This presentation premiered at WaterSmart Innovations

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INNOVATIONS

BLUE A LA CARTE

NET ZERO CLOSED LOOP WATER SYSTEMS

Design of site, building & facilities regarding:
everything water touches, thru a blue lens

Marilyn Crenshaw

www.TheGreenAndBlueArchitect com

PRESENTED AT WSI 2016

ORGANIZATION OF THIS TALK

20 MINUTE PRESENTATION

1)Overview

2)Sources of water

3)Jurisdictions

4)H2O calculations

5)A La Carte Components

6)Food/water nexus

7)Costs of systems

5-10 minutes for Questions & Answers. Please pass your questions to the basket & stage for me to address at the end

WATER SHORTAGE & CRISIS MITIGATED VIA ABUNDANCE

Conventional society typically uses clean potable water once then sends it to “away”. Aquifer depletion is a global problem.

Problem locations in the news: Saudi Arabia will be dry in 13 years, Flint Michigan lead contamination, wells poisoned by fracking, USA's Ogallala Aquifer isn't being recharged, California water crisis, Middle East countries (Iraq, Syria, southeast Turkey, Lebanon) haven't had rain for 3 summers.

What if they implemented ideas in this lesson to stretch their water with closed loop systems?

DEFINITION OF A CLOSED LOOP NET ZERO WATER SYSYEM

1) Collect all sky precipitation off all surfaces (roofs, pavement, earth) , reclaiming all used water to use again & again, filter according to source & intended use, store sources separately according to intended use

2) No import of metered water, no use of watershed (wells, aquifer,rivers)

3) According to 2030 Living Building Challenge guidelines, if construction is completed too late in the season to fill catchments, you are allowed to import water that first year only & still maintain your net zero designation

DESIGNING A NET ZERO SYSTEM IS EASY

1) DO SUPPLY & DEMAND WATER CALCULATIONS (includes safety factor multipliers)

2) SELECT SYSTEM COMPONENTS FROM A LA CARTE MENU'S APPROPRIATE TO SITE & CLIMATE

3) DOCUMENT THE SYSTEM IN AN OPERATION MANUAL

4) (NOT PART OF THIS TALK: FINANCING, ENGINEERING, PERMITS, CONSTRUCTION DETAILS, ANNUAL COMMISSIONING & AUDITS)

CLOSED LOOP VS. OPEN LOOP

OPEN LOOP MEANS YOU IMPORT WATER INTO YOUR SYSTEM. REASONS MAY BE:

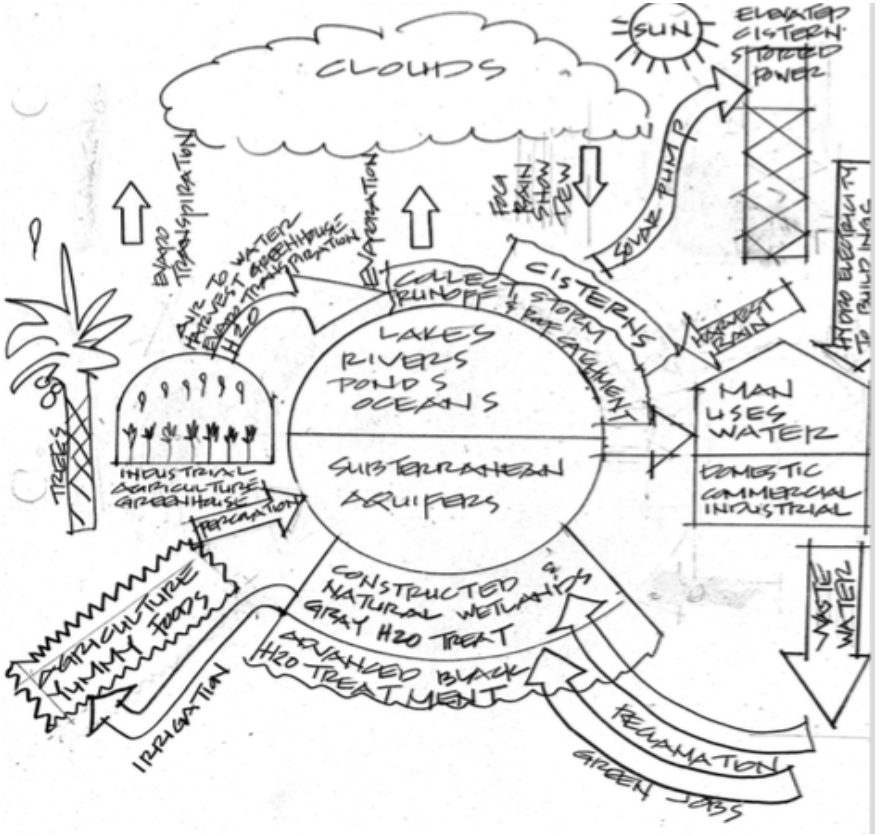
1) Jurisdiction mandates metered water for potable

2)Water Supply from sky & reclaimed used water won't support the occupant population or commercial/ industrial/agricultural enterprise

3)Demand use is seasonal

EARTH'S WATER FEEDBACK LOOP

- Rain & snow falls from the sky, Plants drink surface water & roots drink from percolated water, percolation recharges aquifer, surface water flows to rivers & lakes. Exposed rivers/lakes/ocean evaporates and plants evapo-transpire. Clouds are formed from the evaporation. Cycle repeats



BUILT ENVIRONMENT FEEDBACK LOOP

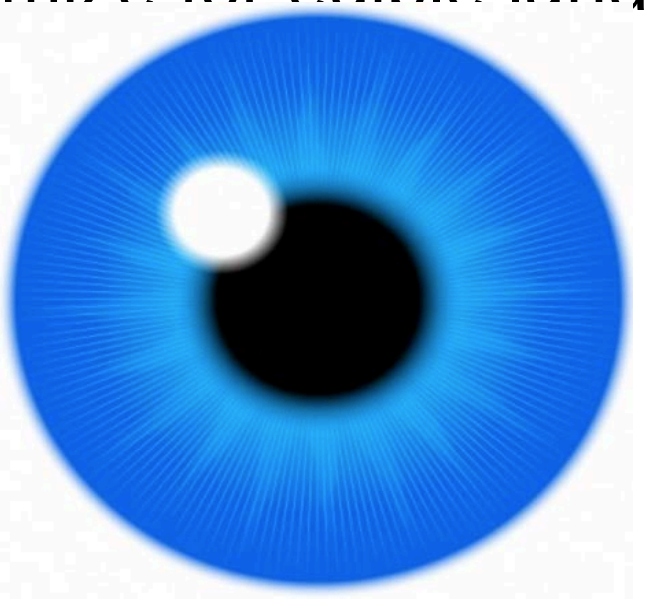
All of the intellectual property, products, service providers, installers & proven successful installations of the individual components exist.

Our challenge is to assemble a la carte menu selections into coherent site specific systems.

Those of us who do it first will be societies “early adopters” which is so important to influence it going mainstream.

BLUE LENS SITE LAYOUT

- Study the topography, direct drainage & switchback swales to collect maximum volumes, collect LOW, store HIGH for gravity pressure, invite percolation
- Locate piping trenches, best spot for renewable energy, optimize for edible landscaping agriculture



WATER SOURCES

GREY VS. BLACK WATER DEFINITION

GREY WATER is used water, typically: from laundry hand washing, dish washing, bathing. Has soap in it.

USED WATER RATIOS: 60% of domestic used water is grey that can easily be reclaimed, 40% is black (27% from toilets, 13% from kitchen)

BLACK WATER is used water, has pathogens, typically: sewage water, some jurisdictions call omnivore kitchen black water because meat & dairy rot into pathogens.

APPROVED GREY WATER USES

1) Irrigation

2)Toilet flushing and laundry

3)Interior & exterior cleaning,

4)Art projects, painting

5)Operations specific to proprietary processes

6)Other

TOILET TO TAP RECLAMATION IN CITIES TODAY

USA : Los Angeles, Calif. Valley City, North Dakota. Cloud Craft, New Mexico. Big Springs & Wichita Falls Texas.

GLOBAL: Adelaide & mainstream, Australia / Windhoek, Nambia, Africa/ Singapore

Toilet To Taps LINKS:

http://www.cnn.com/2014/05/01/world/from-toilet-to-tap-water/

SEWAGE WATER TREATMENT

Photos: From toilet to tap: Drinking recycled waste water

Water recycling – California's Orange County Water District (OCWD), has a plant that recycles used water and returns it to the drinking supply.
It is expanding production to 100 million gallons per day, enough for 850,000 people.

- Primary: remove solids & Settlement
- Secondary: microbial mass settles as sludge, aeration, anaerobic digesters, clarification
- Tertiary: can be chlorine, or open ponds & sunlight to disinfect,
- UV light or distillation: makes it potable

PROPRIETARY RECLAMATION OF SEWAGE TO DRINKING WATER

HIGH TECH

Advantex http://www.orenco.com/systems/advantex_wastewater_treatment.cfm

Aqua Cell http://www.dewater.com/aquacell.html **,**

Global Water http://globalwater.com

Veoli http://www.veolianorthamerica.com/en **,**

BousteadSalcon http://www.bousteadsalcon.com **,**

Living Waters http://texaslivingwaters.org/wp-content/uploads/2014/03/Ed-Archuleta.pdf **,**

WESTERN WASTEWATER TREATMENT SYSTEMS LLC

LOW TECH

Http:///livingmachines.com/Systems/sewage-treatment

Http://earthship.com/Systems/sewage-treatment

Http://www.blueplanetgreenliving.com2009/08/26/from-swamp-to-gas-pump-cattails-take-on-new-role/

WATER MEMORY FOR PRISTINE

According to Masoru Emoto , water has memory, so when toilet water is purified to tap water, the sewage memory is still there.

Distillation is the method that both Earth's feedback loop & our constructed feedback loops can use to purify the memory

Since only 10% of our water needs to be potable (for drinking/cooking/bathing), we can either filter & UV light our rain water roof catchment (rain has been purified from earth cycle) or distill any other filtered source of water to fulfill potable requirements.

DISTILLERS

Distillation means water makes phase change from Liquid to Vapor.

MECHANICAL METHODS:

Fossil fuel or renewable power boilers make steam. Air conditioning & various commercial mechanical systems extract condensate

PASSIVE METHODS:

Ponds evaporate and plants evapo-transpire. Harvest condensate off green house ceilings. Air to Water fog harvesting. Solar Distillers

JURISDICTION

JURISDICTION DEPTS THAT REVIEW PERMITS RE: WATER

PLANNING DEPT- erosion control, site drainage, riparian zones proximity to water shed, habitat & wild life, site storm drainage, use permits

PUBLIC WORKS- water & sewer meters, grease traps, road storm drainage

ENVIRONMENTAL HEALTH- septic systems, wells, food & beverage service

STATE- rain water harvesting permission or restrictions

FIRE DEPT- fire code, h20reserves, protection

BUILDING DEPT- plumbing code conformance

PLUMBING CODES

GENERAL PLUMBING

ASPE, IAPMO.org, ICC, ANSI, IPC, PMG, Cal Grey Water Code

FARM PONDS

https://efotg.sc.egov.usda.gov/references/public/AL/al378_PondConstruction.pdf

http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_030362.pdf

CALCULATIONS & BUDGETS

OPEN LOOP VS CLOSED LOOP: CHICKEN & EGG

DETERMINE CLOSED LOOP VS. OPEN LOOP

1) Balance supply & demand

Inventory CLOSED LOOP INPUTS: Inventory possible inputs (supply)-precipitation from sky, condensate, reclaimed used water, & subtract safety factor multipliers

Inventory OPEN LOOP INPUTS: aquifer (wells), water shed (seasonal creek/spring/river/lake/ocean) , trucked

Inventory outputs (demand)- residential occupants, food production, commercial operations

2) Identify use intensity land can support via Closed Loop Inputs or make up that difference with Open Loop Inputs

GLOBAL & USA WATER USE

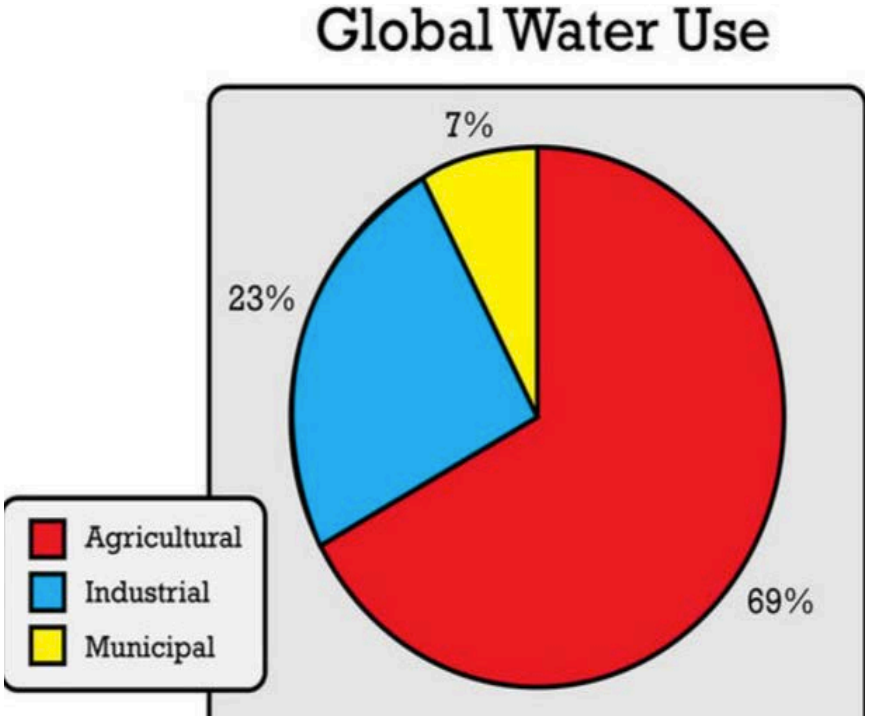
70% of the water we take from rivers & groundwater goes into food production.

30%

Remaining broken down into:

Residential: 7% to 10%

Industrial /Commercial: 20% -23%



Read more:http://www.lentech.com/water-food-agriculture.htm#ixzz4E9DOAfs6

SAFETY FACTOR MULTIPLIERS

MEANS YOU HAVE TO PLAN FOR EXTRA WATER BEYOND THE DEMAND OF OCCUPANTS & SITE ACTIVITES & OPERATIONS (assume 1.5 x demand used):

1) Evaporation & percolation

2)Fire fighting reserves and fire training exercises

3)Leaks

4)Contamination from pathogens or chemicals

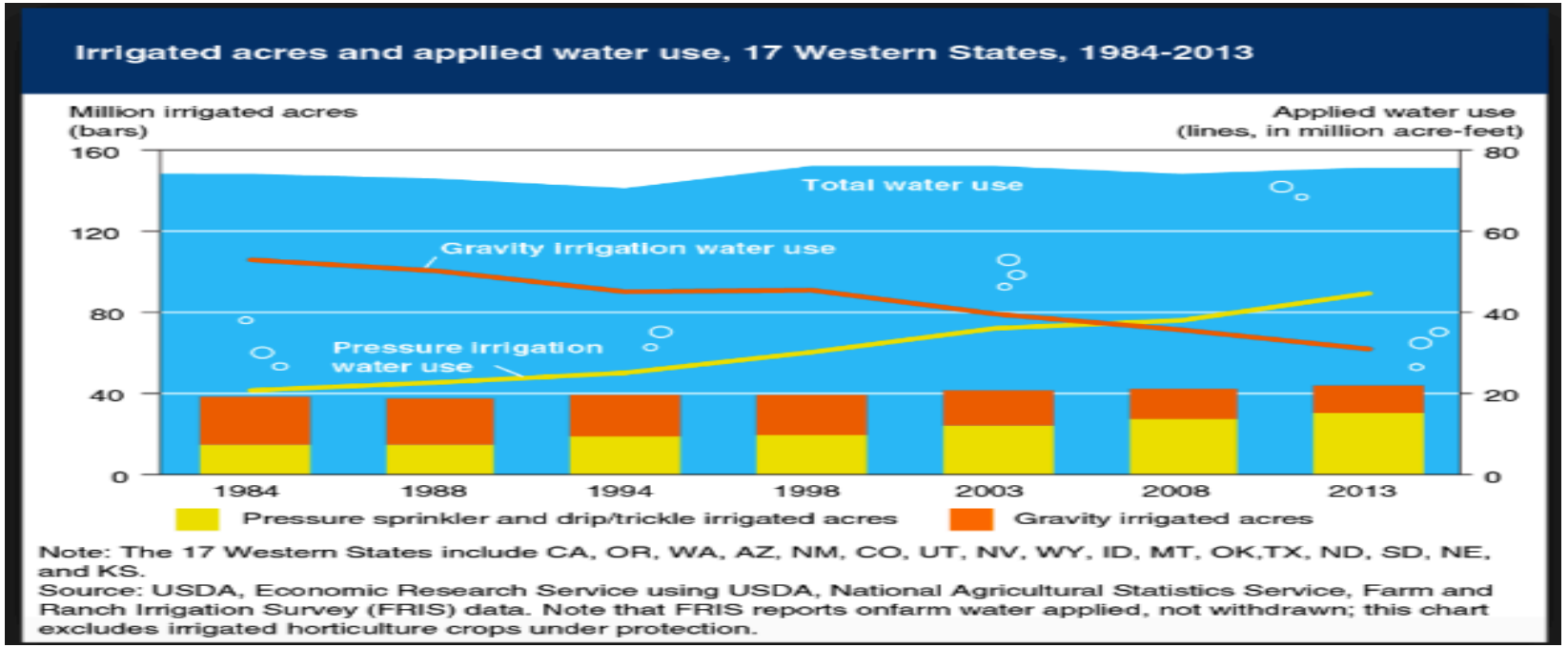
5)Drought

6)Maintenance: flushing mains, cleaning tank, purging well, water quality testing, roof washer pre-filter

BUSINESS WATER USE BUDGET

- First review past water bills or collaborate with a competitor to get accurate water use estimate

AGRICULTURAL IRRIGATION BUDGET



Estimate crop land irrigation per acre

- Climate conditions

RULE OF THUMB WATER CALCS

SUPPLY (Inputs)- calculation subtotals of surface collections, condensate,

SUPPLY RECURRING RECLAMATION- Grey accounts for 60% of used water, must be used within 48 hrs. Black accounts for 40% of used water,(takes 3 months to reclaim , assume min 4 changes/yr for anaerobic/anaerobic, some systems more changes/yr)

SAFETY FACTOR- subtract from supply (you choose if apply to overall site or roof catchment only)

DEMAND (outputs)- calculation subtotals of : residential per capita per day, commercial operations, agriculture

WET SEASON - typically 5 months, catchments refilling

DRY SEASON STORAGE- typically 7 months, rely on reclamation & storage for supply

WATER CALCULATIONS- A

SAMPLE CALCULATIONS

FOR CLOSED LOOP RURAL RESIDENCE:

Doing water calculations requires

assumptions & adjustments (reverse engineering).

Assume 4 occupants X 100 gal/day = 146,000 gal/yr (3rd world survives on 1 to 3 gal/day/person)

EPA says we use 70% indoors.

146,000 X 70% = 102,200 gal. Indoor use demand

WATER CALCULATIONS- B

APPLY SAFETY FACTOR TO INDOOR USE- (logic if you don't get water in system for potable you won't have it to reclaim)

102,200 gal X 1.5 = 153,300 gal from roof catchment (design rood over sized to collect for safety factor)

Assume 1 acre lot X 43,560 sq ft/acre X assume 10" rain/yr X .62 gal/sf = 270,072 gal

Lot surface collection 270,072 gal /1.5 safety factor = 180,048 gal

POTABLE REQUIREMENT is 10% X 153,300 gal/yr = 15,330 gal

Roof area needed: 15,330 gal / (10 inches X .62 gal/inch) = 2473 sq ft

WATER CALCULATIONS- C

30% outdoor use X 146,000 gal = 43,800 gal (agriculture edible crops)

60% of used interior water is gray water .

60% X 102,200 gal = 61,300 gal.

Underground delivery of grey within 48 hrs.

Proprietary system cycle 4 X 61,300 gal = 245,200 gal/yr

40% of used interior water is black water.

40% X 102,200 gal = 40,880 gal

Black H2O can cycle 4 X yr = 40,880 X 4= 163,520 gal

WATER CALCULATIONS- D

DEMAND SUMMARY:

153,300 gal from roof (filter to potable)

213,000 gal (omnivore crops 7 mo dry season X 30 days/mo X 1000gal/acre/day)

366,000 gal total

SUPPLY SUMMARY:

180,048 gal surface collection on the lot (after safety factor reduction)

-15,330 gal from roof (we can't count it twice)

245,200 gal reclaimed grey water

163,520 gal reclaimed black water

663,462 gal of abundant supply total

297,462 SURPLUS

WATER AUDITS

DETERMINE

The amount of water in a system for a 12 month period

Water supplied & collected vs water used & consumed

THEN COMPARE:

Use this difference to estimate system losses thru normal evaporation & percolation

VS. Identify what was used for maintenance & testing

VS. Identify leaks (USA statistic leaks waste 14%/yr)

METERS & SMART MONITORING- make this task easy to review annually, quarterly,monthly, or wet vs dry season basis

COMPONENTS

COLLECTION SURFACES

SOLID ROOFS -baked epoxy metal, galvanized metal, asphalt composition, fiber glass, visqueen green houses, glass green houses, wood shakes & shingles (lesser toxic materials reduce work filters need to extract)

GREEN ROOF (with plants growing on top)

PEDESTRIAN & VEHICAL PAVEMENT

EXPOSED EARTH that is sculpted with switch-backs & swales

CONDENSATE INTERIOR SURFACES (sauna ceilings, interior side of greenhouse ceilings)

GUTTERS & DOWNSPOUTS

MATERIALS:

GALVANIZED,
STAINLESS STEEL,
ALUMINUM,
COPPER,
PLASTIC,
PVC,
WOOD

DISTRIBUTION

PIPE LABELING- *keep storage & distribution separate for each water source*:
http://www.pipemarker.com/Custom+Products/Custom+Pipe+Markers.html

PIPES: pex, clay, pvc, cpvc, copper, abs, black iron, plastic, stainless steel, galvanized iron, brass, poly pipe,

TRENCHES- Plan ahead & organize all utility pipes, excavate once, minimal disturbance to habitat

PUMPS to move water & **PRE-PUMP FILTERS**- to protect pump from silt

PUMP PRESSURIZER for mechanical pressure & **RAISED TANKS** for gravity pressure to get needed PSI

TYPES OF WATER STORAGE

ABOVE GROUND- metal with liner, concrete with coating or liner,**BPA** free plastic

BELOW GROUND -prefab fiberglass, prefab metal, site built cisterns, Earthship rammed earth tires with liner, building integrated concrete basement with coating or liner, milk-crate type structural matrix for enormous volumes underground below parking lots

HYBRID -bladder bags in crawl spaces, repurposed salvaged vessels & shipping containers w/ liners

PONDS & POOLS- concrete site built, prefab, & excavated earth pits with liner

TANK TEMPERATURE CONTROL- partially buy for geo thermal constant earth temp to avoid freezing or heating that grows algae

EVAPORATION MITIGATION

50% water evaporates from open water exposed to sky & from plants exposed to sky

TO AVOID LOSING EVAPORATION FROM CLOSED LOOP SYSTEM:

1) provide covers or roofs over pools , hot tubs, & fountains

2) Green house covers can be placed over ponds, aquaponics, hydroponics, crops planted in ground, & fountains THEN harvest the condensate via interior gutters

STORED WATER AS BACK UP BATTERY (like a dam)

- Need 80 to 100 ft for pressure, more is better
- Equal size cisterns top & bottom
- When let water out of top cistern when wind or solar isn't making power , a micro hydro generator makes electricity at bottom, then that water is collected in lower cistern (not lost to system)
- Next time solar or wind make excess power , pump the lower water cistern back to the upper cistern where it is repositioned as potential energy
- Conventional batteries wear out in approximatley 10 years, then go to the landfill or recycling

APPIANCES, FIXTURES, & EQUIP

GENERAL- Energy Star & Water Sense certified products

RESIDENTIAL- Dishwashers, laundry washing machines, ice makers, air conditioners, humidifiers, dehumidifiers, evaporative coolers, faucets, shower heads, spigots, toilets,

NON-RESIDENTIAL- restroom & kitchen equipment, equipment for commercial enterprises of all industry sectors

FILTER NOTES

SELECT APPROPRIATE– filters to use remove from collected or reclaimed supply source to get it ready for intended demand source

BLACK WATER- can be remediated to grey then to potable

NOTE- Reverse osmosis and alkalizers/ionizers discard a significant percentage but that water can be reclaimed

CAUTION - clorination and water softeners have their reasons for use but not

ALL FILTERS- need maintenance, flushing, cartridge replacement...

TYPES OF FILTERS

PROPRIETARY- Carbon, ceramic, different micron sizes from .1 to 100 , ultraviolet light (UV) light for drinking water (gets rid of pathogens) , reverse osmosis, in line media, carbon, ceramic, anti scale, well disinfection, ozone, alkalize/ionize, whole house treatment, ultra violet light (UV), distillers, Sediment filters

SITE BUILT- Sand filters, Cat tail ponds, Earthship type bio-cells, Mycorestoration soil restoration via mycillium inoculation

MATCHING WATER SOURCES WITH ACCEPTABLE INTENDED USES

- Roof: potable or grey water uses
- Pedestrian paving: grey water uses
- Vehicle pavement: grey water uses
- Exposed earth & landscaping: irrigation
- Condensate: potable or grey water uses

TO CHOOSE APPROPRIATE FILTERS- Identify from water source what is being removed & what the water will be used for

BOUTIQUE WATER FILTERS

AFTER WATER IS COLLECTED & FILTERED TO POTABLE THERE ARE TRENDY TREATMENTS BELIEVED TO ADD SPECIAL PROPERTIES

- Crystals, magnets, gold & silver (yin vs. yang) Moon & sun light (yin vs. yang), gem stones, minerals
- Lava probiotic ceramics, nano colloids, prayers
- Ionizers/ alkalizers
- Ozone, aeration,
- Vortex whirlpool (clockwise vs. counter clockwise)

SMART BUILDING SENSORS

SEPARATE DEVICES CURRENTLY EXIST TO MEASURE & MONITOR:

1) Tank Volume levels, usage meters, contaminant & bacteria detection, water pressure, leak & loss detection, irrigation controllers with moisture sensors, occupancy sensors to emit conservative amounts at commercial soap dispensers & faucets, temperature , security, on grid vs. off grid, water heater controllers
2) Weather precipitation forecast (helps plan water usage)
3) Automate water audits and commissioning

BLUE OPERATION MANUAL

- Compile these documents in a 3 ring binder &keep this at the property in the utility/maintenance room
- Sub-section of LEED Green Building operation manual
- Include the properties' annual water supply & demand calculations, allocate Indoor potable vs. non-potable vs outdoor non-potable use (The subtotals of different water are used for specific aspects of demand)
- Required areas of the collection areas, size of water storage containers, pipe labeling description, what water comes from where & goes to what
- Make a site plan diagram that locates all of the components , & Manf specification sheets of all components
- maintenance schedule & ledger to enter dates of maintenance

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FOOD WATER NEXUS

LANDSCAPE IRRIGATION BASICS

- Ideally all landscaping is EDIBLE agriculture
- Select Native drought tolerant species
  - GREY WATER Underground delivery 8” to 10” below grade (as per Calif Grey Water code)
  - BLACK WATER Delivery to trees, piped piped underground to below root ball before planting tree
- TO AVOID PERCOLATION & EVAPORATION LOSSES: Plant in Green house with a membrane lined bio-cell

EMBODIED WATER IN FOOD

Internet says USA uses 70% of our water for food production

Internet says we need as low as 700 sq ft/person for vegan diet and up to up to 1 acre per person to grow omnivore diet food (raising animal products uses more water).

Efficient drip irrigation requires 1000 gal per acre per day (climate & soil may vary) . Assume 7 months non rainy season = 213 days x 1000 gal /acre x .016 acre = 3406 gal/yr for vegan

VS.

213 days x 1000 gal /acre x 1 acre =213,000 gal water req'd for omnivore diet food production

GROWING FOOD IN WATER

HYDRO-CULTURE

Growing plants in a soil-less medium

HYDRO PONICS

Growing plants with mineral nutrient solutions without soil

AQUA CULTURE

Aqua-farming of edible organisms (sea food) & plants

AQUA PONICS

Symbiotic aquatic animals, plants & bacteria

FOOD WATER NEXUS

- USA annual water use is 129 trillion gallons per year (2010 statistics)
- 70% is for food production: 90 trillion gallons
- 50% of the food is wasted, representing 45 trillion gallons of water use
- Total USA household water use is 10% of 129 trillion= 12.9 trillion gallons

30% of USA household water use is outdoors.

30% X 12.9 T = 3.8 trillion gal , could irrigating edible landscaping

COSTS & FUNDING OF SYSTEMS

BLUE IS ABOUT FINANCIAL SENSE

If water is too expensive or not available your real estate value drops because:

- You can't develop it
- Can't sell it
- Can't rent it
- Can't occupy it

COSTS OF CISTERNS & STORAGE

- 50 cents/gal installed for very large 200,000 gal & up
- Up to $18/gal for underground including excavation
- Common is $1/gal to $2/gal to $5/gal for above ground tanks

WATER SYSTEM RETURN ON INVESTMENT (ROI)

PACE (Property Assessed Clean Energy) financing computes mandatory 20 year ROI by comparing amortization of system capital costs to what utility rates would be with factored in increased. Currently USA water companies are raising water prices 5% to 15% every few years

http://www.usatoday.com/story/money/business/2012/09/27/rising-water-rates/1595651/

PRICELESS: water security when huge fires come, water security when metered water systems have failures, extra water to grow food

REBATES & FINANCIAL INCENTIVES TO PAY FOR SYSTEM

Water Companies

PACE

LEED & 2030 Living Building Challenge incentives

Insurance Rate Reductions

Grants, Corporate Sponsorship

Micro Finance, Sweat Equity

Lots of energy programs to fund the water heating & renewable energy components of your system

https://ww2.kqed.org/quest/2009/08/28/top-ten-energy-and-water-efficiency-tax-credits-and-rebates/

CALL TO ACTION

CREATING YOUR NET ZERO CLOSED LOOP PROJECT IS EASY TO DO

New construction is more easily achieved

Upgrading existing infrastructure is do-able. Find out about modernizing your existing under-performing property & facilities.

Look into PACE loans for either new or existing facilities www.PaceNation.com

Do you see how Water Users with polluted sources such as Flint or Fracking could use closed loop & reclamation to have a safe independent supply of water not co-mingled with the polluted water source?

CONTACT FOR QUESTIONS & CONSULTING

Marilyn Crenshaw Architect

WWW.TheGreenAndBlueArchitect.com

text: 831-713-9860

Arcwoman @ TheGreenandBlueArchitect.com

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