down for no.

Now answering with your thumb, “Does everyone have drinking water? “

I’m going to tell you right up front was my message is,
Catch and store water or any useful energy, material, or information.

• Signal #2: If you want me to repeat certain information, show me this sign. (Circle your hand above your head and tell participants to do it with you.) Questions for clarification are always welcome.

What is my message?
Catch and store water. Everybody jump up and catch water!

My session will cover the hydrological system and the duties or functions of water. My goal it to teach you 1 amazing thing about water, I will ask you at the end and I hope you have at least one amazing new thing to share with me. If you learn an amazing thing will you let me know? Thumbs up for yes.

What is a system?

- energy, mass and information flow among the different elements that compose the system; flows may provide feedback to help control their systems.
- energy, mass and information flow from and to the system via paths or boundaries;
- systems are often composed of entities seeking equilibrium but can exhibit oscillating, chaotic, or exponential behavior.

- a community in an environment and a dynamic and complex whole, interacting as a structured functional unit.

What is hydrology?

Hydrology is the study of the flows and quality of water on Earth.
hydrologic cycle,
water resources and
environmental sustainability.

In Permaculture at the core of everything we design are the 3 ethics. What are they?

Ethics and principles of permaculture apply to water in many ways.
The all 3 ethics: Earth care, People care and Fair share concern water.
The ethic of Earth care values the natural earth, the water, soil, air, minerals and all life.
Water is abundant and has unique properties.

Exists in 3 forms on earth, fluid, solid and gas and is made up of hydrogen and oxygen H2O.

You will hear many things today and I hope if you hear something you question you will research it and if you find out something differs from what I present please share it back to me as feedback-thanks.

71% of earth covered by water. We should call earth Water!
97% of earth water is saltwater.
it is the world's most critical resource.
Fresh water is only 3%

Water is unique, flowing and transforming the earth and life as it moves.
Water is Essential for life, most life is made of 60-70% water, and life began in the sea millions of years before life appeared on land.

Fresh Water is rare, only 3 % of all water, a clear liquid treasure,

The Sustained flow of rivers is truly remarkable, considering that precipitation is an unusual event in most areas of the earth. Localisation of precipitation in space or time is striking,(ie Paris it rains 7% of time, B Mollision)
Few storms last more than a few hours, so that even storm days are mainly rainless. Yet rivers flow throughout the year. The sustaining source of flow is effluent ground water...The amount of soil water is about fifteen the amount in channel storage in rives. (Nace in Chorley, 1969
Of the fresh water, 75% is ice and glaciers,
11% is available ground water* (less than 2500' deep),
14% is deep groundwater and aquifers (2500' to 12,500')

Where is the majority of North America's surface fresh water?
In the Great Lakes

In drinking water the 2Q's are important for life. What are they?
quality - water quality purity of water is required for life,
rain 10x cleaner than ground water,
if its polluted, microbes, chemicals, heavy metals, or other problems you may not be able to use it for all purposes.
Acid rain is a problem for life on earth and in the oceans and can be as low as 2.4pH in some industrial countries like China and Russia and downwind.
Possible to clean water by using multiple filter stages, sand filter with uniform sand size, carbon, uv light, adding amendments to balance pH, etc.

quantity- how many gallons- is enough, you need to design foe a year around supply.
You want to optimize the harvest to supply water for zone one first.
1 gallon per person per day,
3 days without water you would be in serious trouble
Humans need five to 13 gallons of clean water a day for basic needs.
Today an average person's in US hydrological cycle uses 69 gallons of

water inside their home and an equal amount in outside irrigation per day. They return most of the water inside to the sewer system or septic tank, and the outside water would more likely return to the water table.

The ethic of Fairshare, requires using the resource of water fairly, making sure all get what is necessary for life, over 1 billion people now do not have good resource of clean fresh water, 80% off all communicable disease worldwide is caused by water, WHO and by 2025 possibly 50% of population may have water shortage issues and in 50 years a possible fresh water.
When it comes to water, poverty kills.
Since 1992 the UN considers water a product like oil, encouraging it's privatization and commercial development, now large water companies are buying systems all over the world.
Water is the next oil, and the threat of oil issues contribute to the blindness surrounding the water.

Sacristy causes prices to rise, hurt the poor most, water higher price than gas many places already.look at link:
http://www.worldwater.org/conflict/map/

Water Is culturally important. -Understanding water is integral to the whole system of our planet.

Water is sacred in many cultures, along with essential elements earth, wind, and fire- celebrate- today come on celebrate permaculture today celebrate, rain dancing, seasonally celebrations based on the weather and rains.

The Chinese symbol for water is control.

• Doodle #1: Draw a doodle representing the most important thing you've just learned. Your doodle can be a line, a shape, a squiggle, an

icon, a cartoon, a symbol, or anything visual. Explain your doodle to the person sitting next to you.

An important Water Permaculture Principles include:

Multiple functions for every element

2.Duties:

Duty #1: to procreate life (in growing organisms) -
Strategies
- drinking zone 1, highest quality of water
- livestock-
- irrigation -

Rainwater is main source for us, rainwater harvesting is the main permaculture technique used.patterning the landscape, to catch water, using plants and catchments.

A 1% increase in organic matter allows soil to hold 16,000 more gallons of water per acre.

- food preparation
- Provide for wildlife on land, underwater, and in the soil.
- meteorological cycle, climate control

exercise:
toast to each other with water!
To life giving water we give gratitude!

Duty #2: to develop productive water systems (aquaculture). 20x more productive that agriculture,
Yield of system increases as life increases.
-. pond or tank aquaculture -t**echnique**
- groundwater, aquifer recharge
- river and creek recharge
- ocean recharge

Duty #3: to develop hydraulic uses for energy production, chemical, mechanical and other uses

- Energy and design solutions due to gravity and falling water
- waterwheels,
- hydro, micro hydro
- ram pumps
- emergency water for fire
- supply water for toilets and graywater systems
- **Use natural processes and renewable resources.**
- universal solvent cleaning
- fermentation and chemical solutions
- cooling
- locks and dams
-water jet cutting
-trompe

The harvest is unlimited, we are only limited by our imagination-trompe

Maximizing edge is permaculture principle.

The deltas and marshes where fresh water and salt water meet is an incredible edge and ecotone, these edges are the some of the most productive ecosystems on earth.

Prevent Run off-

How to prevent runoff?

-Retardation swamps and basins: Swales, dams, swamps, basins, water spreading generally delay flood and run-off.
Sand beds and sand sheets have similar effects.
-Catchment form: Dendritic (tree form) catchment the most efficient.
Dense streamlines remove water quickly;
-Vegetation: Type and density affect run-off.
annuals or bare areas increase run-off, as does burning or cultivation.
-rock areas: increase run-off.

Name other ways useful for water storage ?

Tanks at home for freshwater supplies
Stock ponds, Small ponds in gardens (frogs)
Bogs, Use of larger catchment area to supply tanks;
catchment can be of tar material,
sealed pond using clay, concrete,
sheets of rubber, pond liner, HDPE, bladders, ferrocement,
Roads, airstrips, firebreaks, swales, ditches - all potential catchments if designed to concentrate water in storage structures such as roadside tanks and contour ponds.

What determines how much water is available ?-
Rain duration MAIN factor. How variable rain may seem, yet stable for each area overall, creeks and rivers flow continuously.

70% of water in the US is used for agriculture, 20% industrial, 10% home

How much water should permaculture use?
Permaculture position would conserve all resources using them as necessary.

Problem is we are taking out more than we are returning causing desertification.

What are water rights?
In Oregon without right, only able to water ½ acre with well.
Water rights, you must use them or lose them, invisible structures causing problems**.**

Do no harm.

• Doodle #2: Draw a doodle representing the most important thing you've just learned. Your doodle can be a line, a shape, a squiggle, an icon, a cartoon, a symbol, or anything visual. Explain your doodle to the person sitting next to you.

How much water is used during the fracking process?
Generally 1-8 million gallons of water may be used to frack a well. A well may be fracked up to 18 times.

What fluids are used in the fracking process?
For each frack, 80-300 tons of chemicals may be used. Presently, the natural gas industry does not have to disclose the chemicals used, but scientists have identified volatile organic compounds (VOC's) such as

benzene, toluene, ethylbenzene and xylene.

-Multiple elements for every function.
water lows through the earth in diverse ways. moving nutrients and life along with it as it travels the planet.
Water flows via creeks and rivers to the sea, water evaporates to vapor into the air and gathers in clouds, travels via winds then precipitates to the surface of the earth again with rain, snow, ice, hail, fog, freezing fog, hurricanes.

Increase Diversity.

Water flows through plants, fungi and animals, Traveling in the soil and groundwater, into aquifers and underground rivers of water, springs and wells.
Flowing in rivers of ice or glaciers, sublimating to vapor from ice and snow.
Transpiration by plants and flowing through life in many ways, agriculture, building products, food, materials, water in life itself, being born, living, and dying always moving the water to its next phase, Locked in the tundra,and ice caps.

Use resources wisely.
Store and hold resources, as high as possible and use water as many times as possible before it passes through the system increasing the efficiencies with each reuse.

Have fun, go to the beach, or swimming or fishing and celebrate water.

• Shout Out #1: Shout out a number between one and ten. Now tell me (state the number) facts you already know about more duties for water.

3.Permaculture Designing for water

The 2 forces of water called Erosion and Displacement forms valleys and deltas, important Patterns in nature in many places.
Managing Surface Run-off
Generally we want to Stop runoff, slow and hold resources as early and high as possible.

What is my message?
Catch and store. Everybody jump up and catch water!

All this is natural for the earth, and knowing about complex systems that water is involved in helps us make the best decisions when we are creating a design that shows care for the earth, supporting he ethic of earth care

-Think Needs when designing connecting elements
When does rain occur?
Make an alignment with its uses and season.

Protect building, structures, plants, animals from flow and overflow risks.

When all these factors are taken together, the severity of drought and the need for irrigation are greatly reduced.

The solution to the problem is in the question.

I am giving you numbers and statements and I ask you to ask your own questions and do your own research to verify any questions yourself. Hope fully you can begin your own project to conserve this rare and valuable resource.

Ability to calculate amount of water the system will handle and to size all components, pipes and fittings correctly.

1000sq ft house will produce 623 gallons of water per inch of rain
1000
231in3 = 1 gallon
1000ft2=12inx12inx1in=144,000in23
144,000in3/231in3=623.37 gallons

#everyone design for their home a quick calculation and type of storage possible.

Our function in the cycle:
Valuing this essential resource, applying necessary and conservative use through self regulation, accepting feedback and giving back to nature best water possible .

Water is powerful.

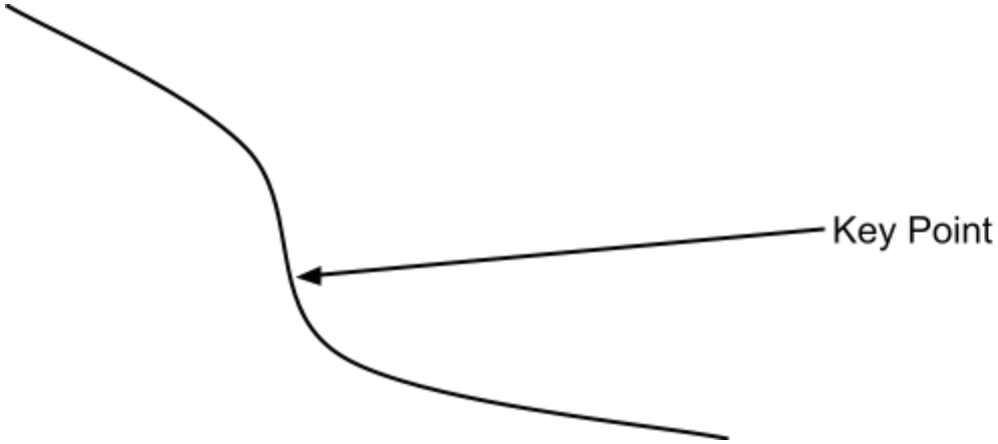
What water weighs is what makes gravity work for it. What does it weigh?

1 kg/litre
= 62.4 lb/ft3
= 8.34 lb/gallon
Weight per US gallon is based on *7.48 gallons per cubic foot*.
Calculations or rules of thumb are helpful when you are sizing your design

and talk about various techniques for engineering your system.
55 gallon drum weighs 440 lbs,

Patterns in nature: What is a keypoint?

Draw Picture of hill and valley



Key point : **Keypoint** is where the lower and flatter part of the valley floor steepens. Where the landscape turns from convex to concave occurs a keypoint.

The **Keyline** is a contour line through the keypoint, following the valley shape. P. A. Yeomans, described and explained in his books *The Keyline Plan*, *The Challenge of Landscape*, *Water For Every Farm* and *The City Forest*. Page 161 PDM Figure 7.15

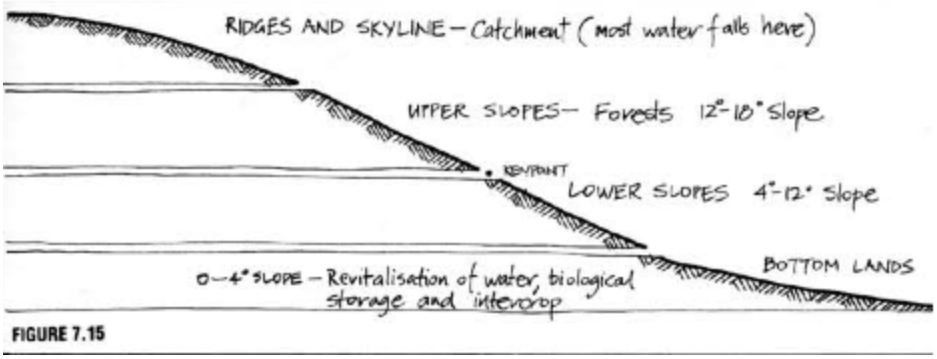
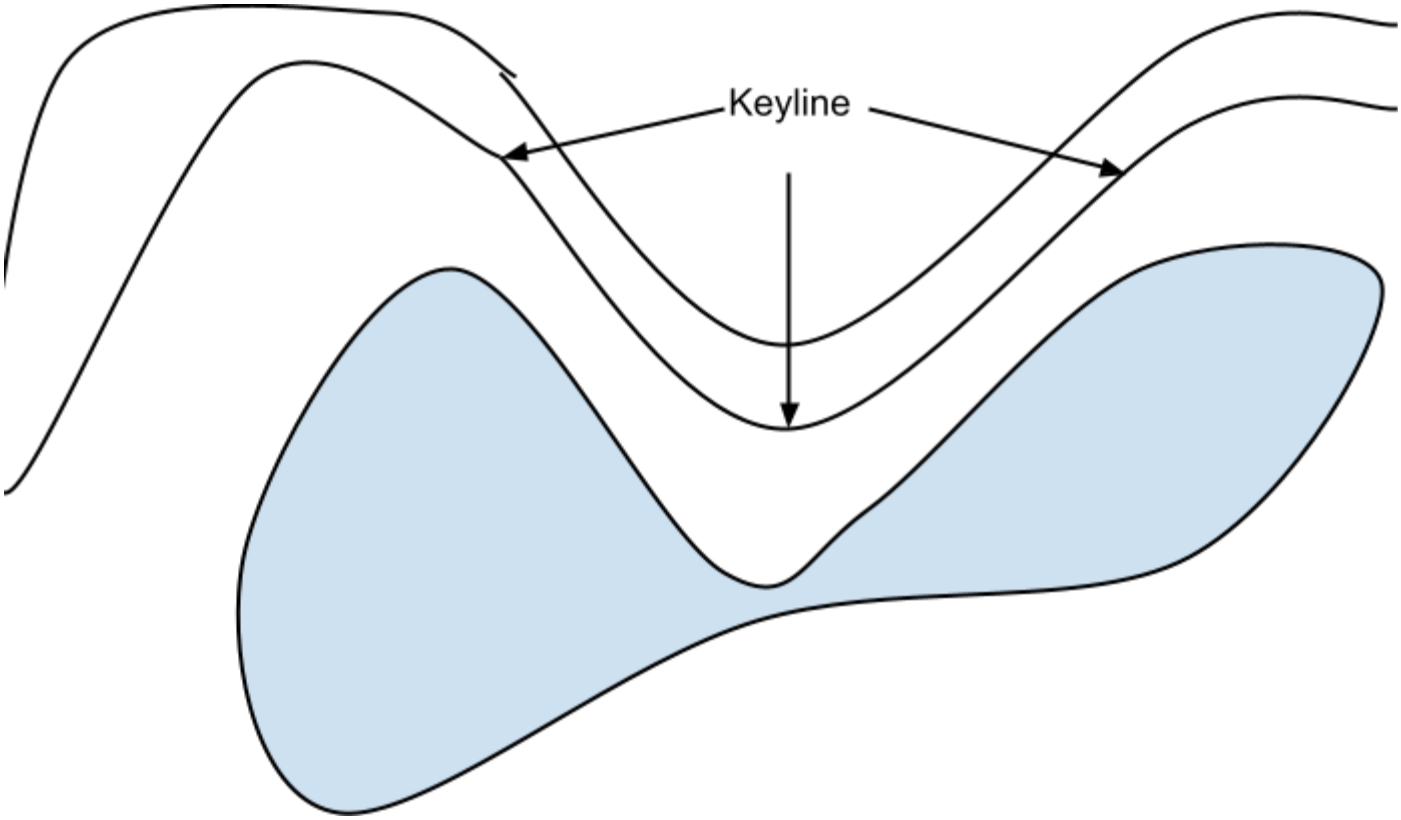
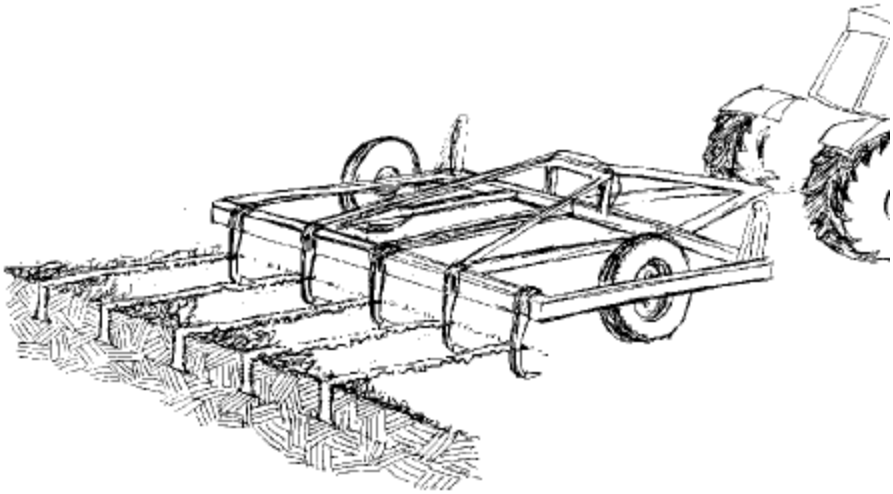


FIGURE 7.15





Keyline plow

- **Pop-Up #5: The last person to pop out of his chair has to explain to**

the whole group how he plans to use what he has learned.

Design for disaster.
Always be thoughtful in a failsafe way, water leakage or catastrophic failures happen. If you build or install water catchment that can roll or move, be careful to strap down and prevent from 10 tons come rolling down the hill towards your house after an earthquake.

Water Control: Managing Surface Run-off in Broad Landscape

General rules:

Modest trials; extend on successes
Do not concentrate flow across even low slopes or they will gully out
Always spread and absorb flow in pits, swales, sands.
Try to totally absorb run-off into vegetated areas
Beware absorbing run-off into bare areas as this can raise the water table and cause salting
Plant trees over shallow water table

Water harvesting earthworks.
What are earthworks?
Earthworks is engineering using soil or rocks.

Swales water harvesting, A swale is a ditch which runs dead level to contour. A-frame, water level, or laser

Swaled at 1-3m vertical intervals, swales of 2m deep, broad (3-5m); tree planted.
Steeper slopes can be sculptured as “net and pan”, “boomerang” banks.
Low slopes (3°) set out as a series of large diamond-shaped basins of 0.5 hectare, each with a tree in the low corner, and a spillway to the next diamond; even light rain soaks into these. Try for 150-200m deep ponds in

small areas

What are Gabions?
-cages or containers for erosion control, flood control, and protection. Use in water paths to slow water and sink it in.

Essentials of Dam Building:
page 163 PDM figure 7.17

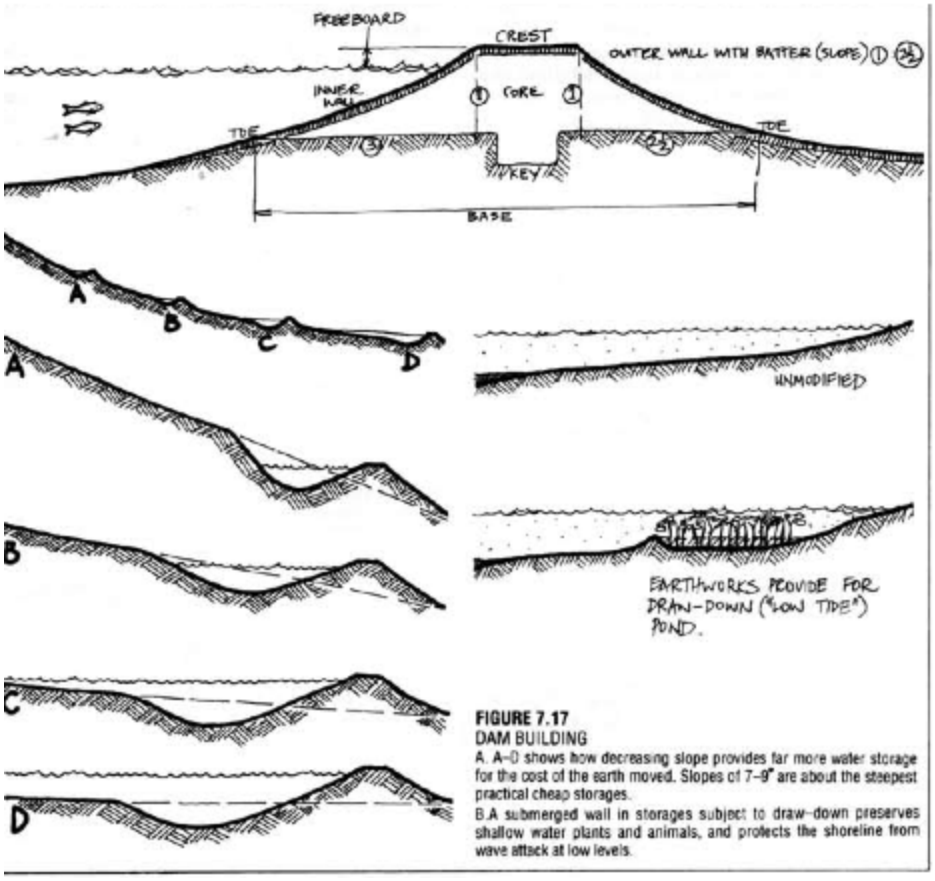


FIGURE 7.17
DAM BUILDING
A. A–D shows how decreasing slope provides far more water storage for the cost of the earth moved. Slopes of 7–9° are about the steepest practical cheap storages.
B.A submerged wall in storages subject to draw-down preserves shallow water plants and animals, and protects the shoreline from wave attack at low levels.

Backslope: 3:1 ratio,especially in sandy soils.
Frontslope: 2-2.5:1 ratio
Crest: 3m wide
Freeboard: 1m
Compaction: every .3m of soil rolled down by bulldozer
Key: a clean cut at base for first layers
Spillway: made along the contour and end well away from the dam wall.

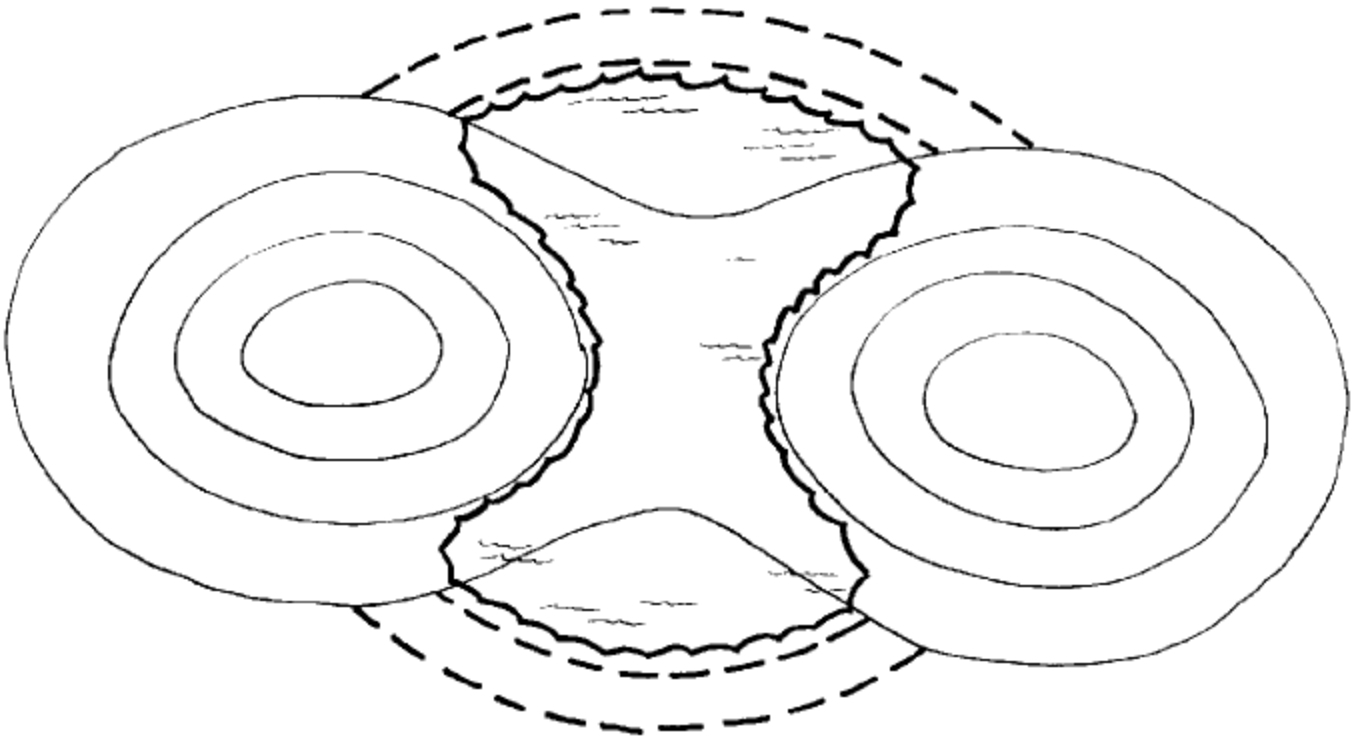
May lead to another dam.
Surface, fibrous-rooting plants grown on frontslope (avoid tap-rooted trees)
Silt traps may be needed in diversion drains leading to dams
Plant windbreak surrounding dam to reduce wind evaporation loss
Make dams deep. Try for shade. Taper sides to “V” or cone if practical

What types of dams do you know?

Saddle dams: on skylines, in saddles

Barrier dams: across valleys (only useful where silt is not a problem or if effective silt-traps in-stalled)

Contour dams: wall of dam follows contour
Pediment dams: dam site on a flat at the foot of hill slope
Ridge dams: dam is on a flat ridge area



Saddle dams

page 158 PDM Figure 7.4

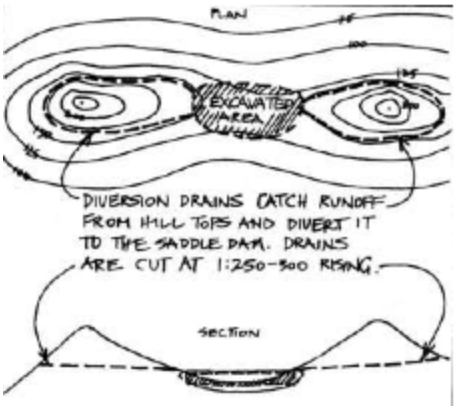
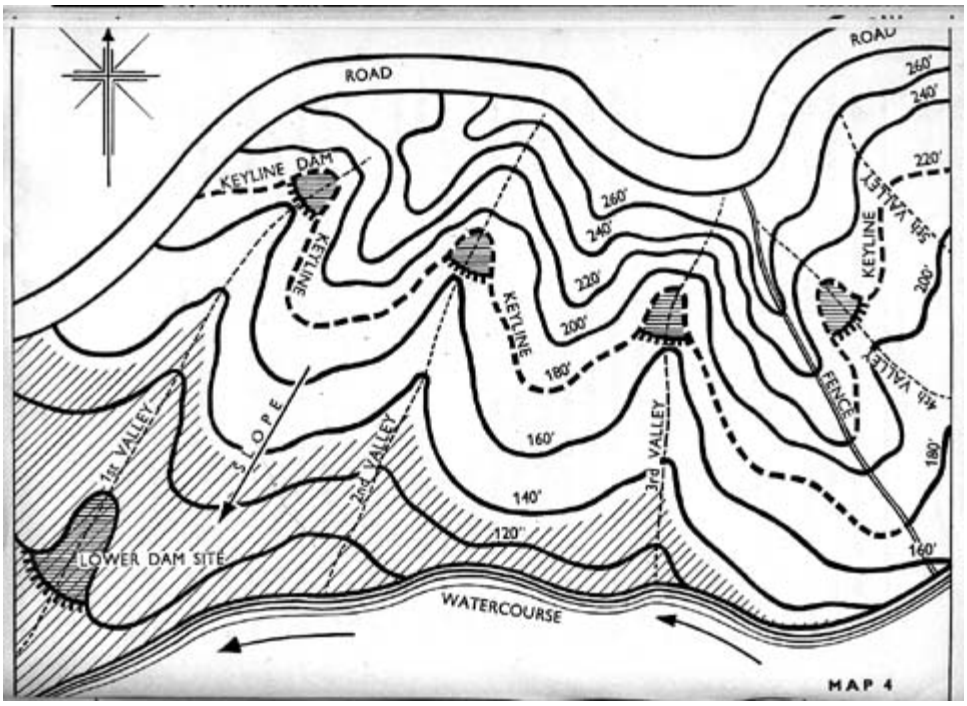
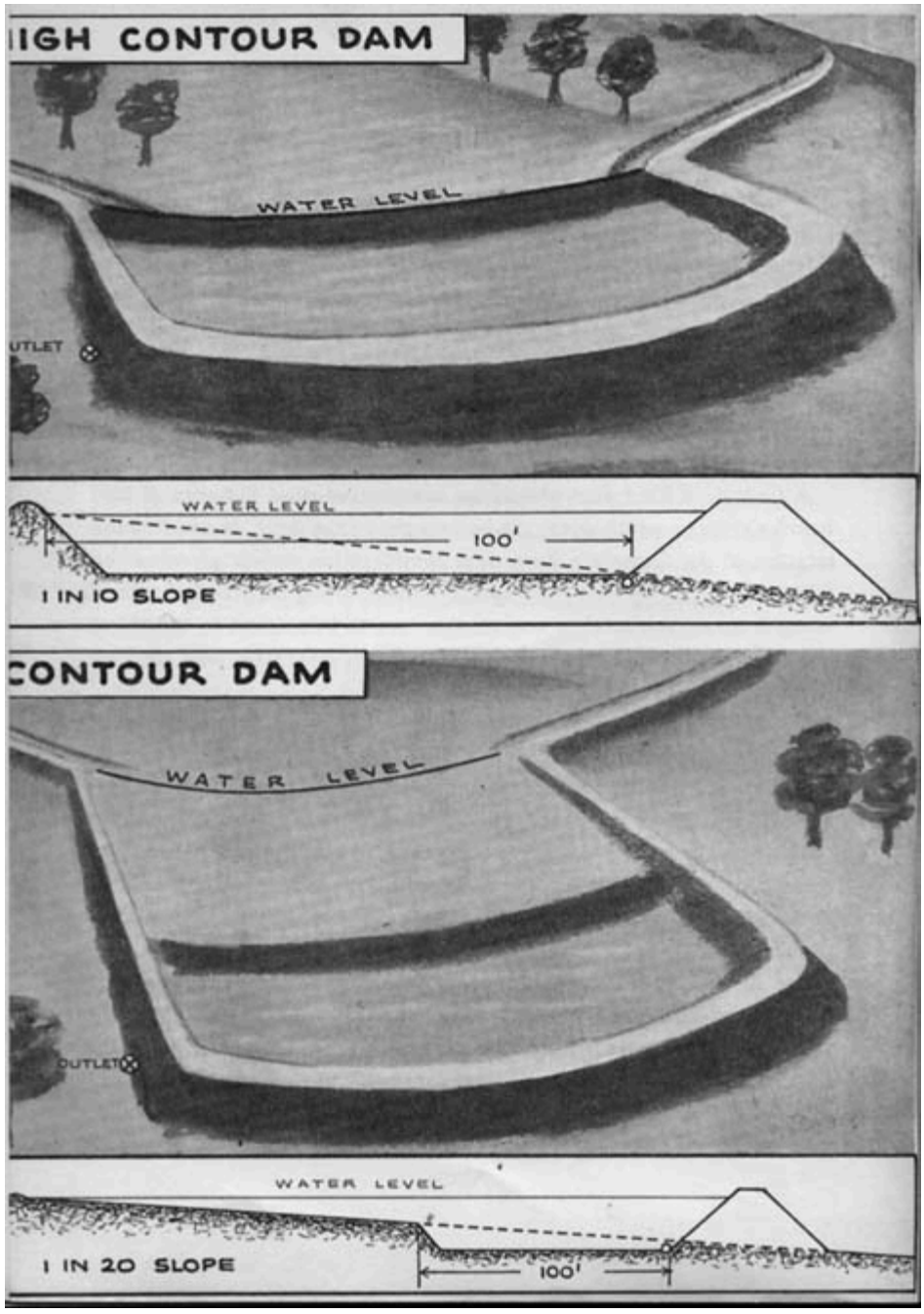
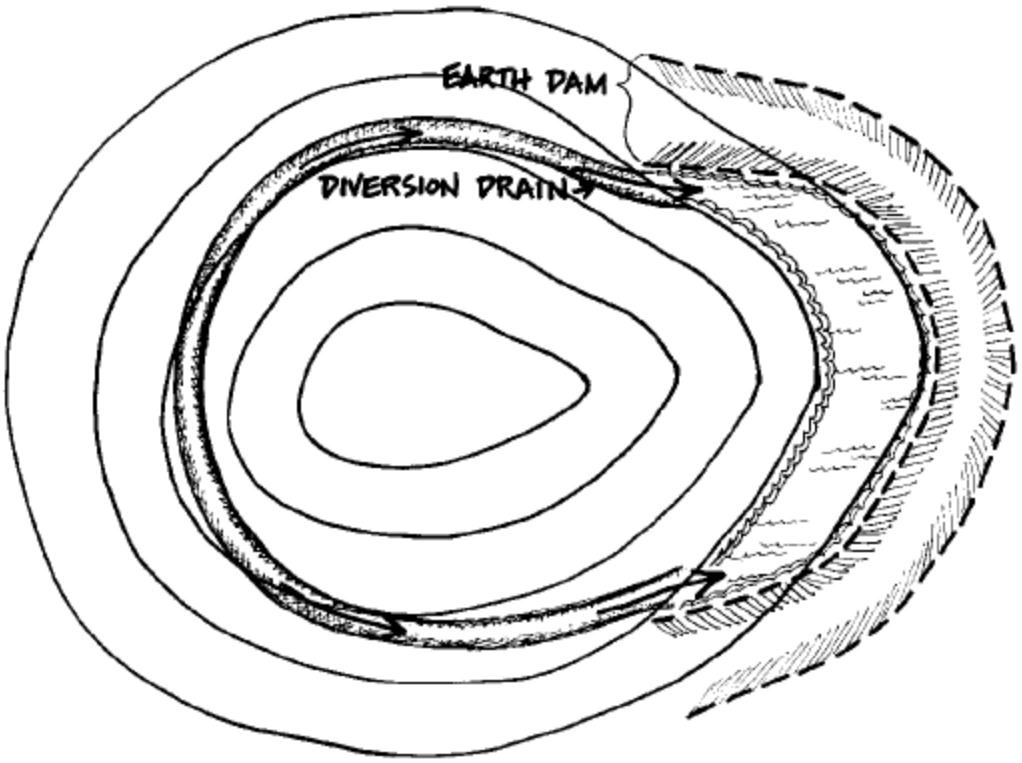


FIGURE 7.4
SADDLE DAM
Very useful for fire control, wildlife, limited irrigation. The "highest" type of dam in the landscape that fills from hill runoff.


ROAD
ROAD
KEYLINE DAM
KEYLINE
KEYLINE
KEYLINE
260'
240'
220'
200'
180'
160'
140'
120'
1st VALLEY
SLOPE
2nd VALLEY
3rd VALLEY
4th VALLEY
FENCE
LOWER DAM SITE
WATERCOURSE
MAP 4

Valley dams


IGH CONTOUR DAM
WATER LEVEL
UTLET
WATER LEVEL
100'
1 IN 10 SLOPE
CONTOUR DAM
WATER LEVEL
OUTLET
WATER LEVEL
1 IN 20 SLOPE
100'



Contour dams

60sec- Pair Share #1: Turn to your neighbor—the person sitting next to you—and tell him the most important fact you just learned in this class.

Evaporation strategy

Cover water surface with rounded, hexagonal “light concrete” blocks using polystyrene beads in aggregate. Paint upper surface white. Try for 0.8 specific gravity and make 1-2m across. Make a sequence of 3 dams, and empty from top dam to the lower dams as soon as these will hold the water. Each time you do this surface reduces by 30%. Several series of 3 is better than a chain of 6 or more dams long.

What holds most water?

Ways to hold the most water is by using plants and trees,

Organic matter also increases the soil's ability to take in water during rainfall events, assuring that more water will be stored. Ground cover also increases the water infiltration rate while lowering soil water evaporation. Water stored out of sun will evaporate slower.

Evaporation versus precipitation, land may salt if evaporation is greater.

Way to divert water using Hard surfaces like roads, gutters, trenches, walls, sidewalks, driveways, and roofs. **Gutters page 166, figure 721**

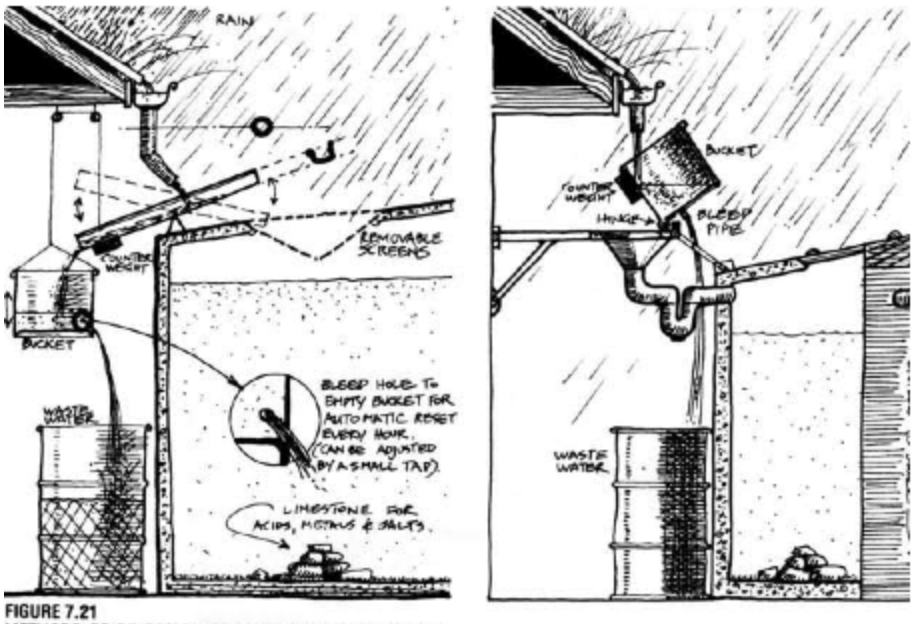


FIGURE 7.21
METHODS OF REJECTION OF FIRST WATER FLOW OFF A ROOF.
The first rains wash the roof, and are rejected; these systems automatically reset when empty.

Name ways to store water?
Cisterns, tanks, ponds, in the ground-bogs .Water catchment is possible in many ways as above and below the earth.

What are the Considerations on designing the type of system appropriate for your situation? resources, frequency, amount, etc

Irrigation
Irrigation Rules

Irrigate under mulch (reduces salt problems & increases irrigation efficiency)
Irrigate at dusk or night if possible (put on a timer)
Give long watering every 3-5 days rather than a little bit every day (increases leaching effect,
particularly for salt, and takes water down)

Allow for leaching, put enough water on to leach sal
Use sealed pipes to convey water; leaky drains may raise the saltwater table.
Only use sprinklers under tree canopy. Never in the open by day.
Do not over-water; use timers and pits to check on this; turn off drip in winter if enough winter rain.

Name the Different types of Irrigation?

1-drip or trickle, efficient, especially in drylands, needs filtration, control

Hole in a pipe
Flagon or clay pots in ground with nail in cork
Rocks in deep hole to lead roots down
Relatively cheap
Water the root zone directly
Can use reasonably saline water
Waters only the plant, not the weeds around it

-Flood irrigation (surface & sub-surface-wasteful and difficult to control) flood, hardest to design for landscapes. Using Flag with swales.

page 169, f 7.27

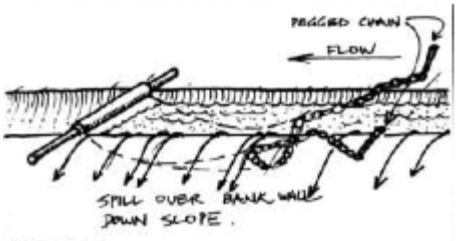


FIGURE 7.27
FLAG
A plastic sheet, one end supported by the channel banks, the other weighted by a chain, forms a temporary dam, causing the channel to flood out and irrigate land downhill.

-Sprinklers (not efficient, can build up salt in soil, spray most wasteful, lost to evaporation can be as high as 90%

-Under canopy

Sub surface irrigation:
Pitcher irrigation: 12” wide porous pitchers buried in ground 3’ diameter, 2’

deep, filled with manure and soil.
Tops of pitchers just above ground level, covered and kept topped up. Gourds, pumpkins, and melons cultivated. Can also be used for planting trees (narrow necked jars).

Components of irrigation systems

Water source: dams, bores, soaks, run-off, swales, pipelines, creeks, tanks, lake

Energy source: water at head, pressure with pumps- electric, fuel, wind, ram, manual, animal, prime or self priming

Distribution network:
- net and pan, pipes, channels, buckets
- pipes- aluminum, concrete, plastic, copper, galvanized
- fittings- steel, Stainless steel, plastic, copper, brass

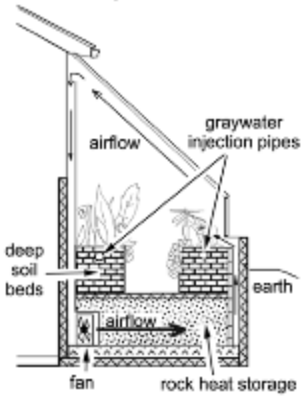
Emitter: dripline, sprinkler, bucket
- nozzles
- pressure regulators
- flow regulators
- filters- paper, mesh, strainers, sand, biological
- gages
- check valves
- timers
- controllers

Waste water systems

Graywater untreated water from sink, shower, washing machine water used in landscape or home. Discharge below surface use to water trees and water loving plants.

ATTACHED GREENHOUSE WITH GRAYWATER FILTERING SOILBEDS

Figure 9.10



SIMPLE SOILBOX GRAYWATER FILTER SYSTEM

Figure 9.11

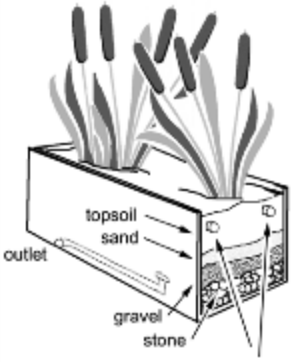
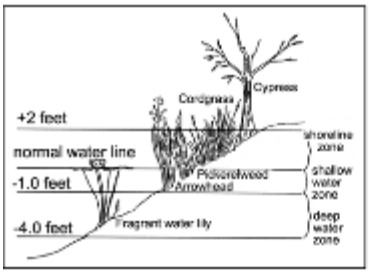


Figure 9.7: AQUATIC PLANTS

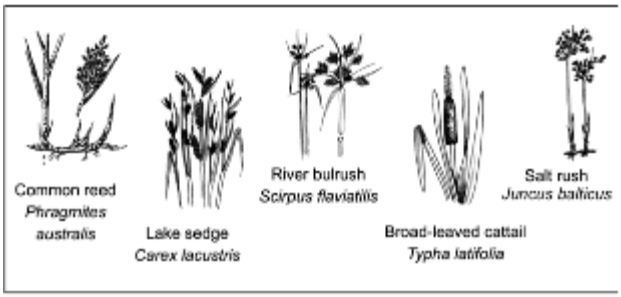


A CONSTRUCTED WETLAND REQUIRES FOUR COMPONEN FOR FUNCTIONAL SUCCESS

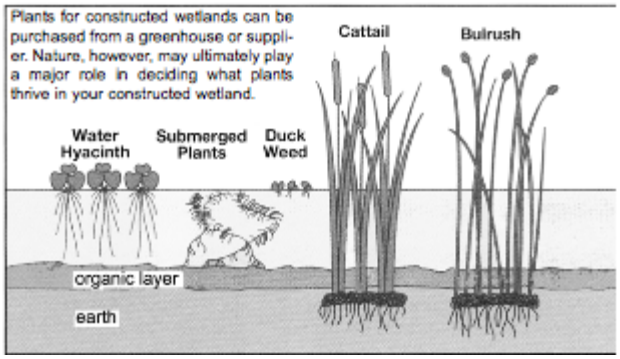
1) A substrate (such as gravel)
2) Aquatic plants
3) Water
4) Naturally occurring microorga isms (both aerobic and anaero bic)

Two or more growing seasons n be necessary before plants are cc pletely established.

Sources: University of Florida, Institute of F and Agricultural Sciences. Circular *Aquascaping: Planting and Maintenance.* National Small Flows Clearinghouse, Pipe Summer 1998, Vol. 9, No. 3: *Constru Wetlands, A Natural Treatment Alternative.*



Plants for constructed wetlands can be purchased from a greenhouse or supplier. Nature, however, may ultimately play a major role in deciding what plants thrive in your constructed wetland.



From “The Humanure Handbook” Joseph Jenkins, chapter 9
http://humanurehandbook.com

Black water septic system needs to be used to treat and kill pathogens

Common water treatments:
Aeration = oxygenation
Settling
Skimming
Filtration-sand , charcoal page173, figure 7.32

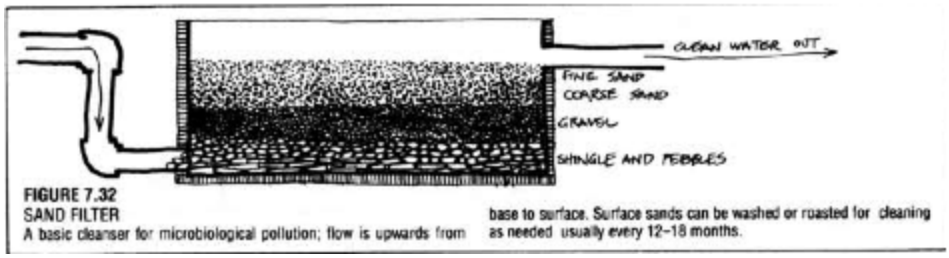


FIGURE 7.32
SAND FILTER
A basic cleanser for microbiological pollution; flow is upwards from base to surface. Surface sands can be washed or roasted for cleaning as needed usually every 12–18 months.

Coagulation or Flocculation -lime, salts, organic gels
Biological - bacteria, plants
PH- lime

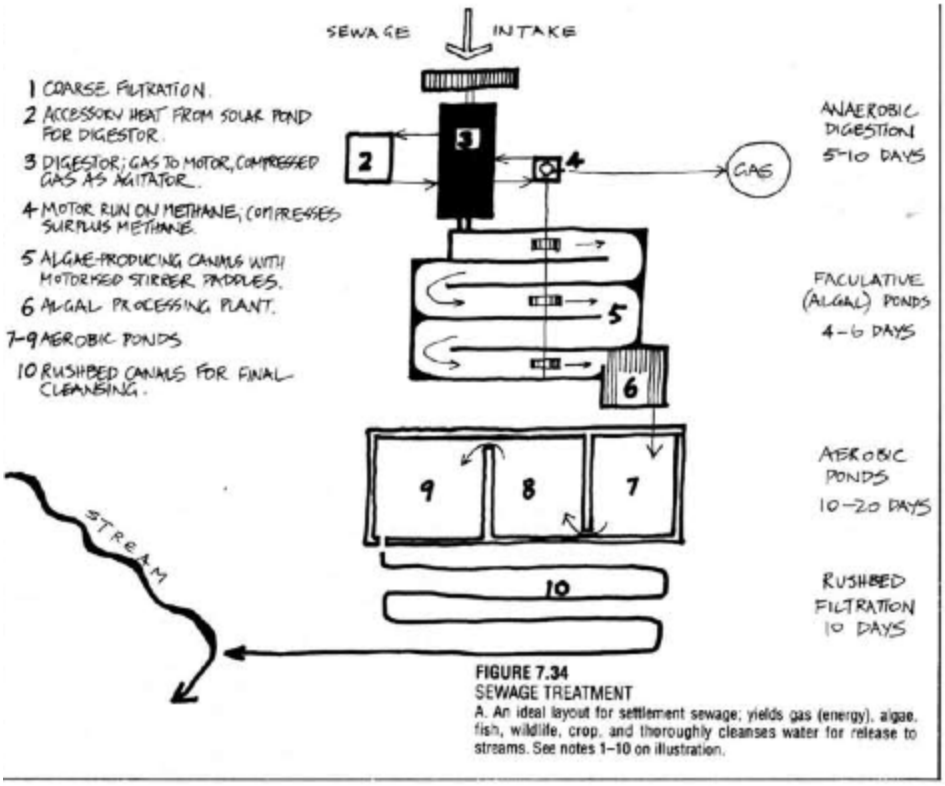


FIGURE 7.34
SEWAGE TREATMENT
A. An ideal layout for settlement sewage; yields gas (energy), algae, fish, wildlife, crop, and thoroughly cleanses water for release to streams. See notes 1–10 on illustration.

Humanure, compost toilet design.

Humanure Toilet

A hinged humanure toilet box will be 18" wide and 21" long. Get two boards 3/4"X10"X18" and two 3/4"X10"X19.5". Get two hinges. Get one piece of 3/4"X18"X18"

plywood and one 3/4"X3"X18". Hinge the two pieces of plywood together.

Cut a hole in the larger piece of plywood to fit the top of the 5 gallon toilet receptacle. Make sure the hole is only 1.5" back from the front edge of the plywood. Always use identical receptacles in a humanure toilet so they will all fit correctly. Buy a standard toilet seat

Urine 10:1 water to urine for good fertilizer.

-Draw a doodle with slogan to illustrate what you have learned.

Closing Exercise-

Do water cycle dance, start with water drop in a stream flowing down to the ocean, get to the sea,you rise into the air and fly to the clouds then wind blows over the land and you fall to earth, patter on the ground.

What is my message?
Catch and store. Everybody jump up and catch water!

What is one amazing thing you learned today about water?
Catch and store. Everybody jump up and catch water!

-Now play water song