



MONTANA DNRC FLOODPLAIN PROGRAM 2013

Floodplain Legal & Sustainable Development Workshops July 22-26 2013



drought, fire, flood

Donald Watson, FAIA

MOTIVATING QUESTION

drought, fire, flood



How can Montana best achieve a prosperous, resilient future?

OUTLINE

I - MITIGATION PRINCIPLES & MEASURES

- *drought*
- *fire*
- *flood*

II - WHAT WORKS

- *integrated watershed planning*
- *community design workshops*
- *model projects*



drought

DROUGHT is an extended period of below normal precipitation which causes damage to crops and other ground cover, diminishes stream flow, depletes soil and moisture, and,—because of these effects—causes social, environmental, and economic impacts to Montana.

Montana Drought Response Plan (1995)



<http://drought.mt.gov>

Map Key

- Drought Impact Type
- Continental Divide

Moisture Status

June 2013

- Extremely Moist
- Moderately Moist
- Slightly Moist
- Near Average (Normal)
- Slightly Dry
- Moderately Dry **(Drought Alert)**
- Extremely Dry **(Severe Drought)**

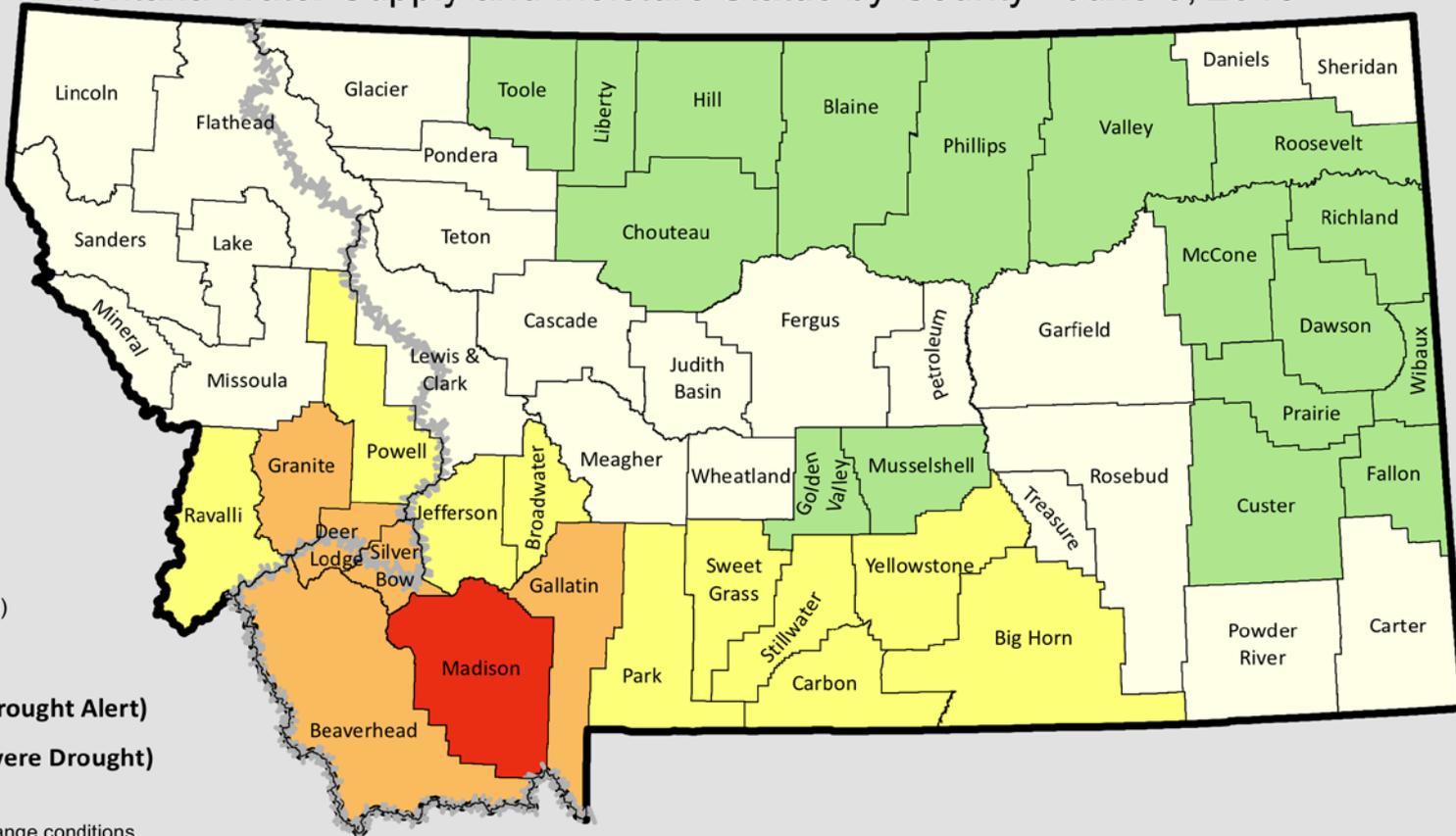
Drought Impact Types -

- A** = Agricultural - Soil Moisture, Range conditions
- H** = Hydrological - Water Supplies, Streamflow, Groundwater

Drought Alert - Governor's Drought Advisory Committee strongly encourages local officials to convene local drought committees.

Severe Drought - Local officials should have local drought planning efforts underway or should reconvene the local drought committee at the earliest opportunity. For recommended responses, see the Montana Drought Plan

Montana Water Supply and Moisture Status by County - June 6, 2013



Montana County Moisture Status - Climate Summary

According to the National Weather Service Montana May Weather and Precipitation Report, "Overall, May had above normal temperatures and below normal precipitation. The heaviest precipitation fell over the higher elevations in central Montana, with amounts exceeding 16-inches in the Big Snowy Mountains. Flooding and flash flooding was observed in Miles City on the 18th. Another wet round occurred at the end of the month. Three to nine inches of rain fell over wide portions of eastern Montana. Again, flooding was reported at several locations as the soil became saturated. Snow had largely melted out at lower elevations across the state. At higher elevations, at the end of the month Flattop Mountain had 72 inches on the ground (80), Spur Park 30 inches (36), Black Bear 31 inches (64), and Noisy Basin 55 inches (67)."

The June 10, 2013 USDA Crop Weather Report notes that, "Much of Montana had hot days and mild nights for the week ending June 9. Lewistown received the highest amount of precipitation for the week with 2.84 inches of moisture. Topsoil moisture adequate and surplus is 90 percent compared with 72 percent last year and the 5 year average of 85 percent. Subsoil moisture was 71 percent adequate and surplus compared to 69 percent last year and the 5 year average of 77 percent. The weather outlook for June 17th through June 23rd is for near normal temperatures and above normal precipitation both east and west of the Great Divide. Warm, sunny weather following the heavy rains of the last weeks of May has greatly improved range conditions and promoted grass growth. Winter wheat continues to develop behind last year with 21 percent in boot stage 5 and 3 percent headed. Spring wheat condition is off to a good start with 59 percent and has begun to enter boot stage." Winter Wheat is rated as 32% Fair; 45% Good; and 10% Excellent.



<http://nr.is.mt.gov/drought/>

U.S. Drought Monitor

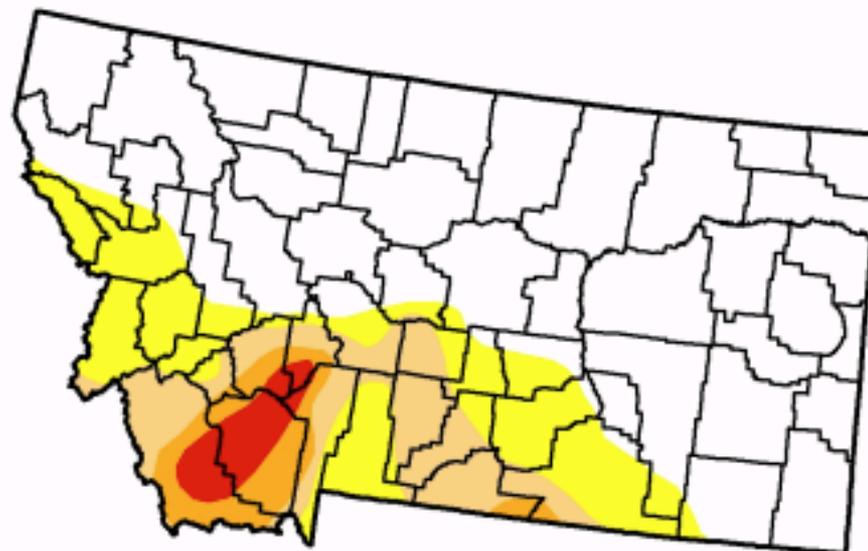
Montana

June 25, 2013

Valid 7 a.m. EST

Drought Conditions (Percent Area)

	None	D0-D4	D1-D4	D2-D4	D3-D4	D4
Current	67.79	32.21	15.70	6.34	2.48	0.00
Last Week (06/18/2013 map)	65.53	34.47	15.70	6.34	2.48	0.00
3 Months Ago (03/26/2013 map)	52.44	47.56	32.08	19.71	3.51	0.00
Start of Calendar Year (01/01/2013 map)	52.56	47.44	33.90	18.90	6.91	0.00
Start of Water Year (09/25/2012 map)	18.74	81.26	62.51	29.15	4.18	0.00
One Year Ago (06/19/2012 map)	56.02	43.98	4.36	0.00	0.00	0.00



Intensity:

- D0 Abnormally Dry
- D1 Drought - Moderate
- D2 Drought - Severe
- D3 Drought - Extreme
- D4 Drought - Exceptional

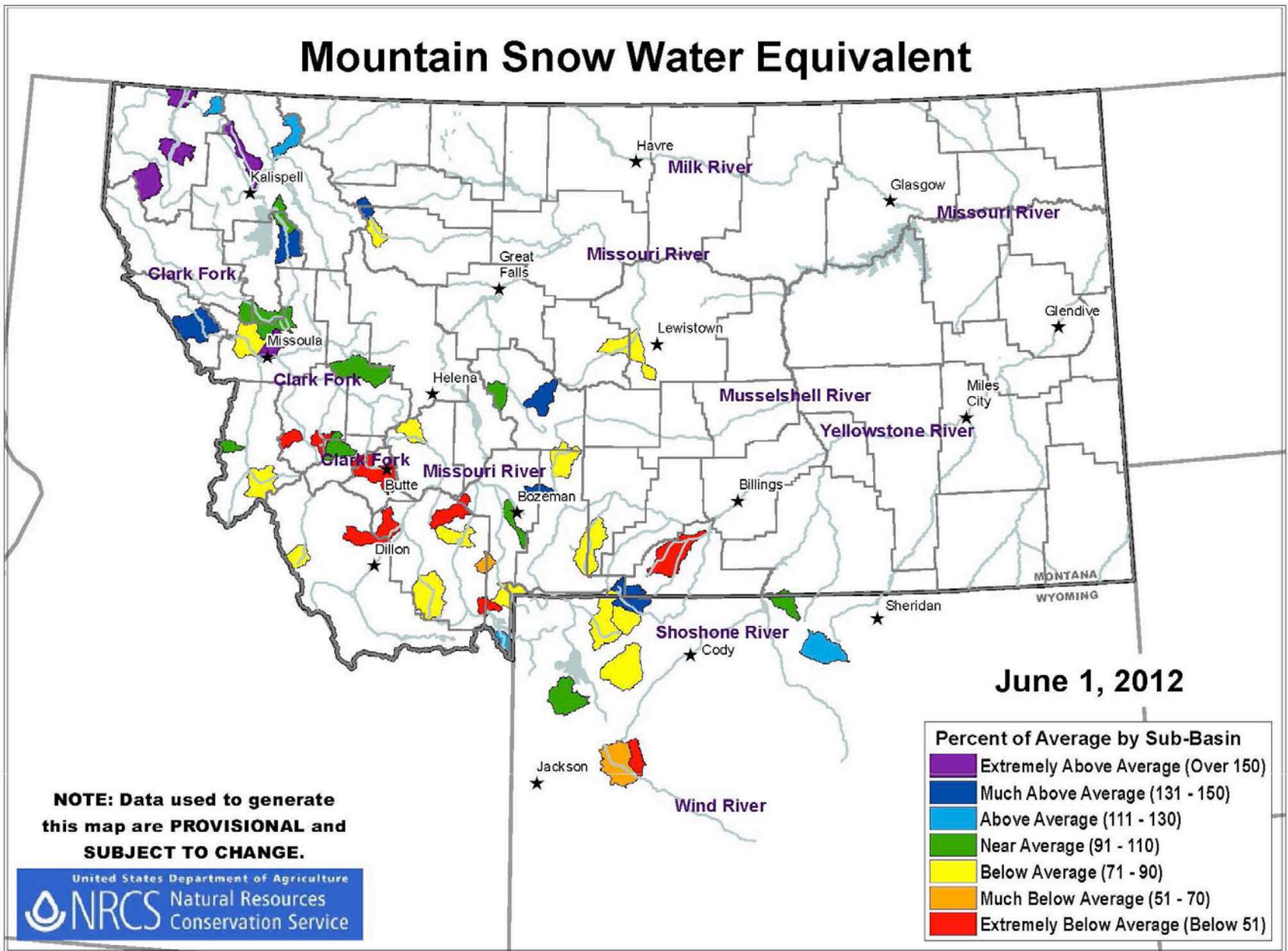
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

<http://droughtmonitor.unl.edu>



Released Thursday, June 27, 2013
Mark Svoboda, National Drought Mitigation Center

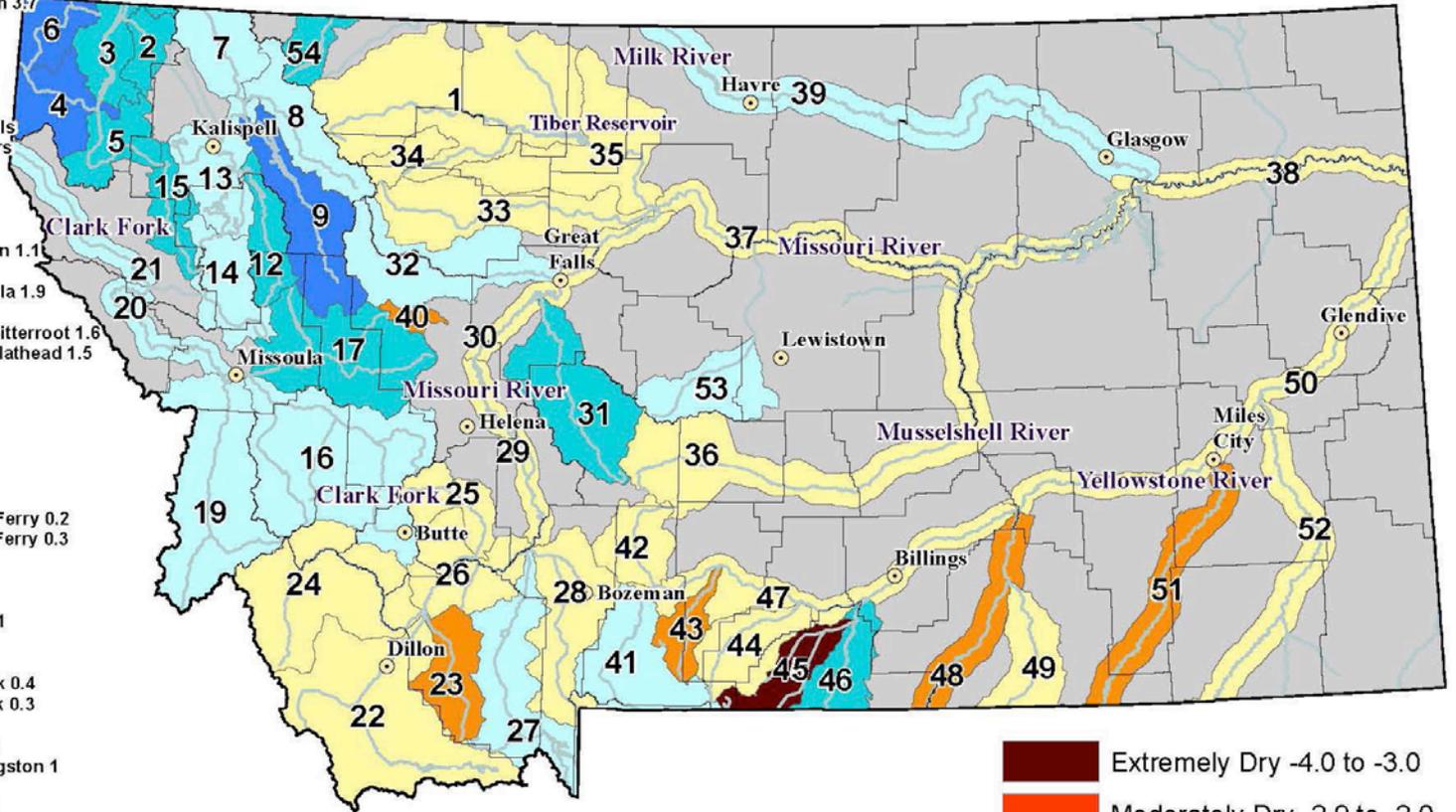
Mountain Snow Water Equivalent



RIVER INDEX & SWSI VALUES

- 1 Marias above Tiber Reservoir 0.2
- 2 Tobacco 2.7
- 3 Kootenai Ft. Steele to Libby Dam 2.5
- 4 Kootenai below Libby Dam 3.7
- 5 Fisher 2.4
- 6 Yaak 3.1
- 7 North FK. Flathead 1.3
- 8 Middle FK. Flathead 1.7
- 9 South FK. Flathead 3.1
- 10 Flathead at Columbia Falls
- 11 Stillwater/Whitefish Rivers
- 12 Swan 2.9
- 13 Flathead at Polson 1.4
- 14 Mission Valley 1.6
- 15 Little Bitterroot 2.3
- 16 Clark Fork above Milltown 1.1
- 17 Blackfoot 2.4
- 18 Clark Fork above Missoula 1.9
- 19 Bitterroot 1.9
- 20 Clark Fork River below Bitterroot 1.6
- 21 Clark Fork River below Flathead 1.5
- 22 Beaverhead -0.7
- 23 Ruby -1
- 24 Big Hole 0.6
- 25 Boulder (Jefferson) -0.1
- 26 Jefferson 0.4
- 27 Madison 1.4
- 28 Gallatin -0.3
- 29 Missouri above Canyon Ferry 0.2
- 30 Missouri below Canyon Ferry 0.3
- 31 Smith 2.8
- 32 Sun 1
- 33 Teton 0.1
- 34 Birch/Dupuyer Creeks 0.1
- 35 Marias 0.9
- 36 Musselshell 0.9
- 37 Missouri above Fort Peck 2.4
- 38 Missouri below Fort Peck 0.3
- 39 Milk 1.2
- 40 Dearborn near Craig -1.6
- 41 Yellowstone above Livingston 1
- 42 Shields 0.1
- 43 Boulder (Yellowstone) -1
- 44 Stillwater -0.4
- 45 Rock/Red Lodge Creeks -3.4
- 46 Clarks Fork Yellowstone 2.2
- 47 Yellowstone above Bighorn River 0.8
- 48 Bighorn below Bighorn Lake -1.4
- 49 Little Bighorn -0.8
- 50 Yellowstone below Bighorn -0.2
- 51 Tongue -1
- 52 Powder -0.9
- 53 Upper Judith 1.6
- 54 Saint Mary 2.4

Surface Water Supply Index (SWSI) Values

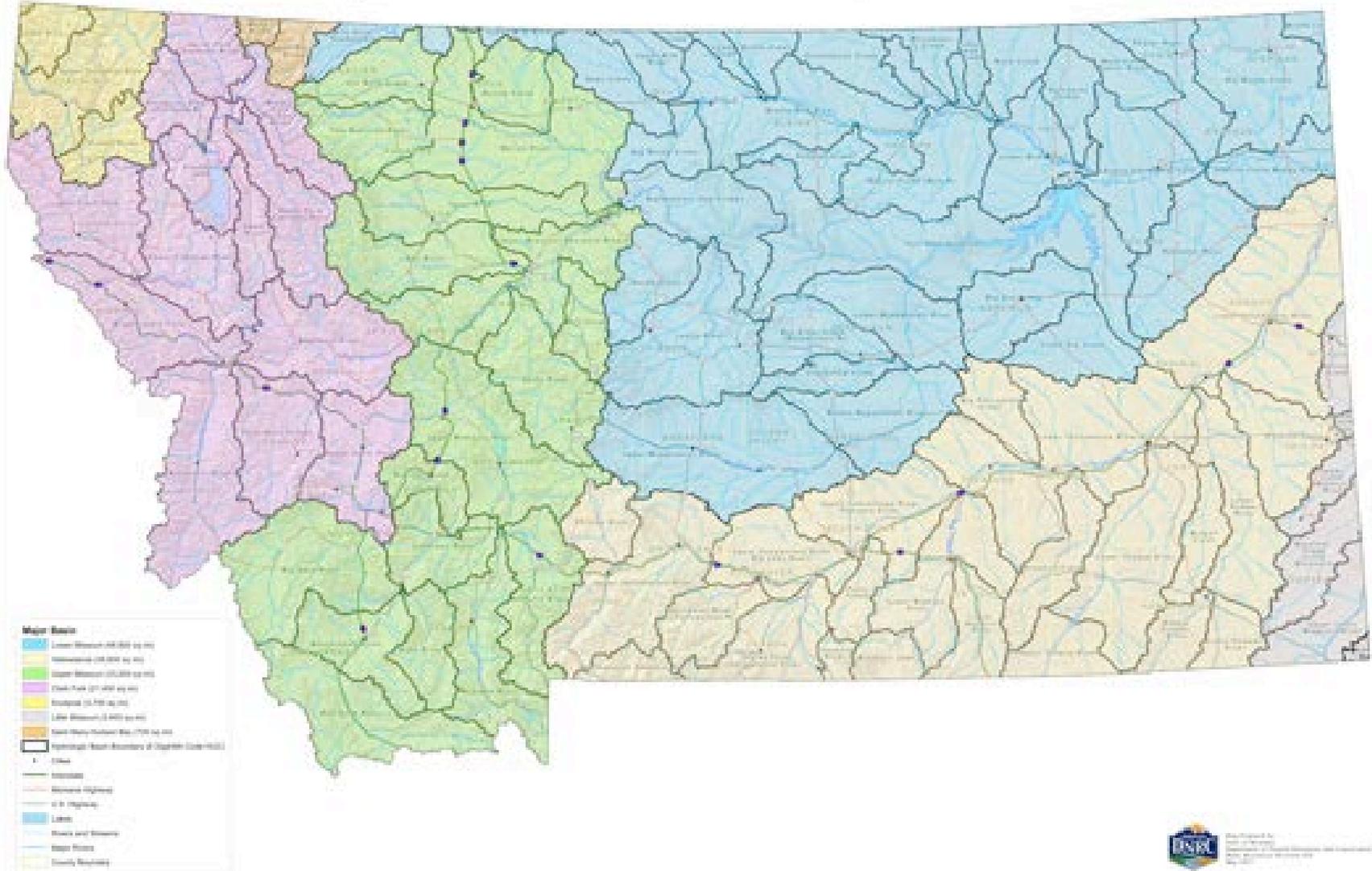


June 7, 2012

NOTE: Data used to generate this map are PROVISIONAL and SUBJECT TO CHANGE.



2015 Montana Water Supply Initiative Major Water Planning Basins



DNRC *Montana State Water Supply Initiative – 2015*

• http://www.dnrc.mt.gov/wrd/water_mgmt/state_water_plan/

DROUGHT MEASURES

Native landscapes
Grasses & wildflowers
Trees & shrubs
Water conservation



DROUGHT MEASURES



Water is wasted as runoff when applied too heavily or too rapidly. Excessive slope and poor location for turf area contribute to this situation.



Low pressure sprinkler systems conserve water by delivering small amounts exactly where needed.



Soaker hoses deliver water slowly and with very little loss to evaporation.



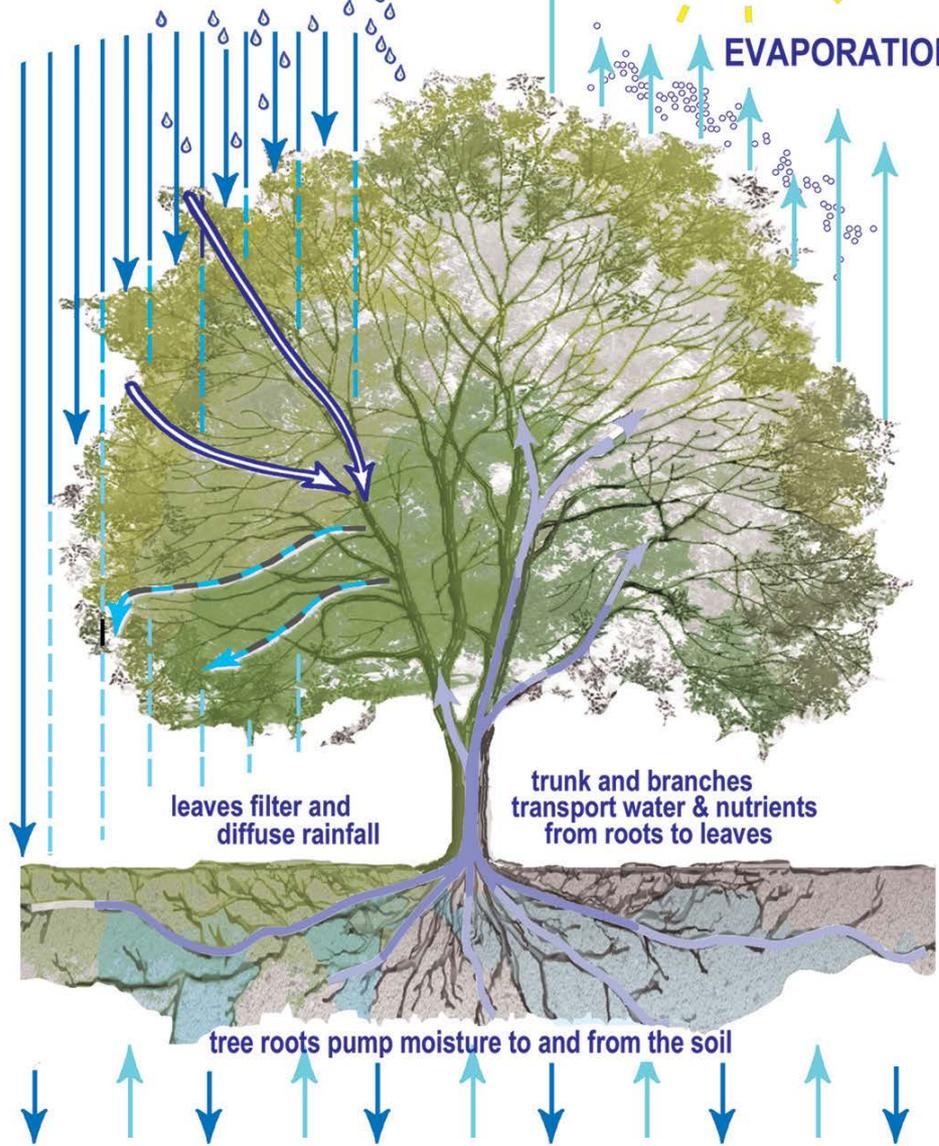
Mulches such as rock or bark can be placed on top of the landscape fabric to attain a particular aesthetic appearance.

Caution: *Rock mulch can serve as a heat sink and also reflect heat to surrounding plants and buildings.*

DROUGHT MEASURES

PRECIPITATION

EVAPORATION



Trees as water pumps

DROUGHT MEASURES



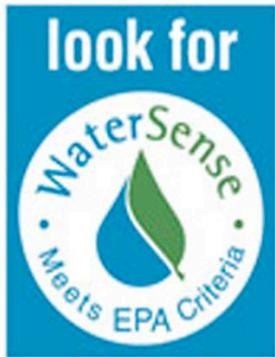
Rainwater harvesting
Composting
Xeriscape
Soil conservation
Biodiversity / birds & insects



DROUGHT MEASURES



Sloan AQUUS Water Reclamation



Water efficient plumbing
Grey water recovery



Gates Prize Eawag Toilet



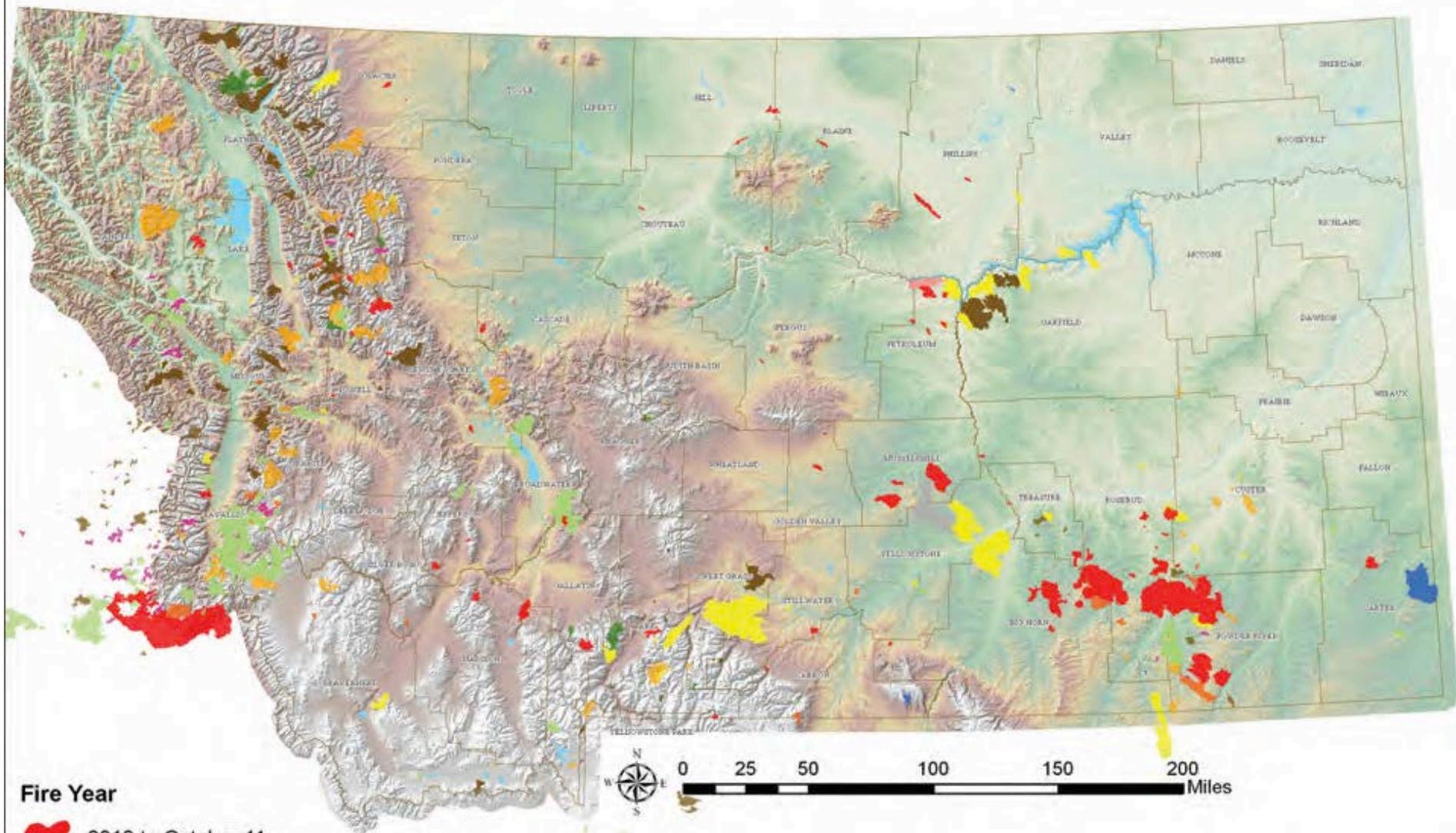
Education

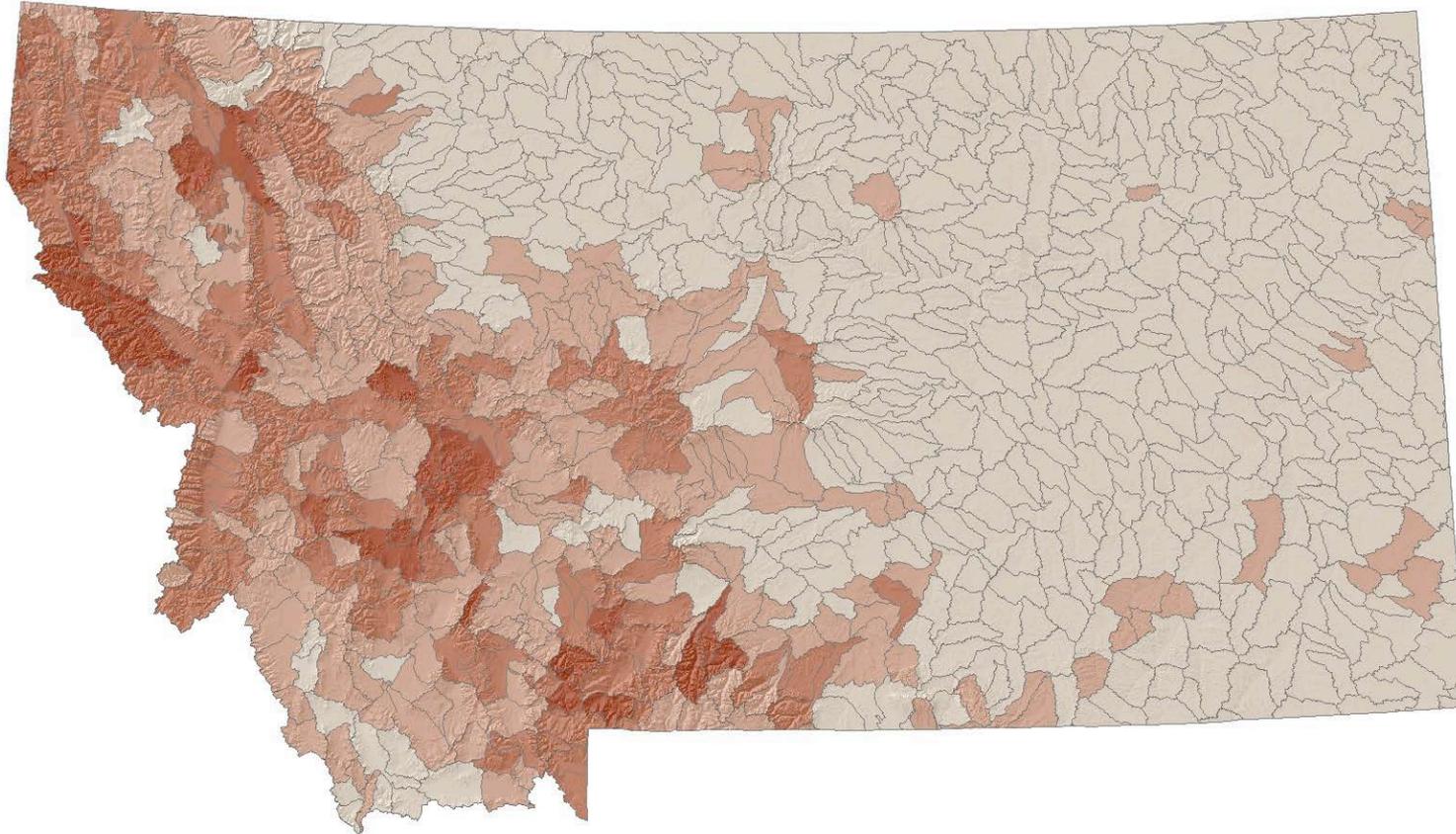
fire



“Drought conditions, the build-up of hazardous fuels, and more homes in fire-prone landscapes are changing how we experience wildfire in America.”

National Association of State Foresters
November 26, 2007

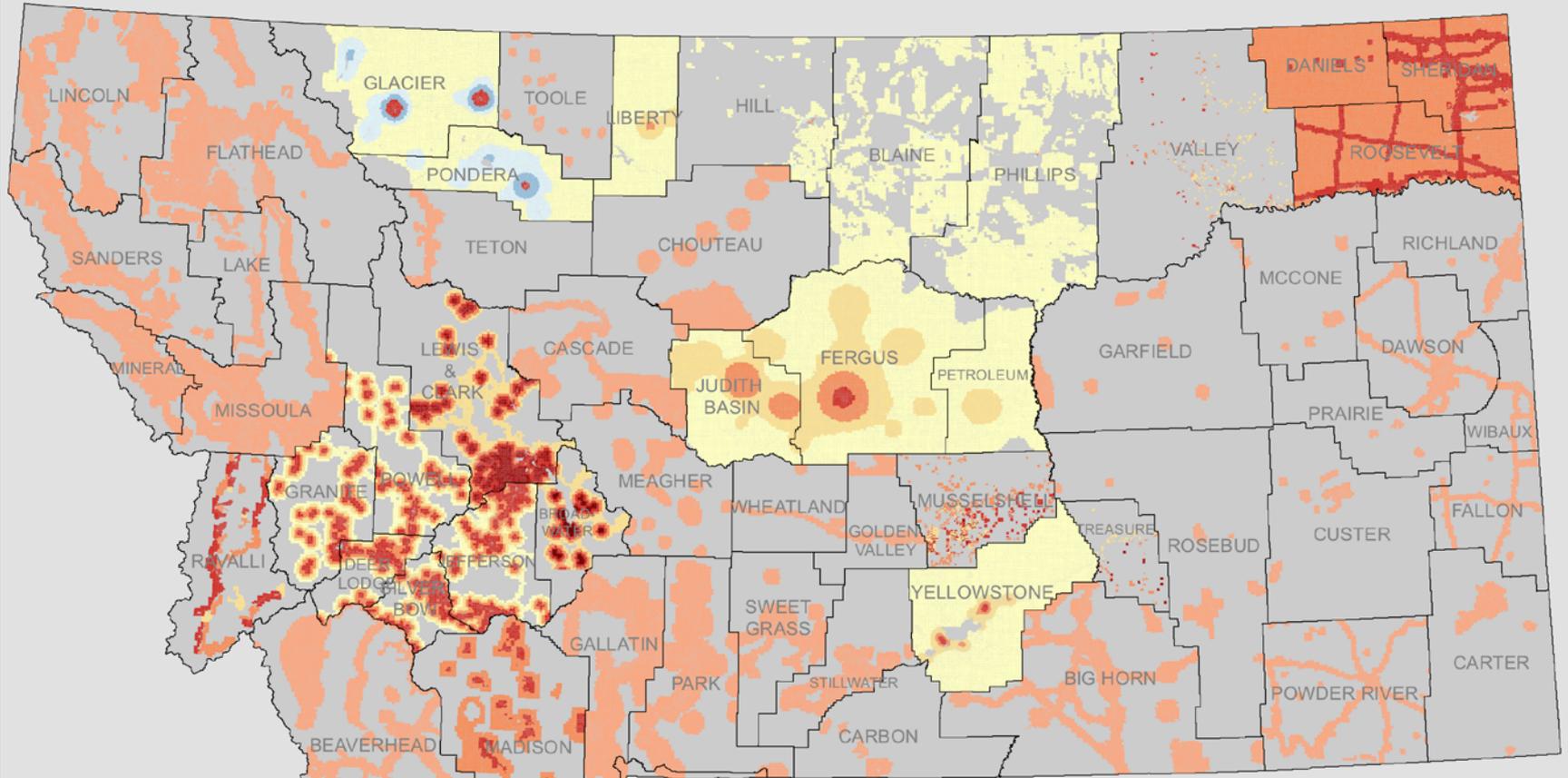




14 communities across Montana have taken actions... to earn Firewise recognition.

Studies by scientists in Montana indicate that the trend toward longer and often drier fire seasons will continue for some time.

Montana Wildland Urban Interface (WUI) Parcels



WUI boundaries were created by individual counties through their Community Wildfire Protection Plan (CWPP) planning processes. Varying WUI delineation methods resulted in multiple county representations that are inconsistent at the state level. Very few counties determined WUI to the parcel level through this process. Montana Department of Natural Resources Fire and Aviation Bureau was required by MCA 76-13-145 to identify WUI parcels using CWPP WUI maps.

Generalized WUI Categories

- | | |
|---|---|
|  WUI for counties with only one category |  High Density Intermix |
|  Extreme Hazard or Very High Risk WUI |  Moderate Density Intermix |
|  High Risk or Hazard, or High Density Interface, or 1 mile WUI Buffer, or Priority 1 |  Low Density Intermix |
|  Moderate to High Risk or Hazard, or Moderate Density Interface, or 2 mile WUI Buffer, or Priority 2 | |
|  Low Risk or Hazard, Low-Moderate Density Interface, or 3 mile WUI Buffer, or Priority 3 | |
|  Rural Land WUI, or Wildland Intermix, or 4 mile WUI Buffer | |



December 2011

FIRE PRINCIPLES

U.S. Dept. of the Interior
Bureau of Land Management (BLM)

FIRE MANAGEMENT STRATEGY (representative only)

- *Avoid dozer line construction **within riparian area**...qualified resource advisor, will review the flagged location for the fire line and identify concerns...*
- *Encourage use of **natural firebreaks and existing roads** to contain wildland fire.*
- ***Protect and/or maintain municipal watersheds.***
- *To **minimize spread of noxious and invasive plant species**, equipment used for suppression should be cleaned before arriving on-site and prior to leaving the incident.*

FIRE MEASURES



Defensible space

FIRE MEASURES



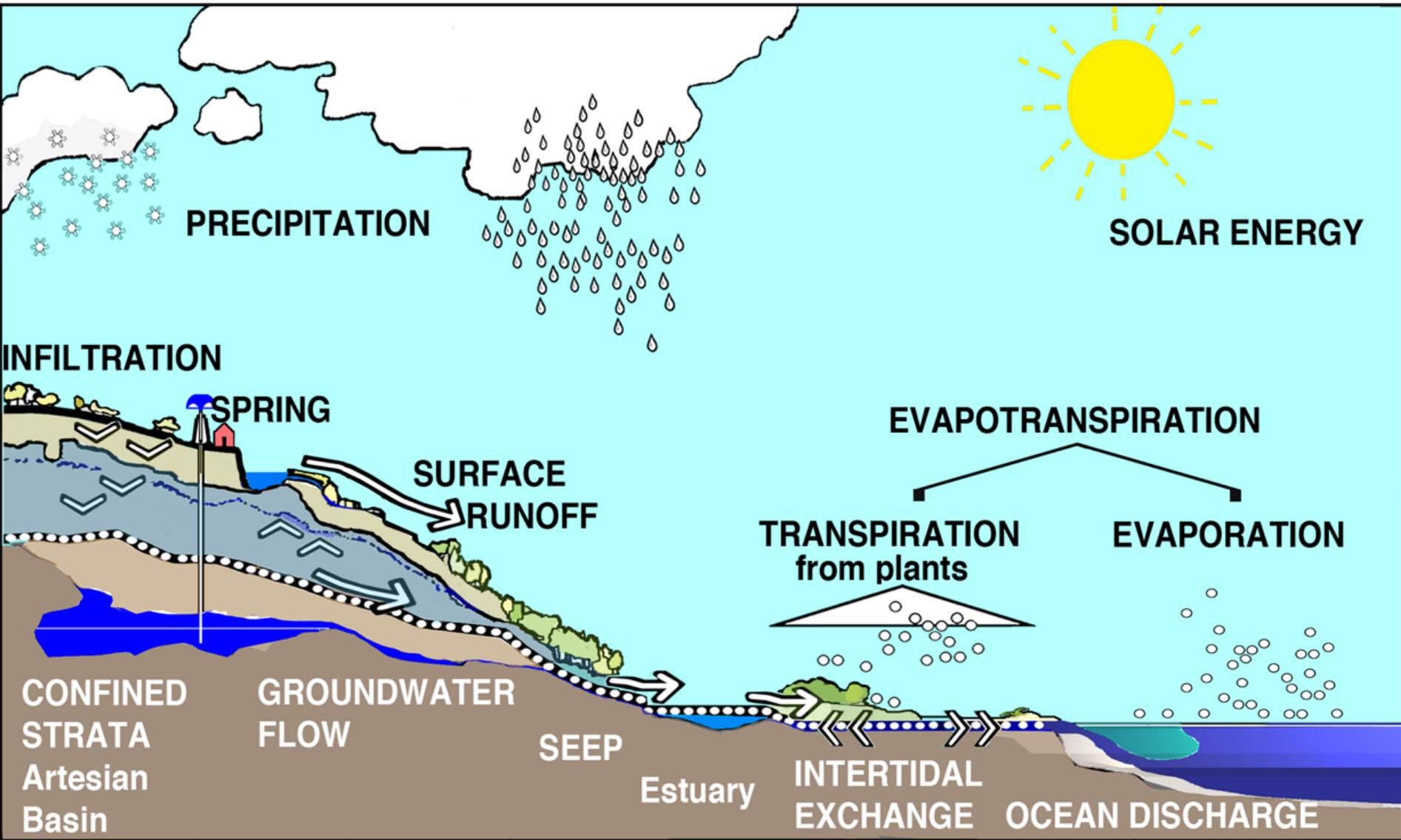
Fire resistant landscaping



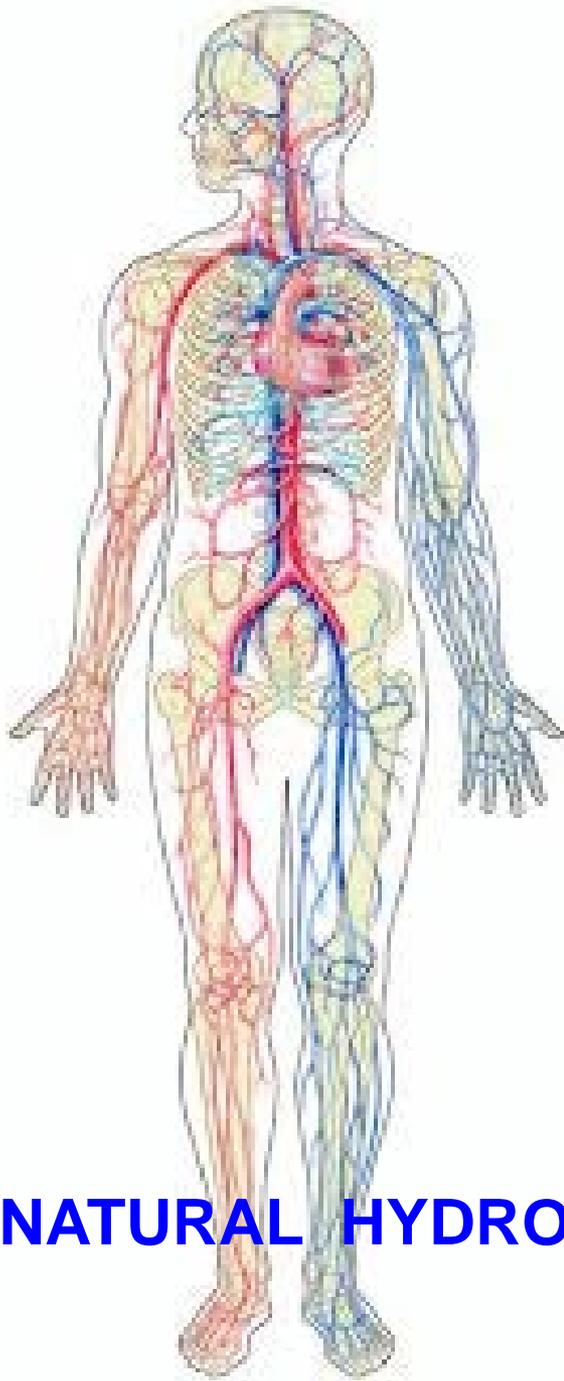
Education

flood





WATER BALANCE ACCOUNT

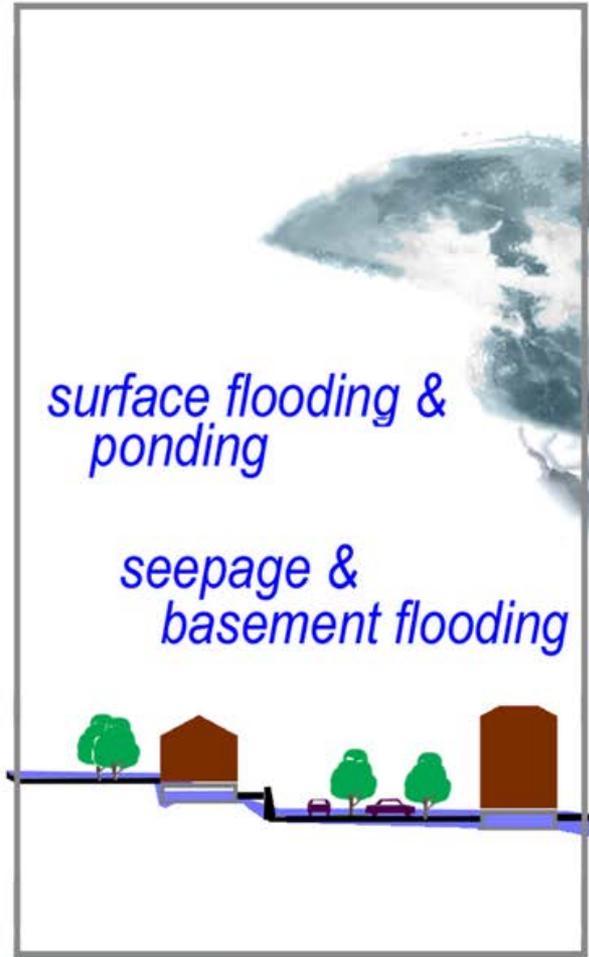
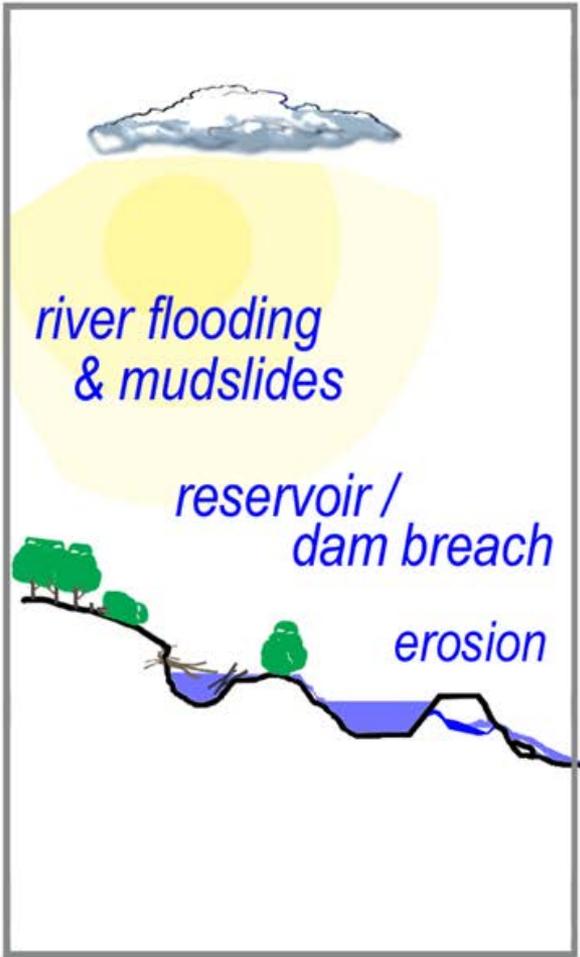


NATURAL HYDROLOGY



DENDRITIC PATTERNS





ALLUVIAL FAN / UNCERTAIN FLOW FLOODING →

SHALLOW FLOODING →

← **INLAND FLOODING (RIVERINE FLOODING)** →



ALLUVIAL FAN – UNCERTAIN FLOW FLOODING



Irrigation gate build after 2010 flood damaged by recent flood water on Boxelder Creek

Crews use heavy equipment to shore up Lower Boxelder Road June 4, 2013



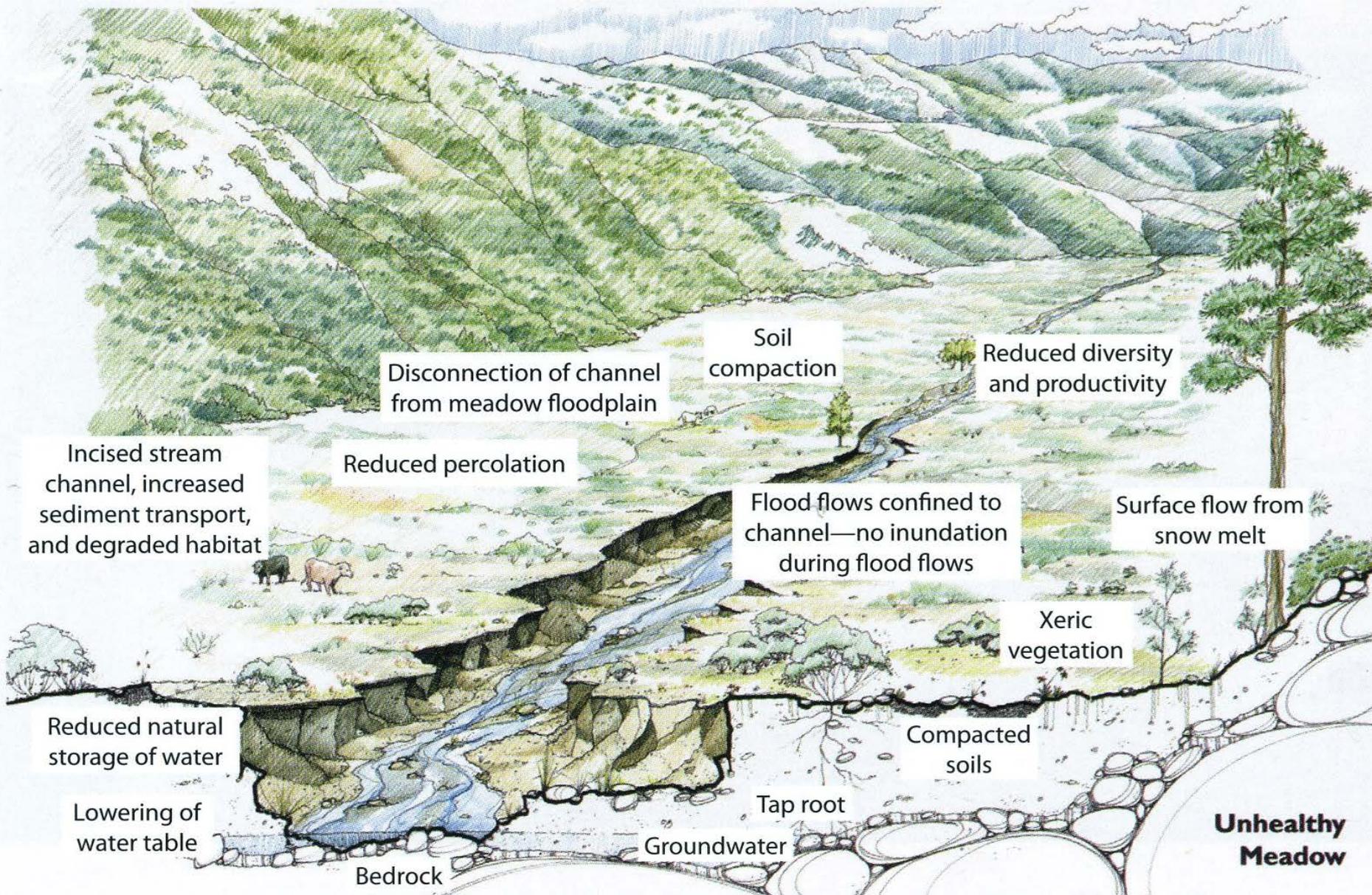


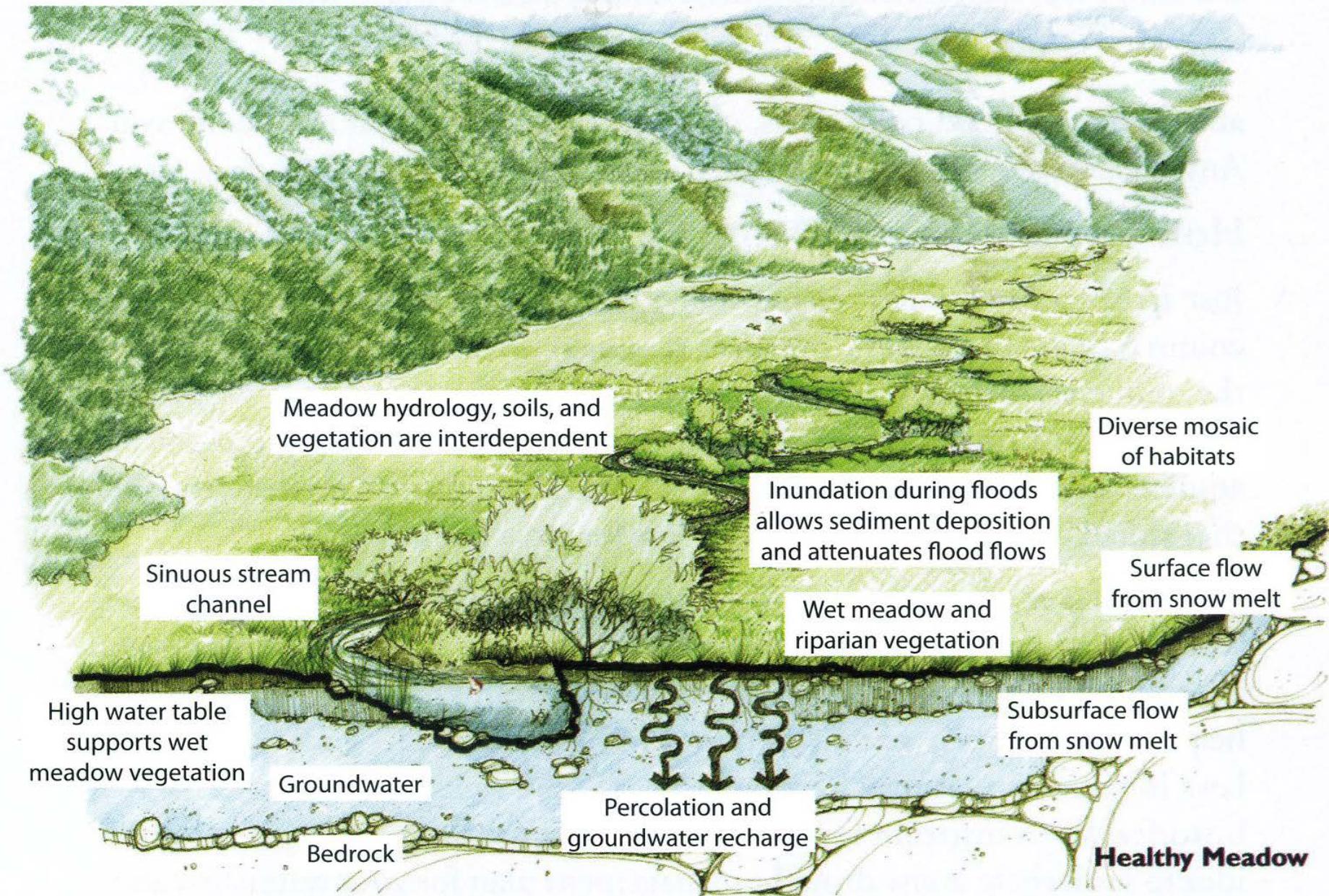
Brandon Udelhoven shared these photos from near Winifred and says:

"We have received almost 3.5 inches over night...all the creeks are flooding and washing away roads and crossings. My father says this is the most water he's seen in his 62 years of life."

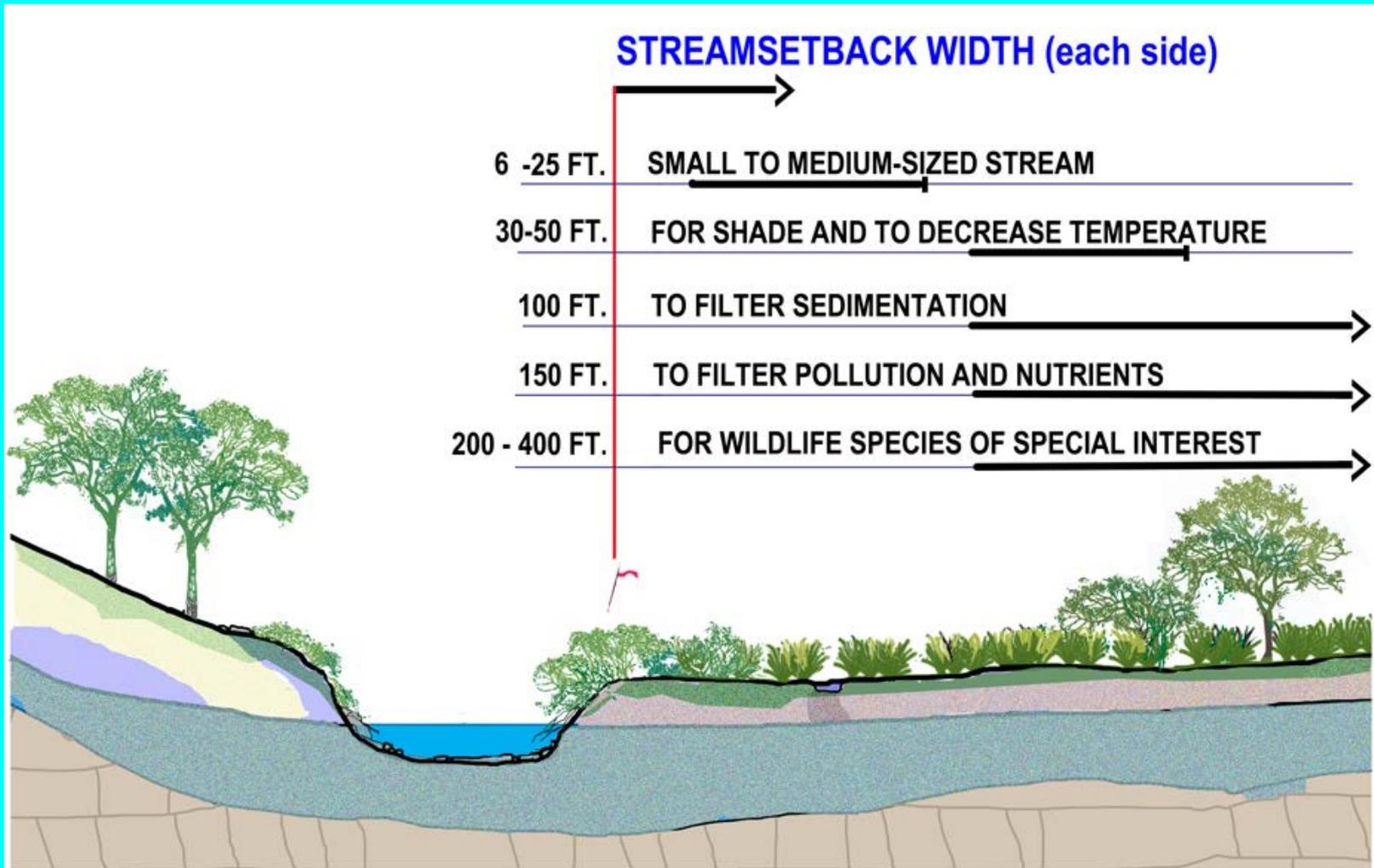
KRTV.com June 3, 2013 *Flooding continues in Montana*

<http://www.krtv.com/news/flooding-continues-in-montana-viewer-photos>





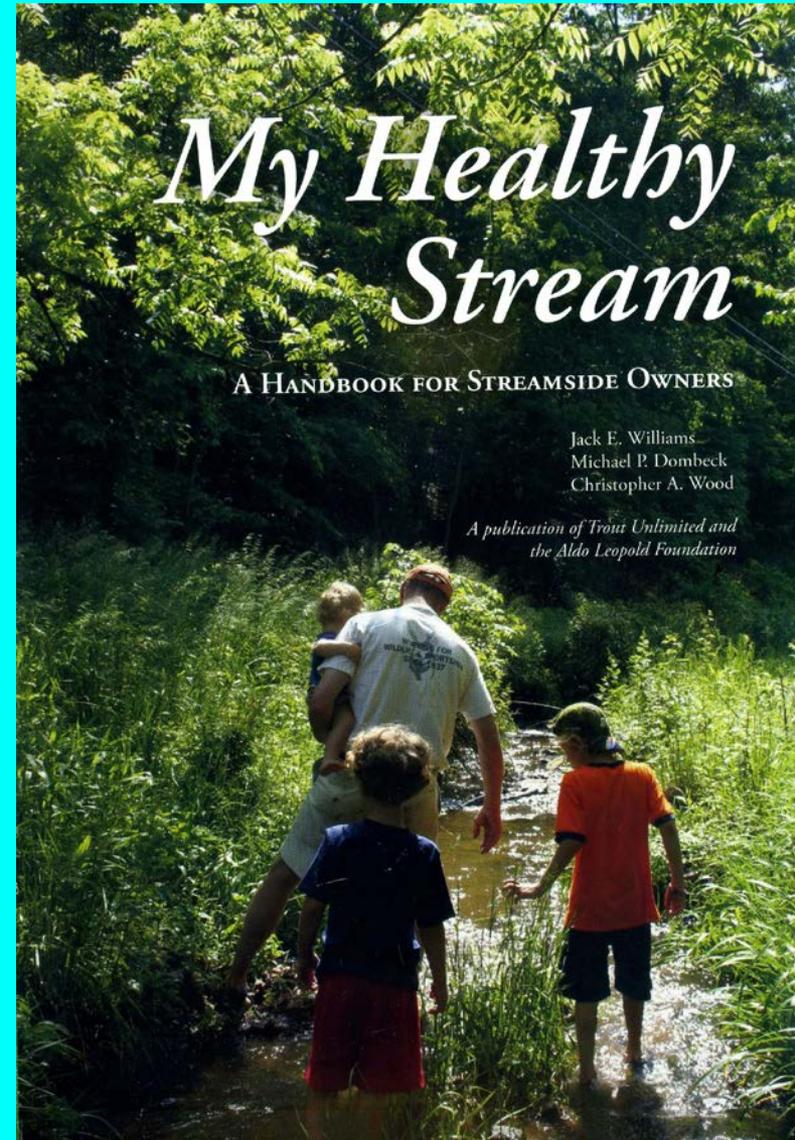
FLOOD MEASURES



Stream corridor / riparian buffer

FLOOD MEASURES

Riparian zone protection
Instream fish restoration
Willow weaving
Silt reduction
Culvert replacement
Irrigation canal screening



FLOOD MEASURES

Different challenges call for different restoration projects. Monitoring your stream can help you determine your restoration priorities and direct you to which methods will be most effective.



Restoring Instream Fish Habitat

PROBLEM: The stream channel has become simplified over time, lacking habitat diversity and deep pools.

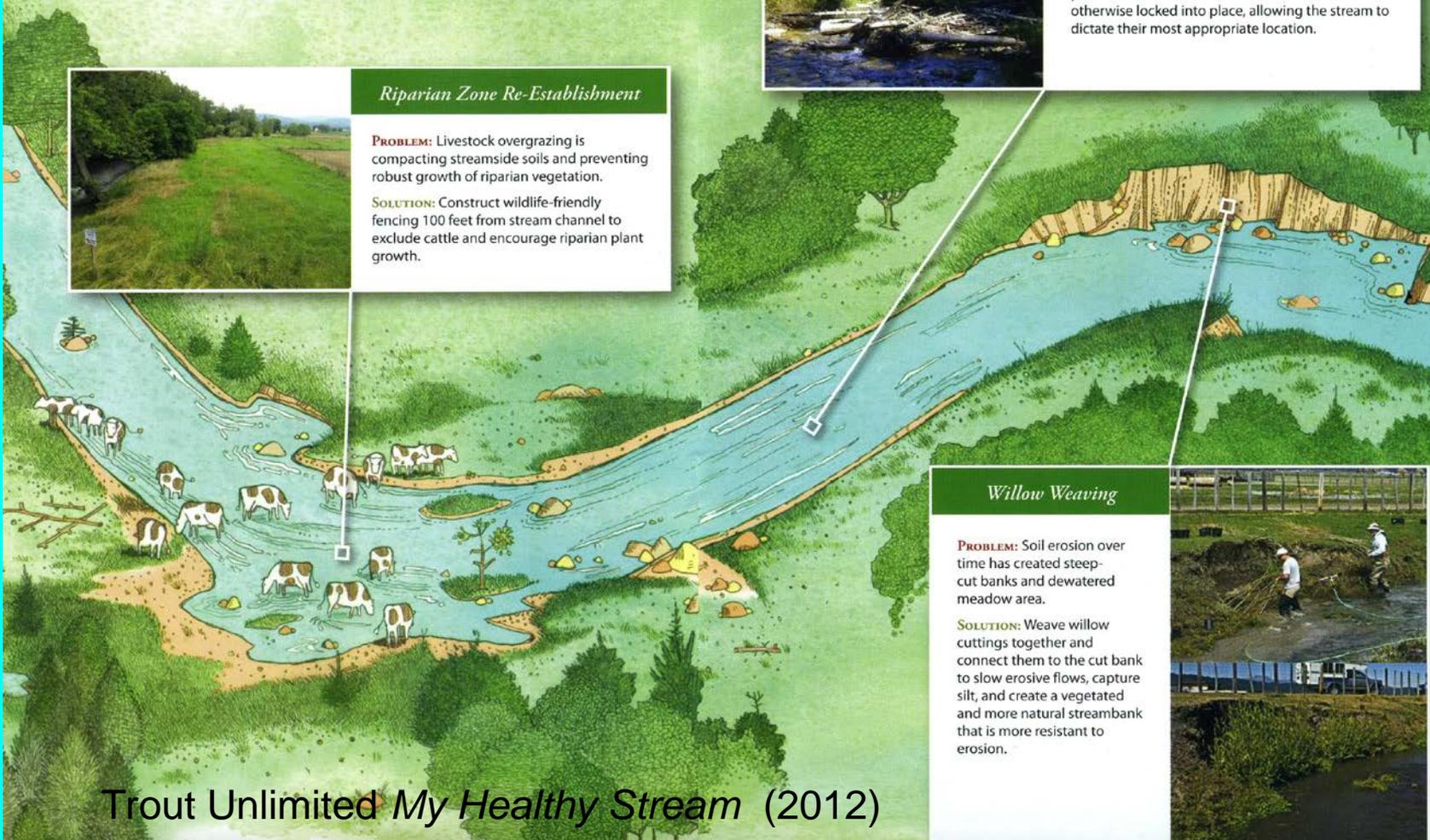
SOLUTION: Introduce logs, root wads, and large boulders throughout the channel, which will help build more diverse habitats as stream flows interact with these structures to dig holes and move sediment. These habitat structures are simply placed into the stream channel and not cabled or otherwise locked into place, allowing the stream to dictate their most appropriate location.

Riparian Zone Re-Establishment



PROBLEM: Livestock overgrazing is compacting streamside soils and preventing robust growth of riparian vegetation.

SOLUTION: Construct wildlife-friendly fencing 100 feet from stream channel to exclude cattle and encourage riparian plant growth.



Willow Weaving

PROBLEM: Soil erosion over time has created steep-cut banks and dewatered meadow area.

SOLUTION: Weave willow cuttings together and connect them to the cut bank to slow erosive flows, capture silt, and create a vegetated and more natural streambank that is more resistant to erosion.



FLOOD MEASURES



www.fws.gov/angered/news/pdf/2001

Riparian zone protection

Solar pump installed by rancher to bring water to cattle and encourage grazing in uplands away from newly fenced and replanted riparian zone.

FLOOD MEASURES



DETENTION

Temporary holding area



RETENTION

Clean and absorb into soils /aquifer

Detention / Retention ponds

FLOOD MEASURES



Figure 5-6. The City of Boulder, Colorado, installed a “pop up” closure to this floodwall at a City office building subject to flash floods.



Figure 5-7. Small patio floodwall with sump pump

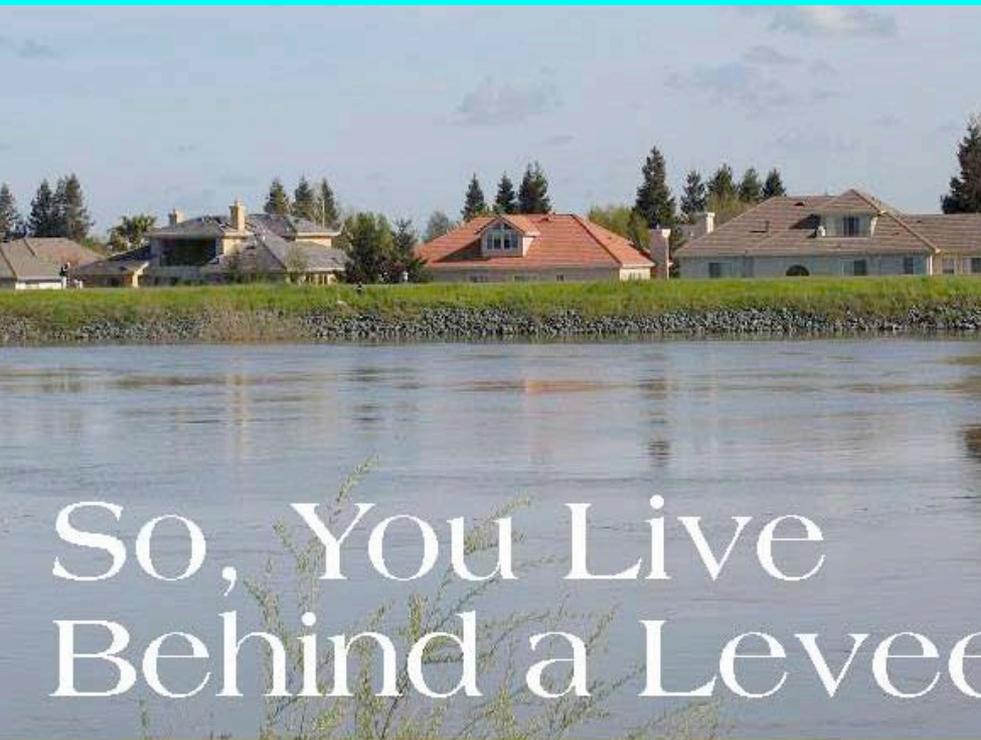


Flood Barriers

L: www.floodsense.UK

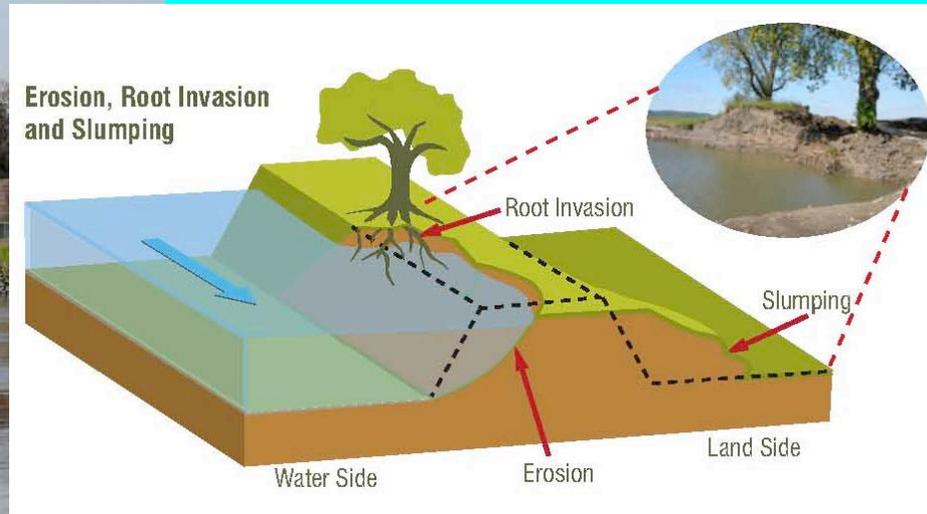
R: FEMA 551 *Selecting Appropriate Mitigation Measures for Floodprone Structures*

FLOOD MEASURES



So, You Live
Behind a Levee!

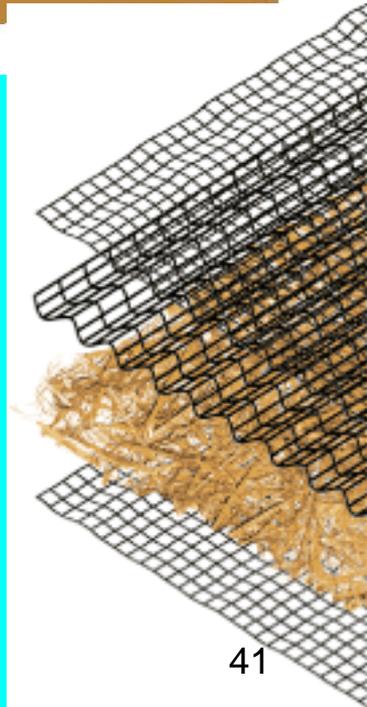
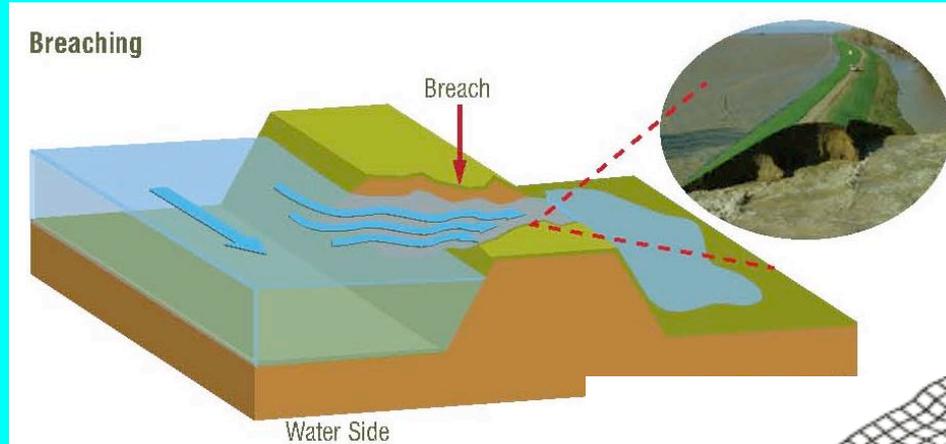
What you should know to protect your
home and loved ones from floods.



Levees

American Society of Civil Engineers *So You Live Behind A Levee!*
content.asce.org/ASCELeveeGuide.html

FLOOD MEASURES



<http://www.conteches.com/Products/Erosion-Control>

High Performance Turf Reinforcement Mats

FEMA <http://www.fema.gov/mitigationbp/brief.do?mitsId>

FLOOD MEASURES



Water gate (BDFS) roll-out plastic construction



BoxBarrier (BAM/Infra /GMB) Box

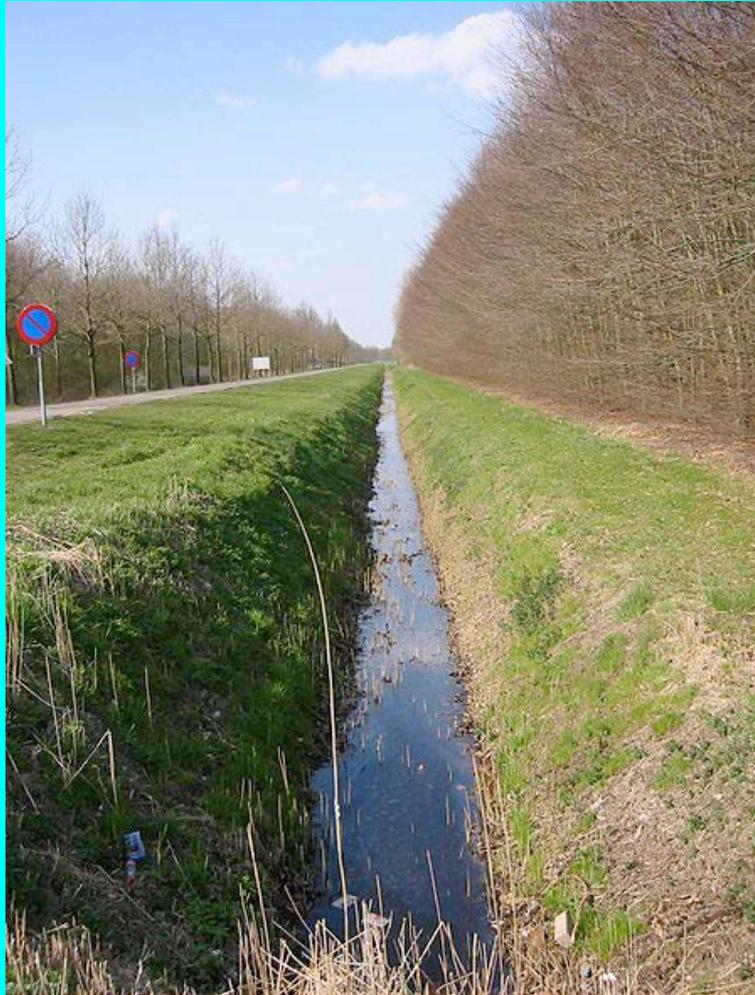


Green Soil Bag degradable, fill with sand, clay grass seeds and roots

Temporary Flood Defenses

VPDelta www.dutchwatersector.com/news-events/news/6465-flood-proof-holland-opens-test-facility-for-new-temporary-flood-defence-systems.

FLOOD MEASURES



Redundant systems

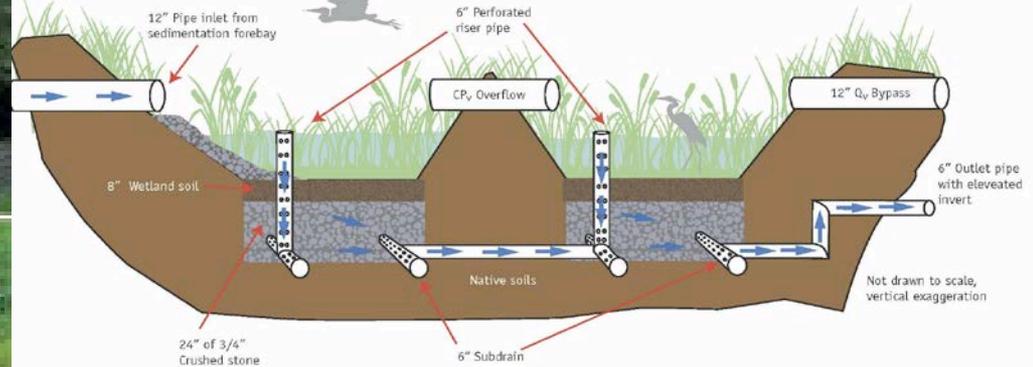
Left and bottom right: <https://en.wikipedia.org/wiki/Ditch>

Upper right: www.mt.nrcs.usda.gov/technical/images/forestimages



DRAINAGE DITCH behind LEVEE Holland

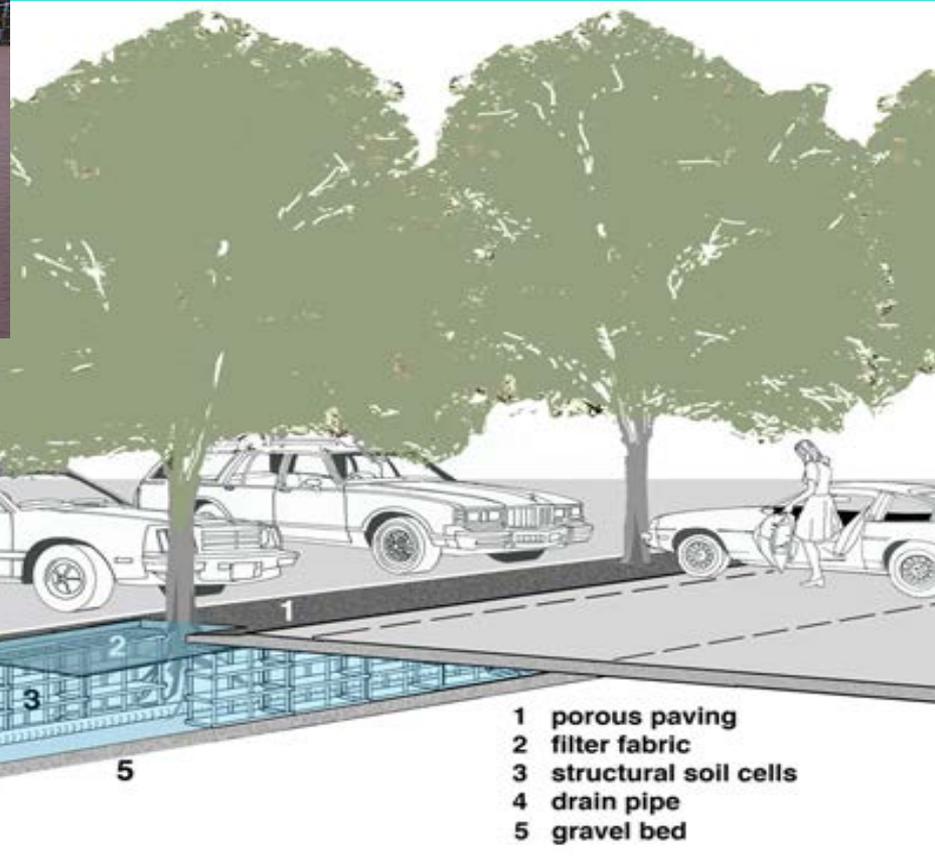
FLOOD MEASURES



Subsurface gravel wetland

Remove pollutants while maintaining saturation of wetland (hydric) soils.
Univ. of New Hampshire Stormwater Center • www.unh.edu/unhsc

FLOOD MEASURES



Structural soil cells, Washington, DC
PHOTO: Casey Trees

Green infrastructure

FLOOD MEASURES



Curb “bump outs” & porous paving

RESIDENTIAL BUILDING



Selecting Appropriate Mitigation Measures for Floodprone Structures

FEMA 551 / March 2007

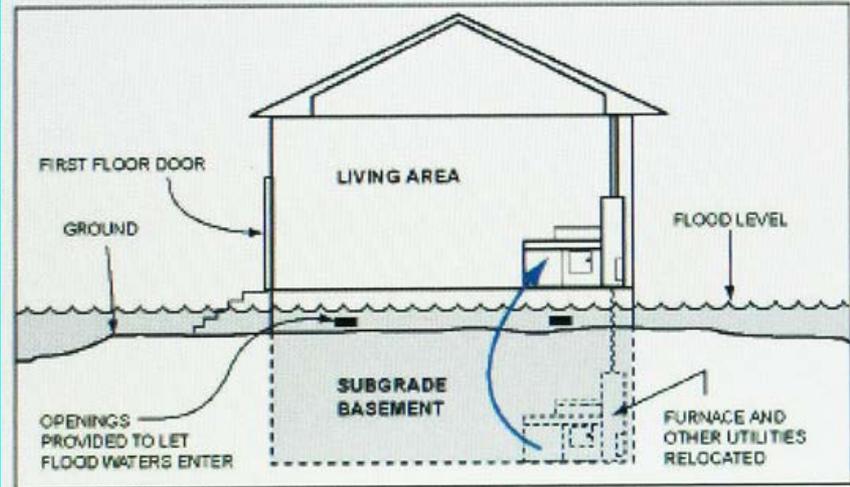


Figure 6-6. Wet floodproofing with a wet floodproofed subgrade basement
(Source: FEMA 312)

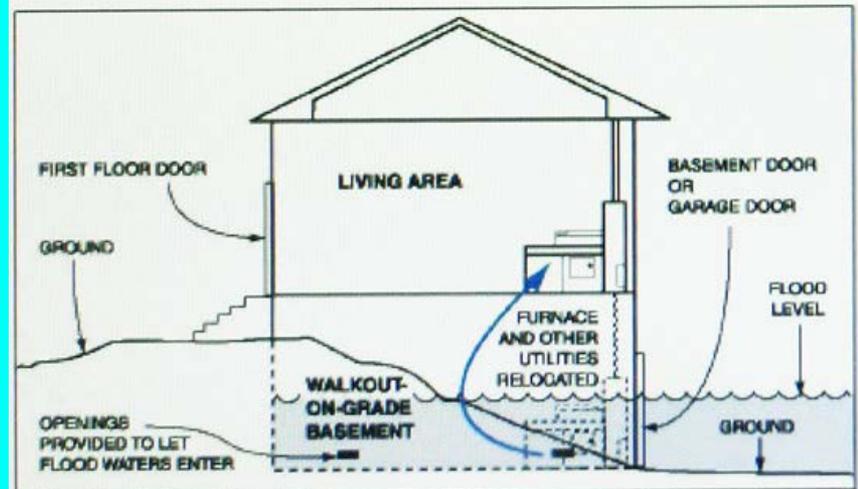
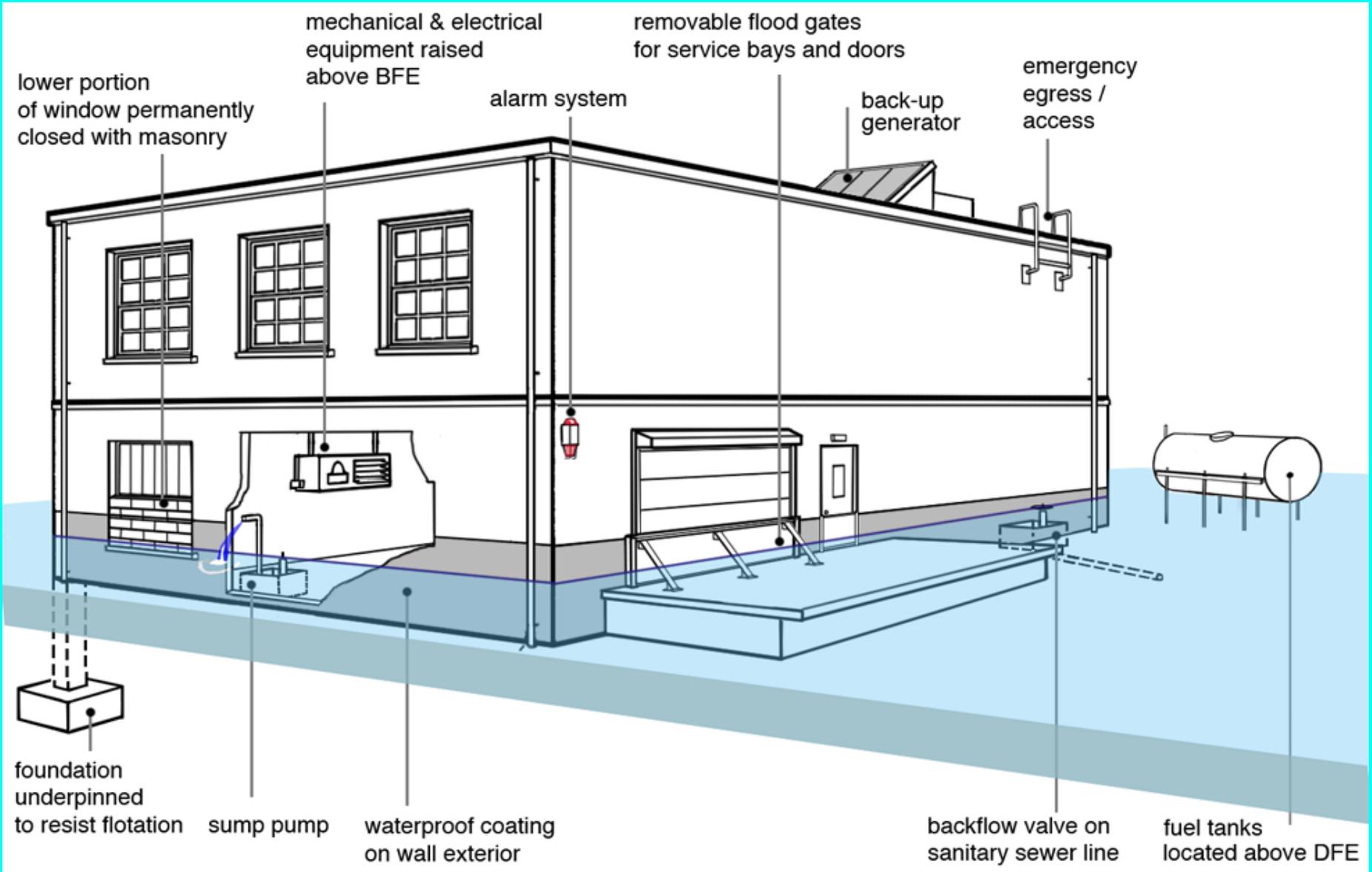


Figure 6-7. A structure with a wet floodproofed walkout-on-grade basement

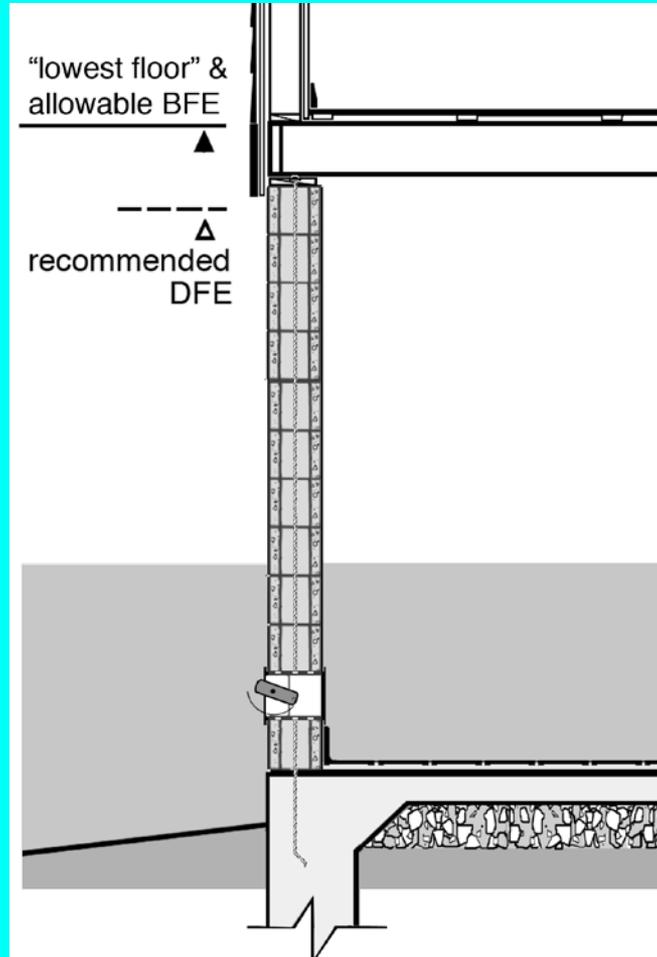
COMMERCIAL BUILDING



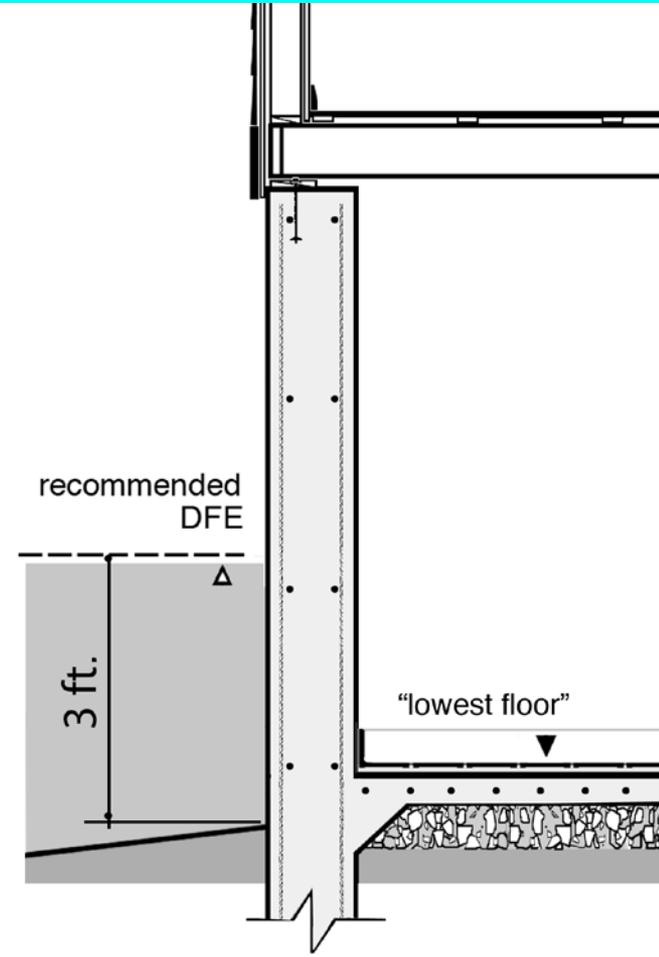
FLOODPROOFING “wet” vs. “dry”



® FloodVent



WET FLOODPROOFING



DRY FLOODPROOFING



Aquarium of the Pacific Long Beach CA Main Street Design

Education



RIVERINE FLOODING

- flood elevation / depth
- inundation / duration
- velocity / (small waves)
- debris / mold
- flash flood / mud flows
- COS (Combined Sewer Overflow)

RISKS & OPPORTUNITIES



RIVERINE FLOODING

- watershed management planning & implementation
- green / blue infrastructure
- water security (water balance)
- food security (soil stabilization)
- community resilience / preparedness

OUTLINE

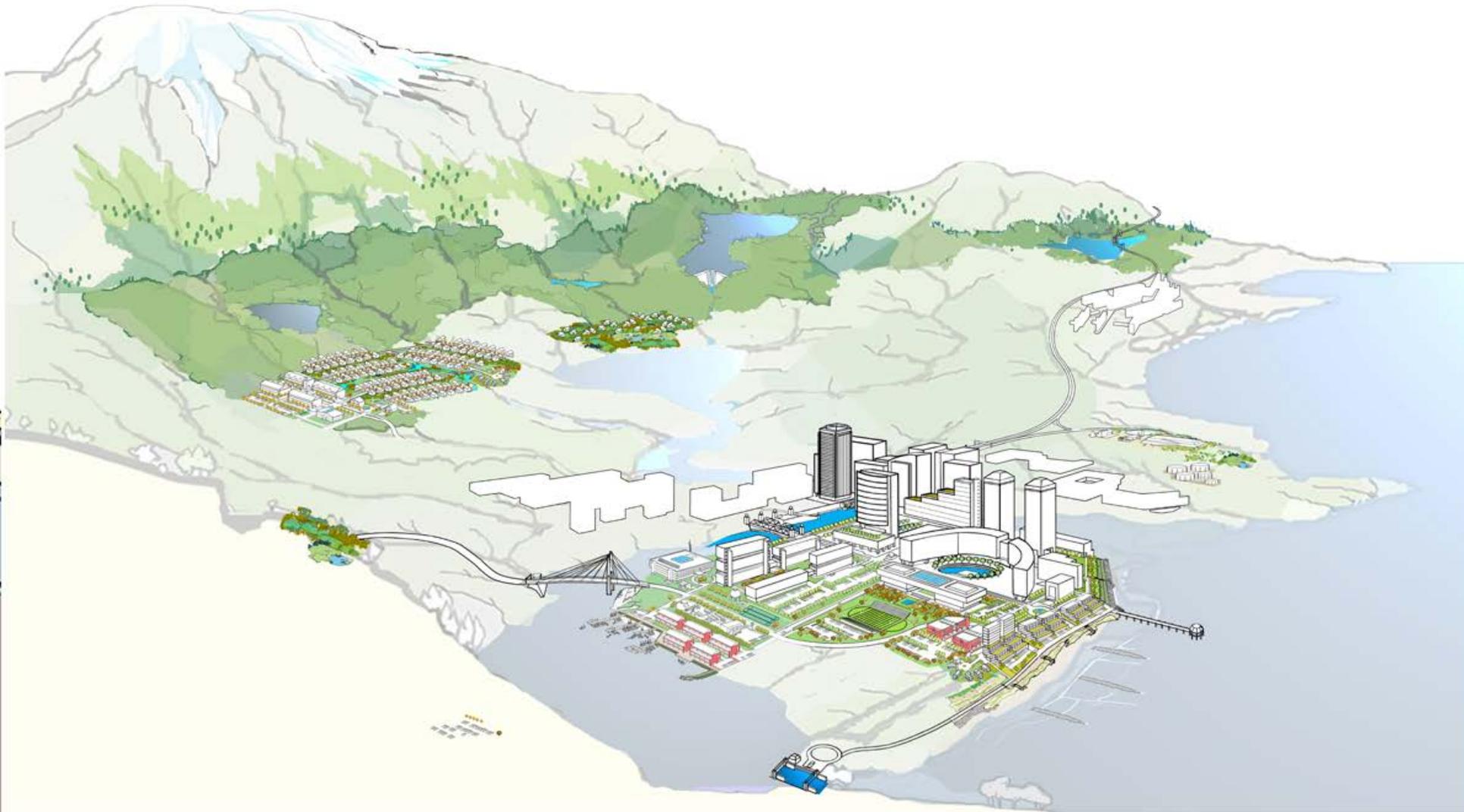
drought, fire, flood



II - WHAT WORKS

- *integrated watershed planning*
- *community design workshops*
- *model projects*

REGIONAL: INTEGRATED WATERSHED PLANNING



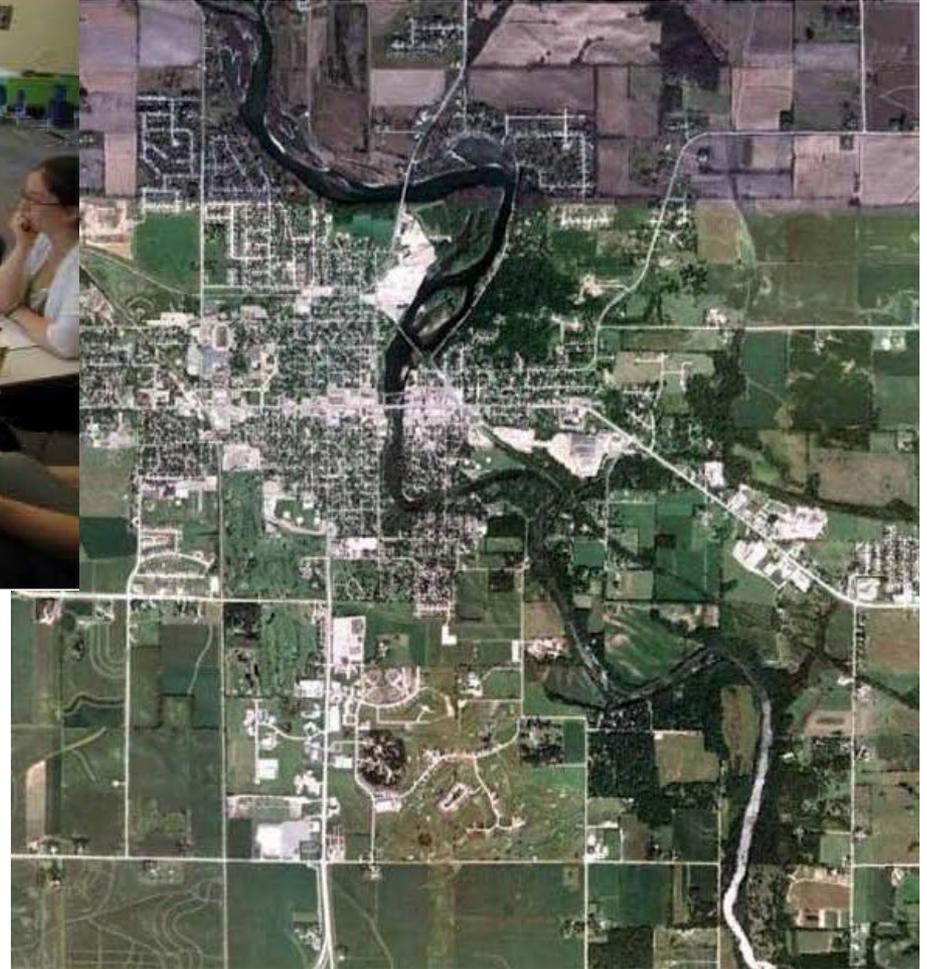
Conserve and improve natural environmental / ecosystem services.

MUNICIPAL: RESILIENT COMMUNITY WORKSHOPS



Engage private and public stakeholders in community / neighborhood plans and projects.

CASE STUDY 1

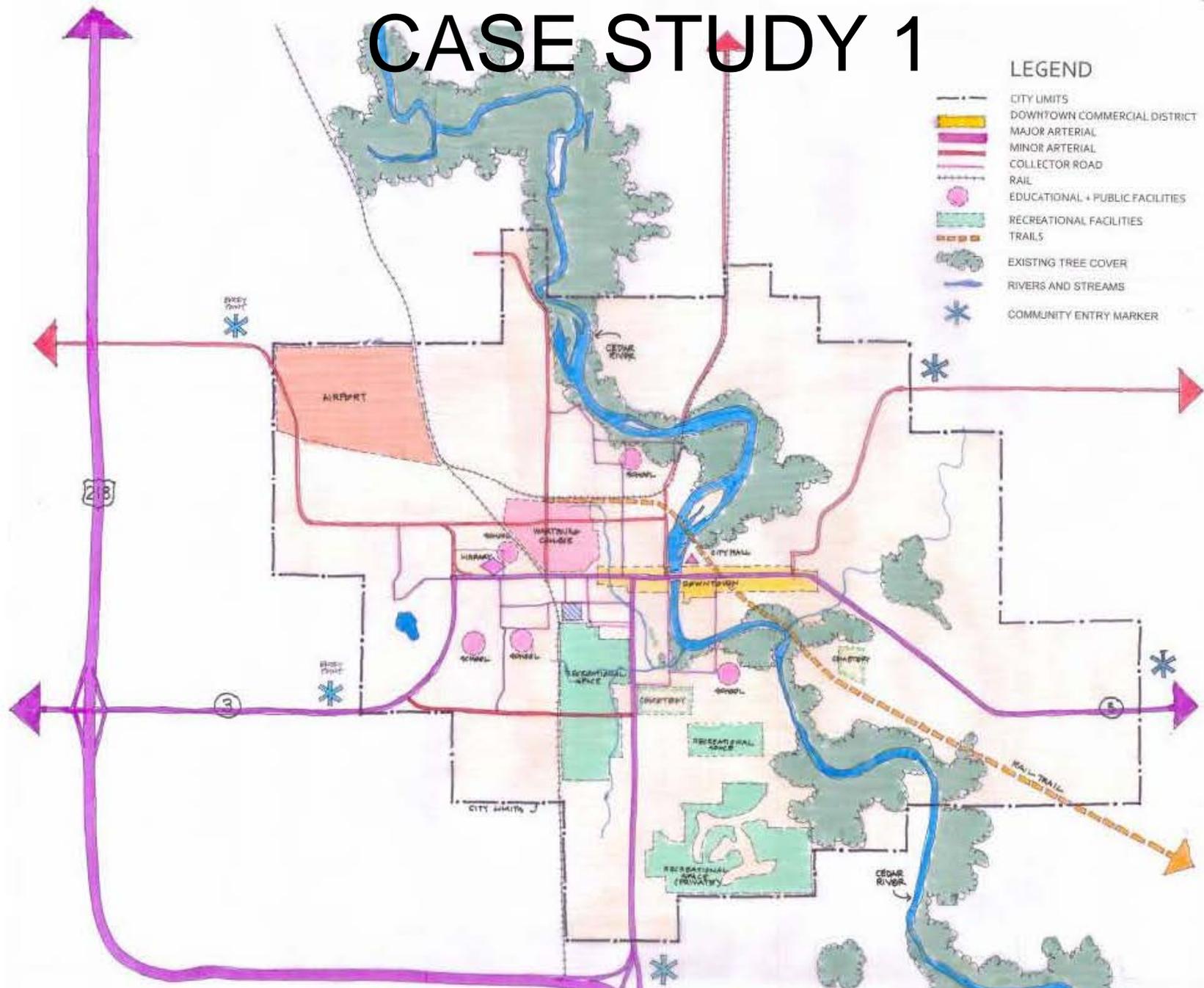


Community engagement
Flood recovery / mitigation
Economic Development
Smart Growth planning

Waverly Iowa Smart Planning Workshop

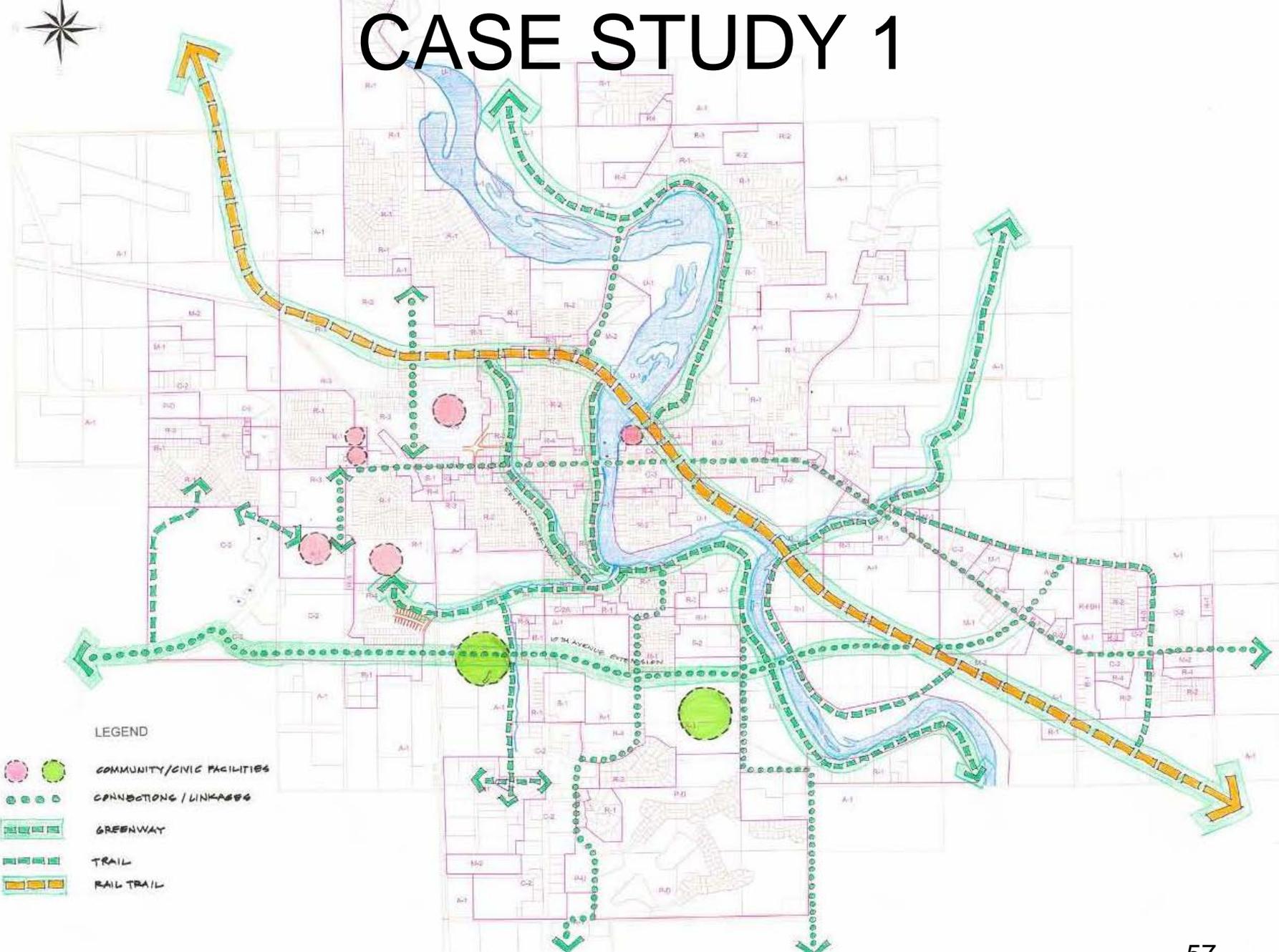
Flood mitigation planning for a small town (pop. 10,000). FEMA/EPA (2010)

CASE STUDY 1



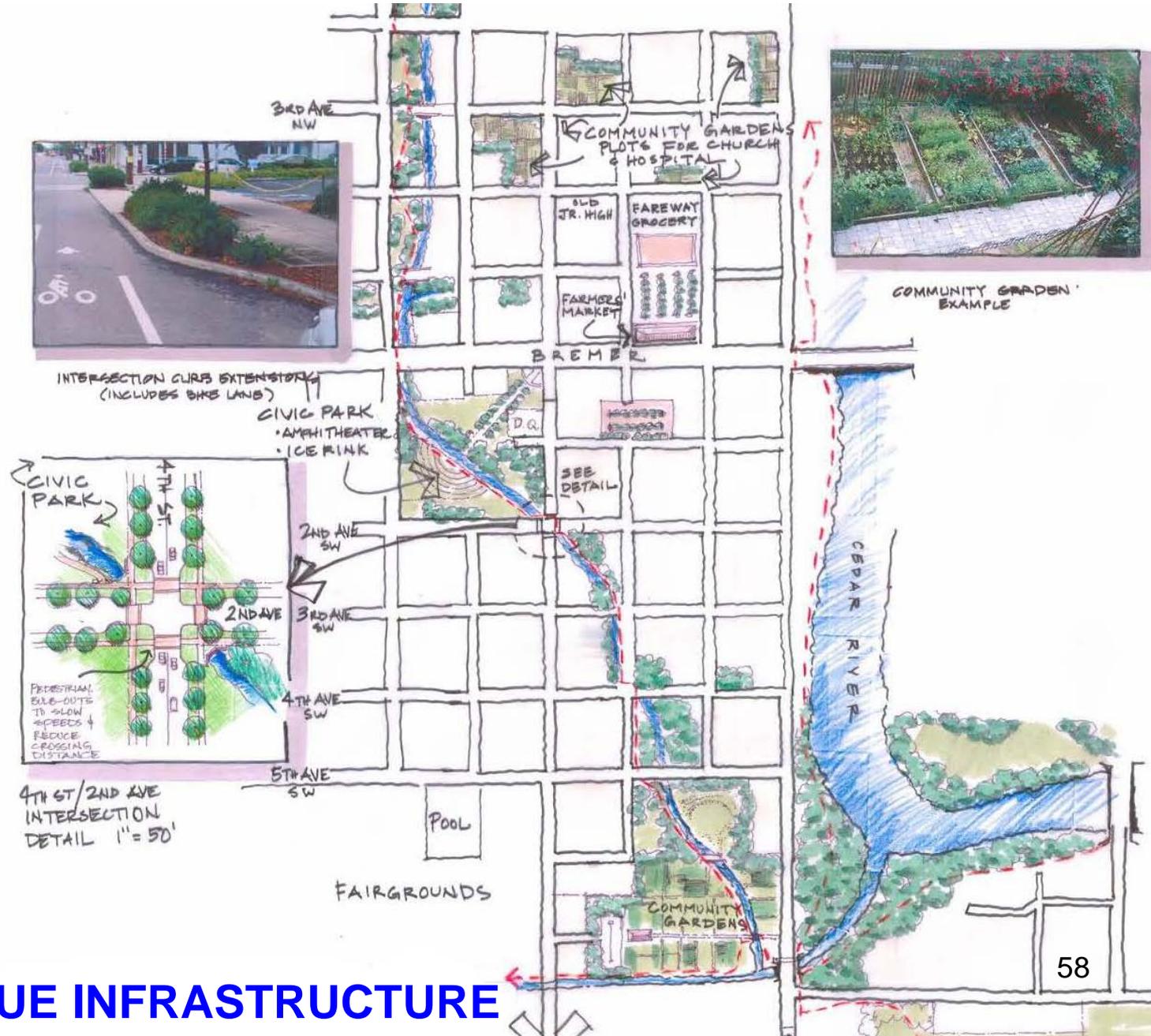
1 COMMUNITY ASSET ANALYSIS

CASE STUDY 1



2 FLOOD MITIGATION / GREENWAY TRAILS

CASE STUDY 1



CASE STUDY 2



Proposed Town Center Arts Enterprise Zone



Lewis Center Oberlin College

Economic revitalization
Vision Climate positive model
Local food / agriculture
Energy self-sufficiency
Education & Research
Community outreach

The Oberlin Project <http://www.oberlinproject.org/>

Also: *It Begins With a Seed* <http://www.bnim.com/bookshelf/oberlin-project>

LOCAL: MODEL PROJECTS

Incentivize catalyst projects to lead the way.

Passive & Active solar
Climate positive
Energy / Food producing
Zero landfill waste
Organic garden
Fish pond / water reserve
Research / training
Affordable / replicable



TRAIL MAGIC Energy Positive Home
Oberlin, OH Donald Watson, FAIA

LOCAL: MODEL PROJECTS

Incentivize catalyst projects to lead the way.

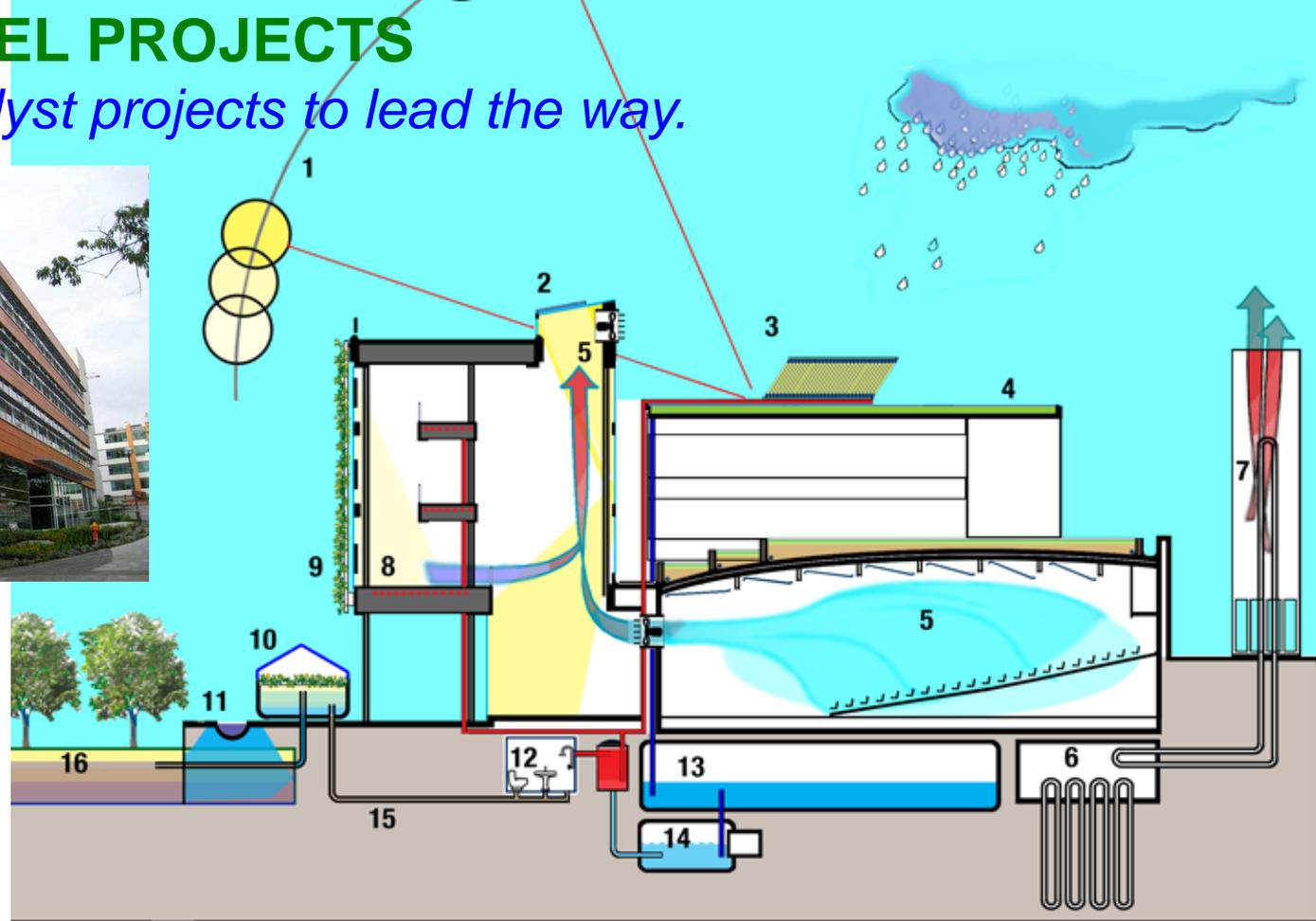


Green roof
Xeric landscape
Annual water storage
Flood control

MEDICAL OFFICE BUILDING CHEYENNE I
Medical Center Blvd. Houston Joe Webb, AIA

LOCAL: MODEL PROJECTS

Incentivize catalyst projects to lead the way.



1 Daylighting and sun tempering

2 Photovoltaic collectors

3 Evacuated tube solar collectors

4 Greenroof / Rainwater harvesting

5 Displacement ventilation

6 Ground source heat pump

7 Heat recovery

8 Radiant heating

9 Deciduous living wall

10 Solar aquatic biofiltration

11 Stormwater to raingardens

12 Solar DHW

13 Rainwater cistern

14 Water purification

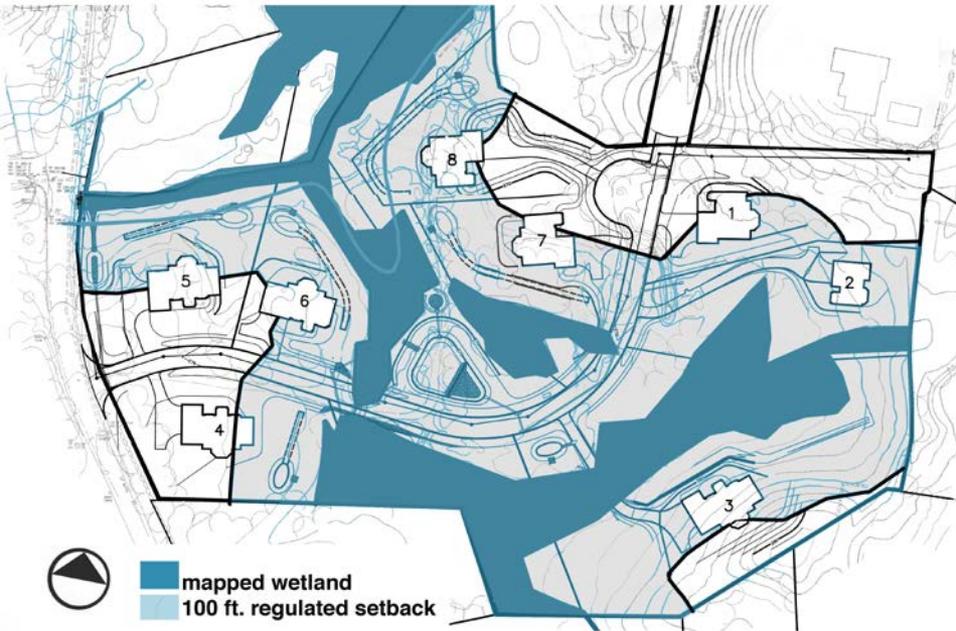
15 Grey and blackwater recovery

16 Greenscape irrigation

CENTER FOR INTERACTIVE RESEARCH ON SUSTAINABILITY (CIRS)

Vancouver Busby / Perkins + Will, Architects <http://cirs.ubc.ca/>

WIN-WIN NEGOTIATION



A - DEVELOPER PROPOSAL - > 80% FOOTPRINT WITHIN REGULATED WETLAND SETBACK

Developer's initial proposal



B - INTERVENOR COUNTER PROPOSAL - < 5% FOOTPRINT WITHIN REGULATED SETBACK

Amended plan after negotiation

MOTIVATING QUESTION

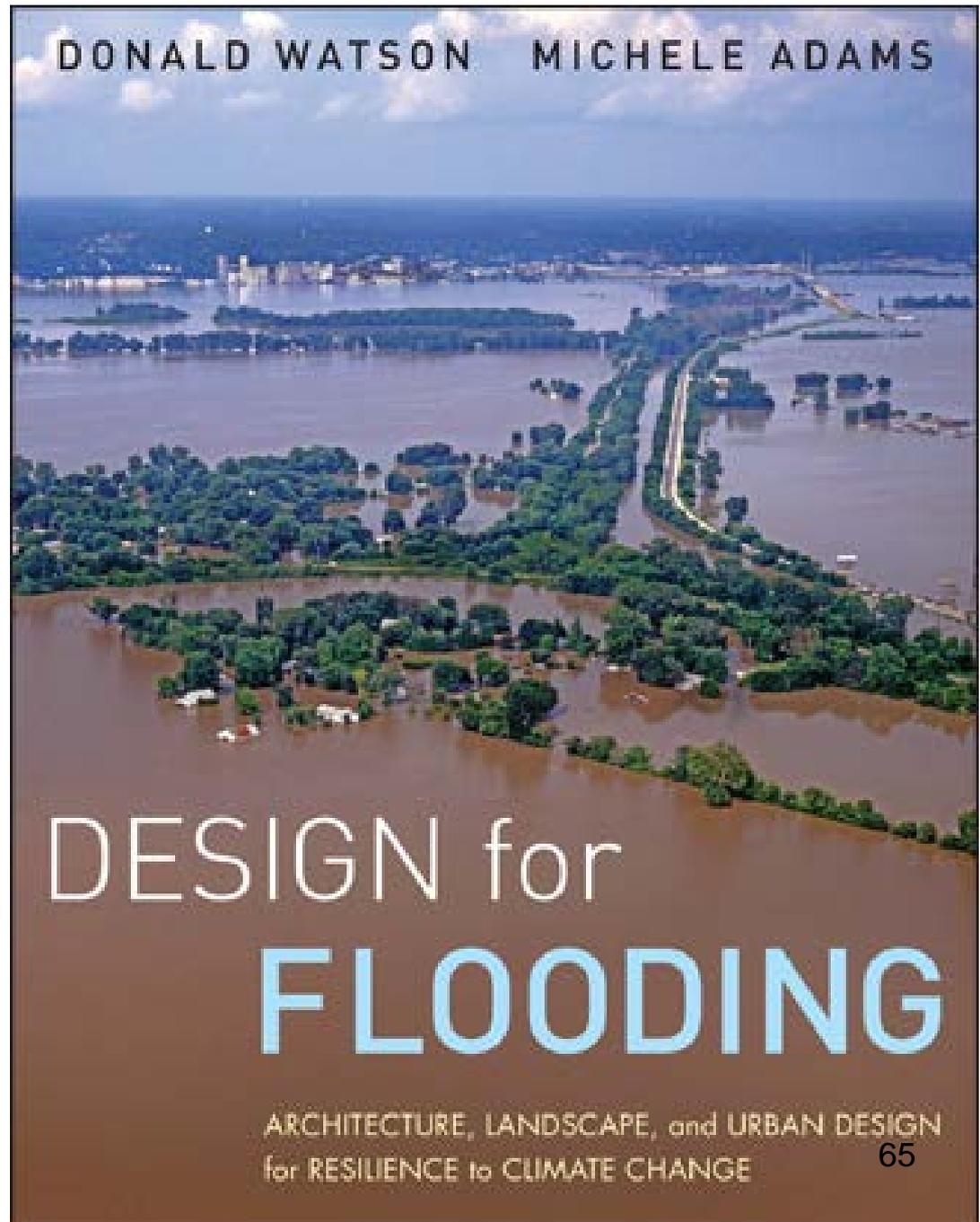
drought, fire, flood



How can Montana best achieve a prosperous, resilient future?

Thank you!

Donald Watson, FAIA
EarthRise design
www.DonaldWatson.com



BREAK OUT DISCUSSION

A OUR COMMUNITY HAS AN EXCELLENT PLAN.

Let me tell you about it.

B WE ARE WELL ON OUR WAY.

We are working on these steps.

C WE HAVE A START.

We need to work on these steps.

D WE ARE A BIT BEHIND.

We need a bit of assist on these steps.