Managed Aquifer Recharge (MAR) for Montana

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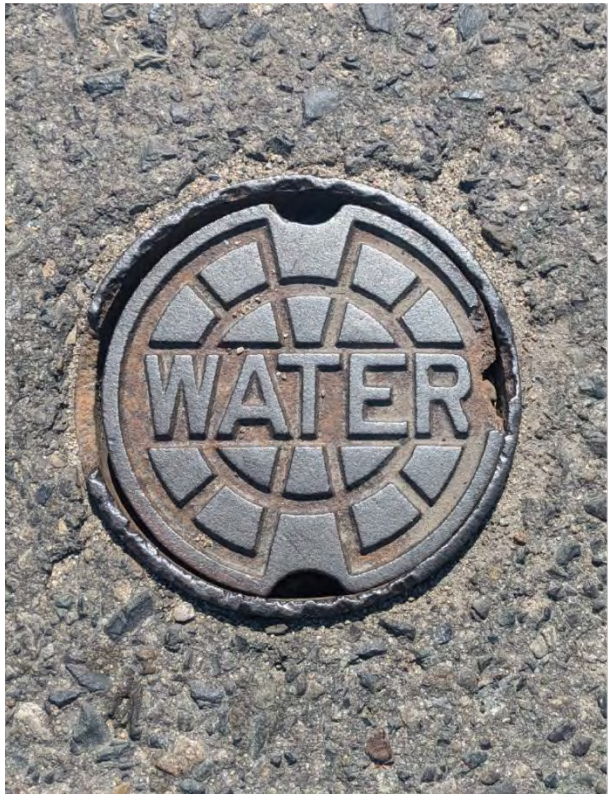
Montana Bureau of Mines and Geology



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MT AWRA October 9, 2025

Outline

- Background
  - Managed Aquifer Recharge (MAR)
  - Methods
- MAR Suitability
  - State-wide surface infiltration suitability map
  - Aquifer Storage and Recovery (ASR)
    - Flathead Valley
  - Big Hole River, Wisdom area
- Moving forward...

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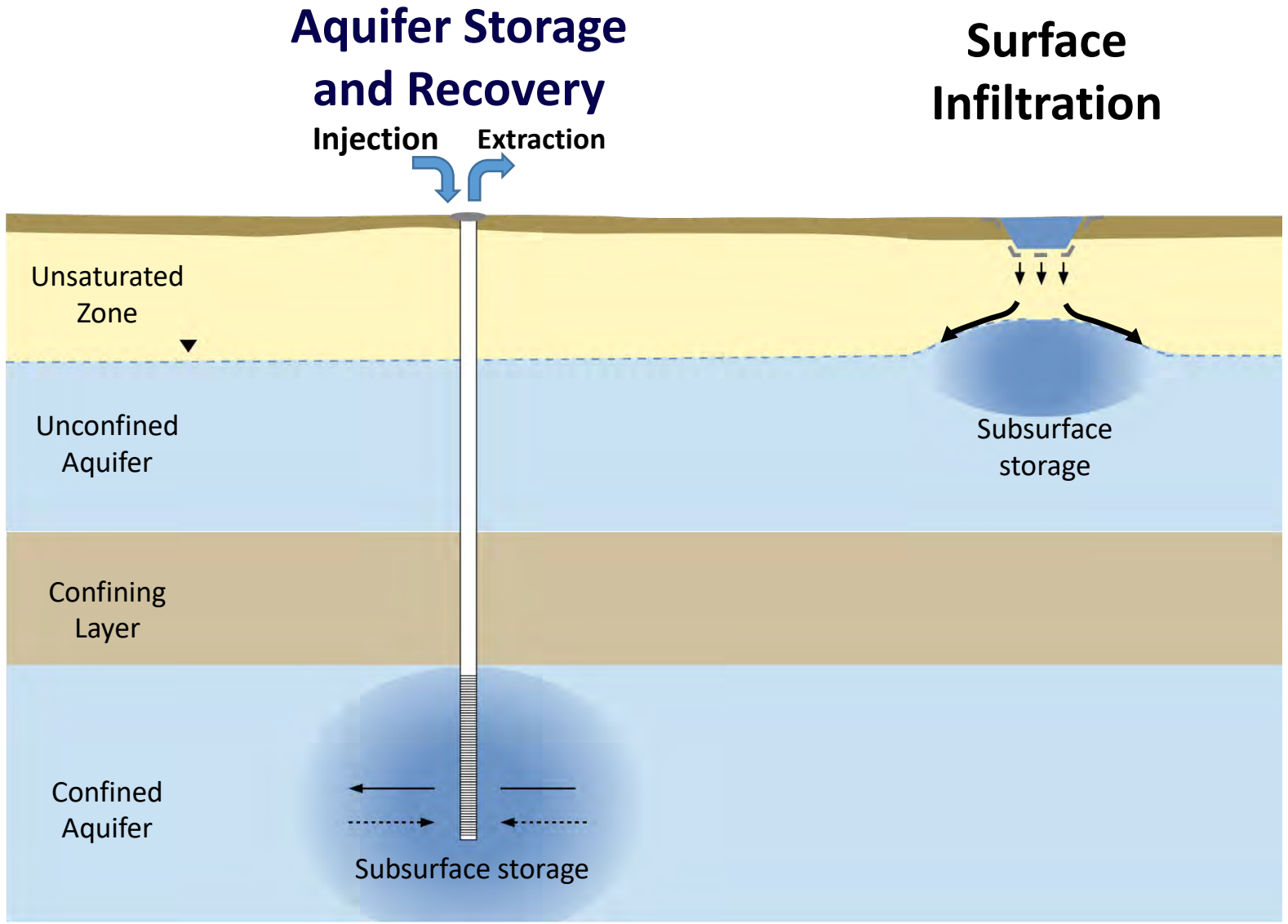
Managed Aquifer Recharge

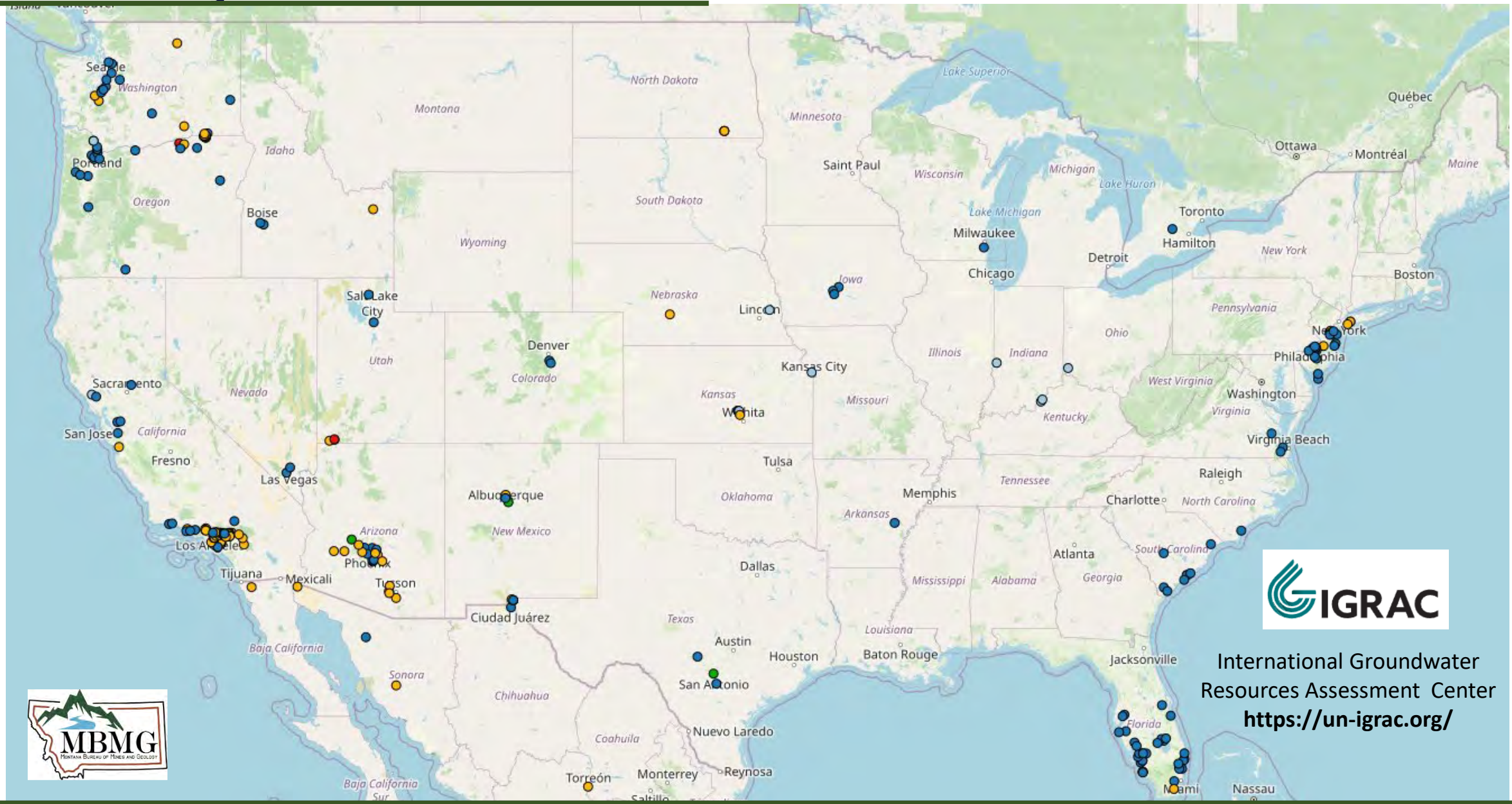
- supplements water supplies by intentionally recharging aquifers;
- method to **“slow water down”** or store water
- intent of recovering water during times of need

- **Surface infiltration**
  Unconfined aquifers

- **Aquifer Storage and Recovery**
  Semi-confined/confined aquifers



Inventory of MAR schemes



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IGRAC

International Groundwater Resources Assessment Center
https://un-igrac.org/

MAR Benefits

- ✓ Improved water supply reliability for agriculture and communities
- ✓ Aquifer replenishment due to land use changes and drought
- ✓ Ecosystem enhancement
- ✓ Improved water quality
- ✓ Flood risk reduction

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Considering MAR

What is necessary to make MAR possible?

Purpose / Scope:
- How much water is needed?
- What is it needed for?
- What time of year is it needed?

Hydrogeology:
- Physical properties

Location:
- Distance to Source Water
- Land Ownership

Other:
- Water Quality of Source and Aquifer
- Engineering Considerations
- Environmental issues
- Cost/Upkeep
- Regulatory requirements

Physical properties
- Type of aquifer
- Transmissivity
- Available Storage
- Soil permeability
- Topography

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Suitability Mapping

State-Wide Surface Infiltration Suitability

Purpose and Scope

- Basin-fill and alluvial surficial aquifers
- Hydrogeologic properties
- Publicly available information
- First-level screening tool

Hanson, A.E.H., Bobst, A.L., Abdo, G., LaFave, J.I., and Sutherland, M., 2024, Managed Aquifer Recharge (MAR): An initial hydrogeologic screening for surface infiltration suitability in Montana: Montana Bureau of Mines and Geology Report of Investigation 37, 26 p., 1 sheet.

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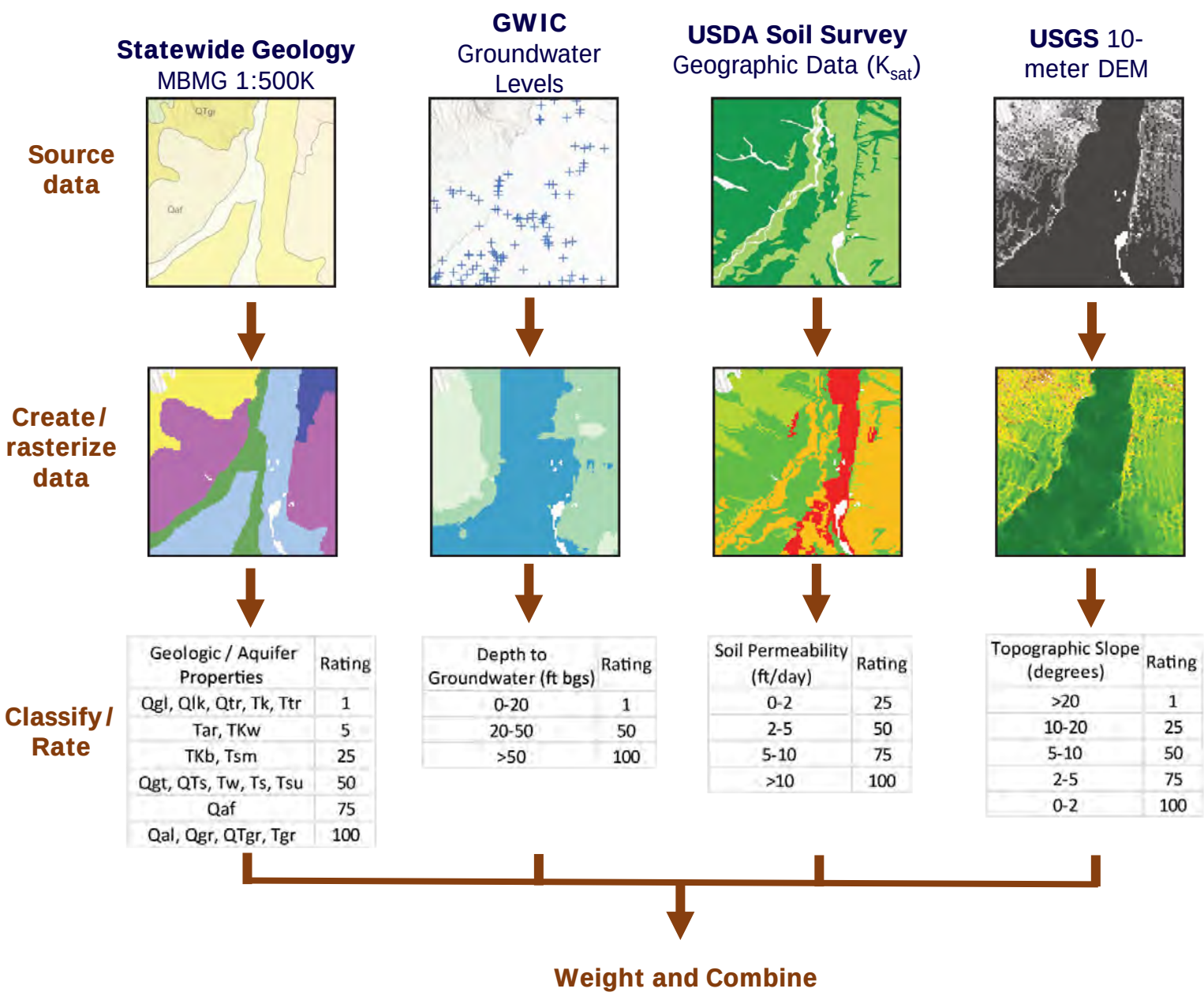
Methods

Multi-Criteria Decision Analysis (MCDA)

A method of evaluating and combining geospatial data

Four Criteria were chosen:

1. Geologic/Aquifer Properties
2. Depth to Groundwater
3. Soil Permeability
4. Topographic Slope



Results

16.5% of the state analyzed

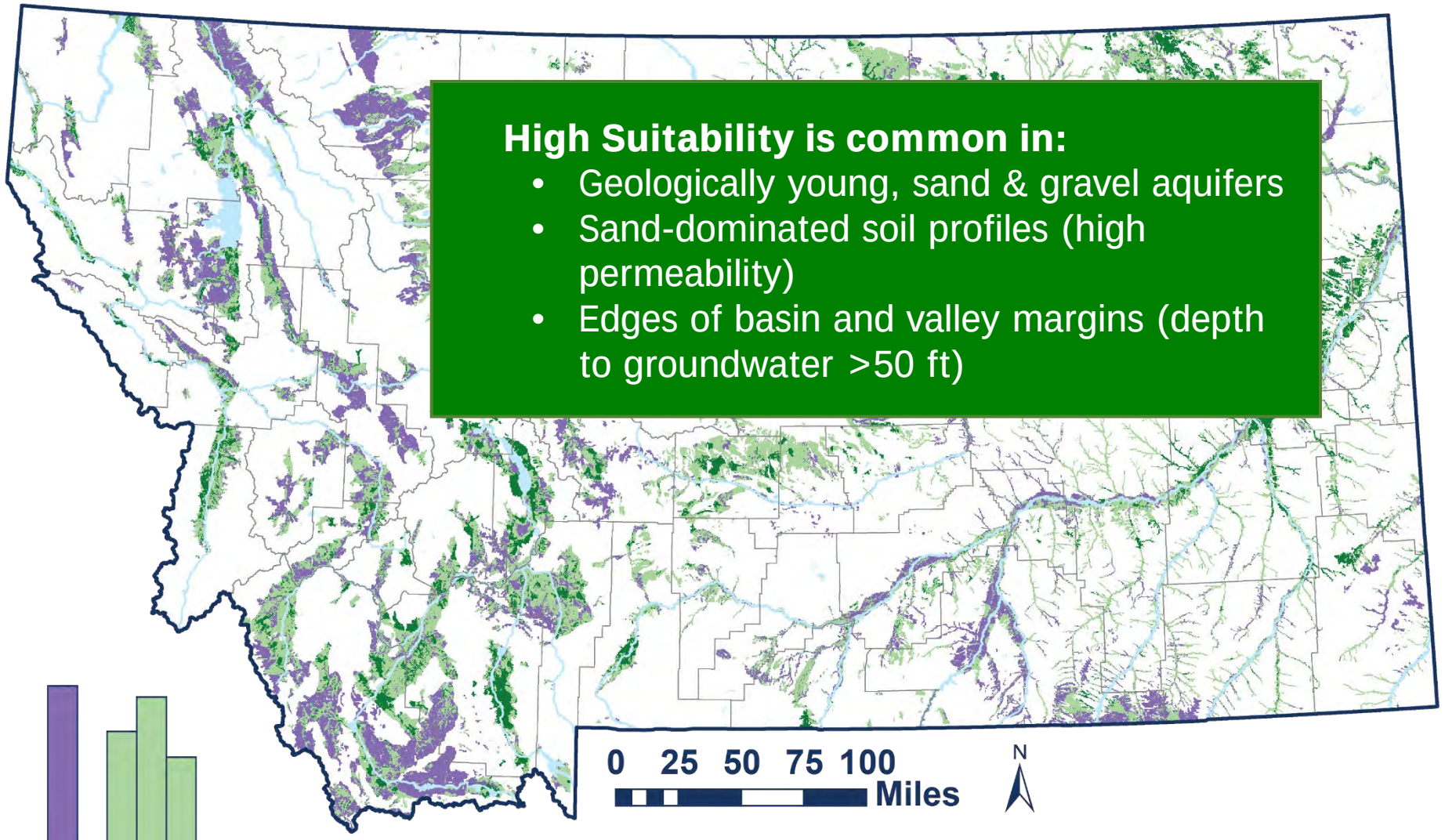
15% High
(2.3 million acres)

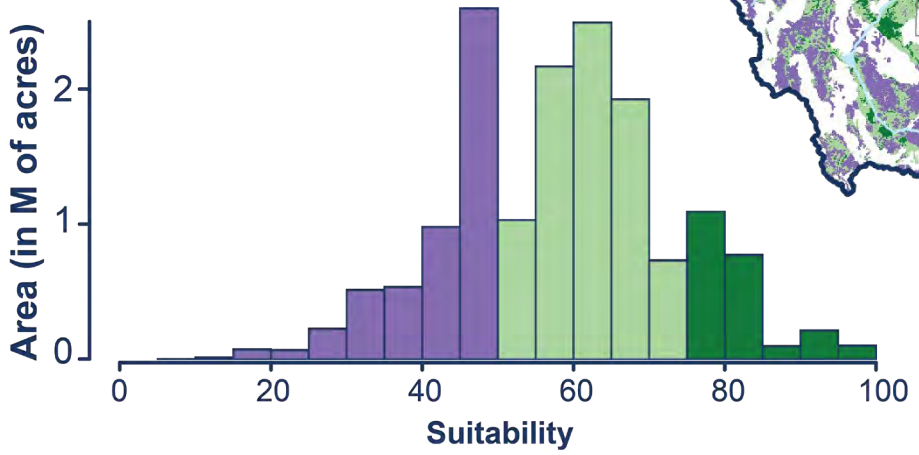
53% Medium
(8.3 million acres)

32% Low
(5.0 million acres)

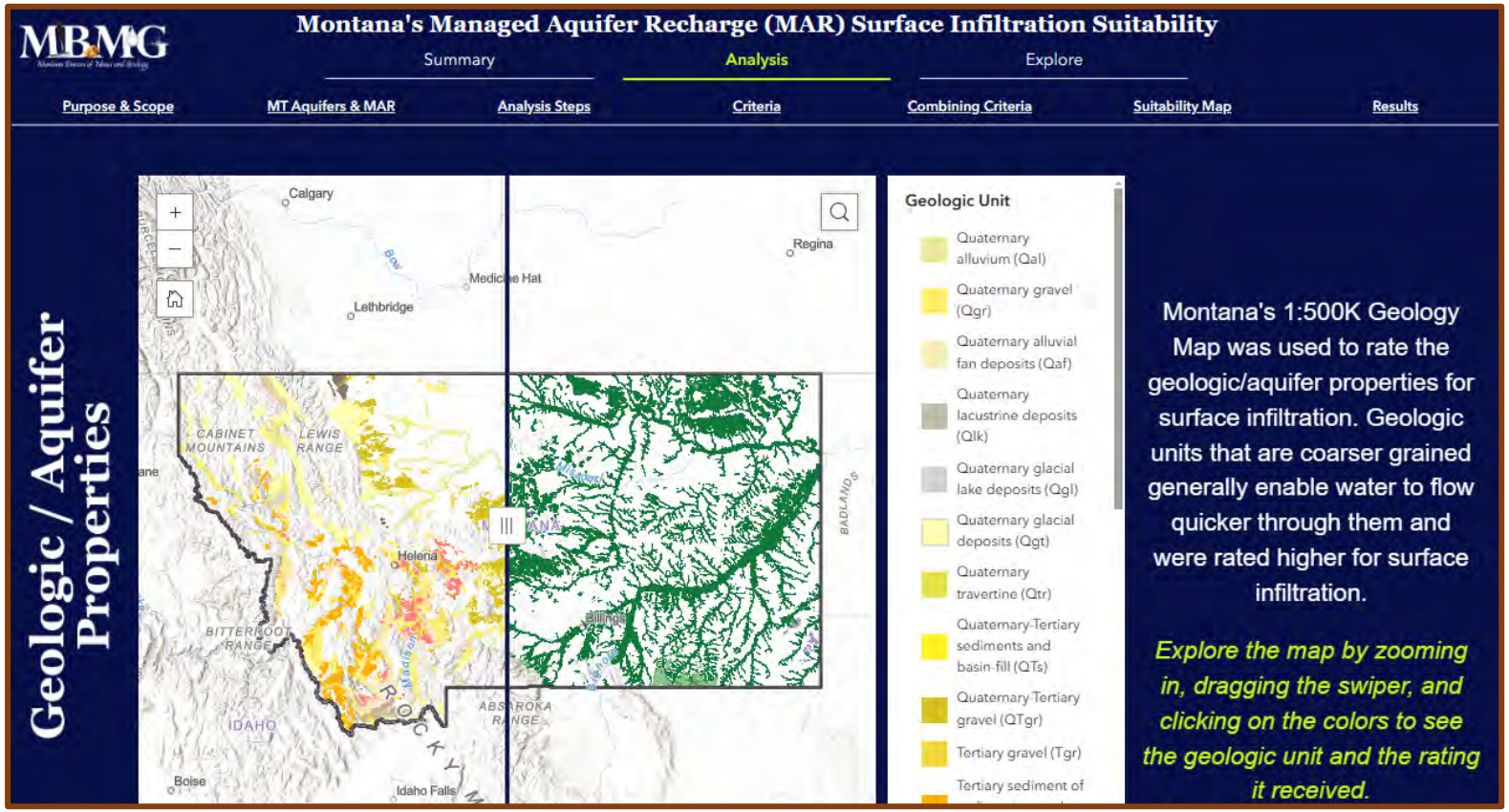
High Suitability is common in:

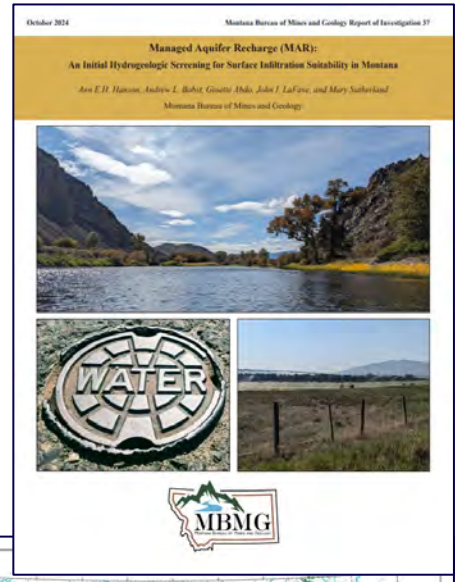
- Geologically young, sand & gravel aquifers
- Sand-dominated soil profiles (high permeability)
- Edges of basin and valley margins (depth to groundwater >50 ft)

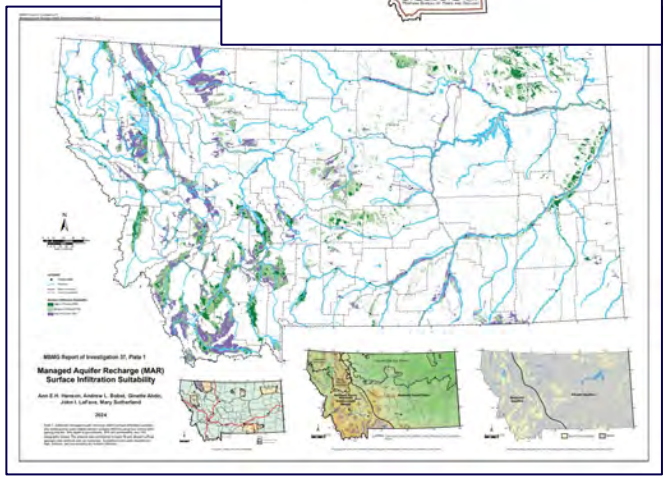




Publication and Web App







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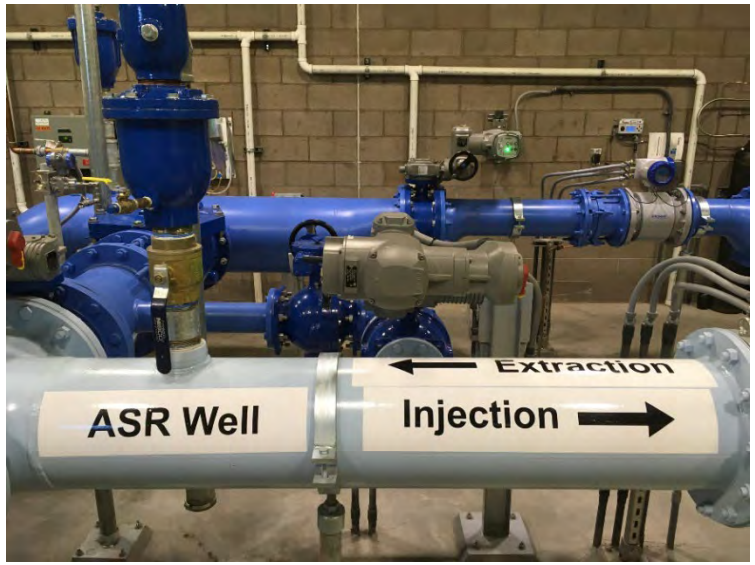
Aquifer Storage and Recovery

Andy Bobst
Ann Hanson

Flathead Valley

- Several hydrogeologic studies
- Understanding of the stratigraphy
- Target aquifer '**Deep Aquifer**'
  - ✓ Thick, confined to semi-confined
  - ✓ Primary water source
  - ✓ Can produce over 1,000 gpm



Aquifer Storage and Recovery - Summit Water Resources (summitwr.com)

Approach

- Hydrogeologic Properties
- Publicly Available Information
- First-Level Screening Tool

Methods

Multi-Criteria Decision Analysis (MCDA) – method of evaluating and combining geospatial data

Three Criteria:

1. **Rechargeability**

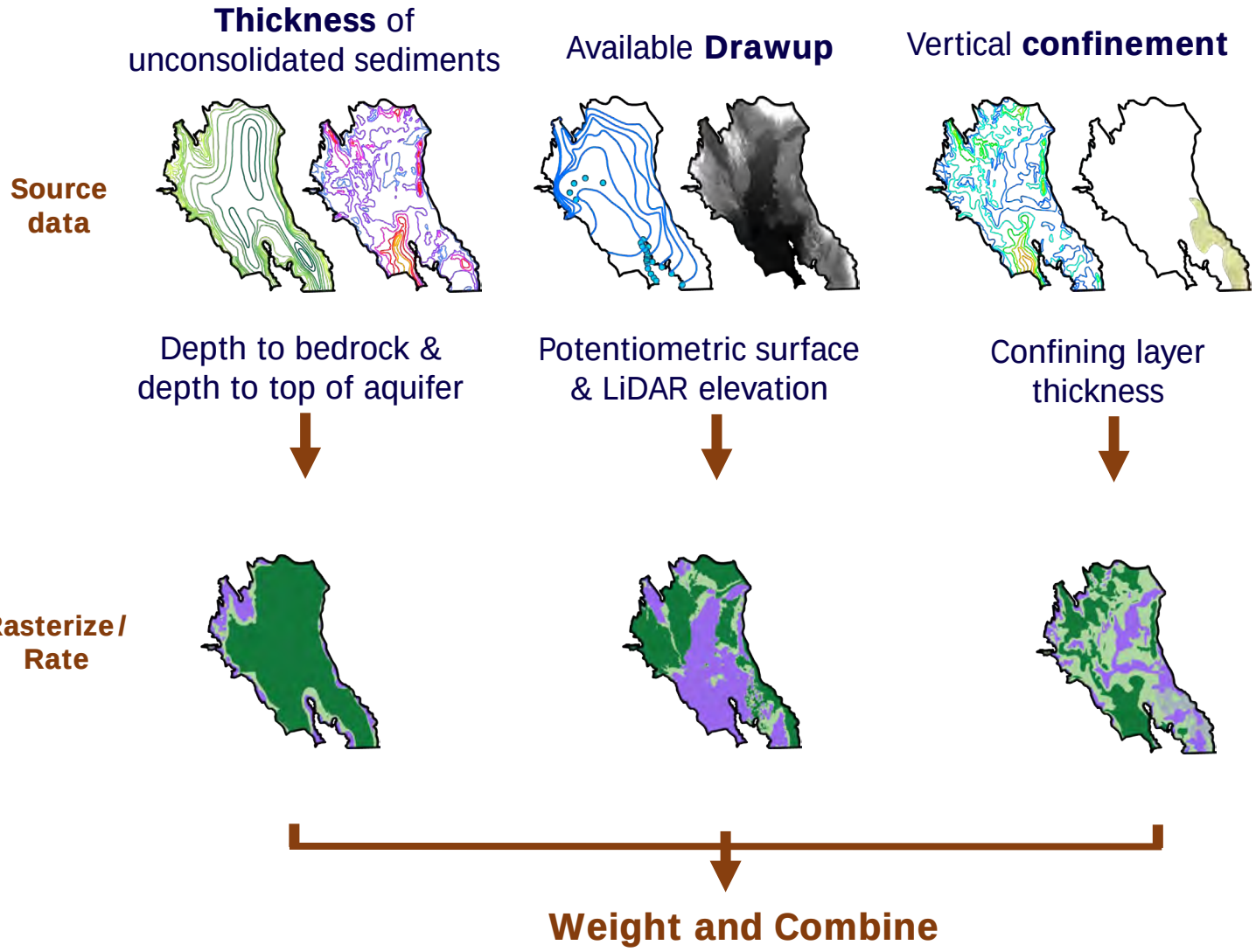
   Thickness of sediments below the confining layer

2. **Available Storage**

   Drawup

3. **Recoverability**

   Vertical confinement



Provisional information not for distribution

ASR Suitability

Deep Aquifer

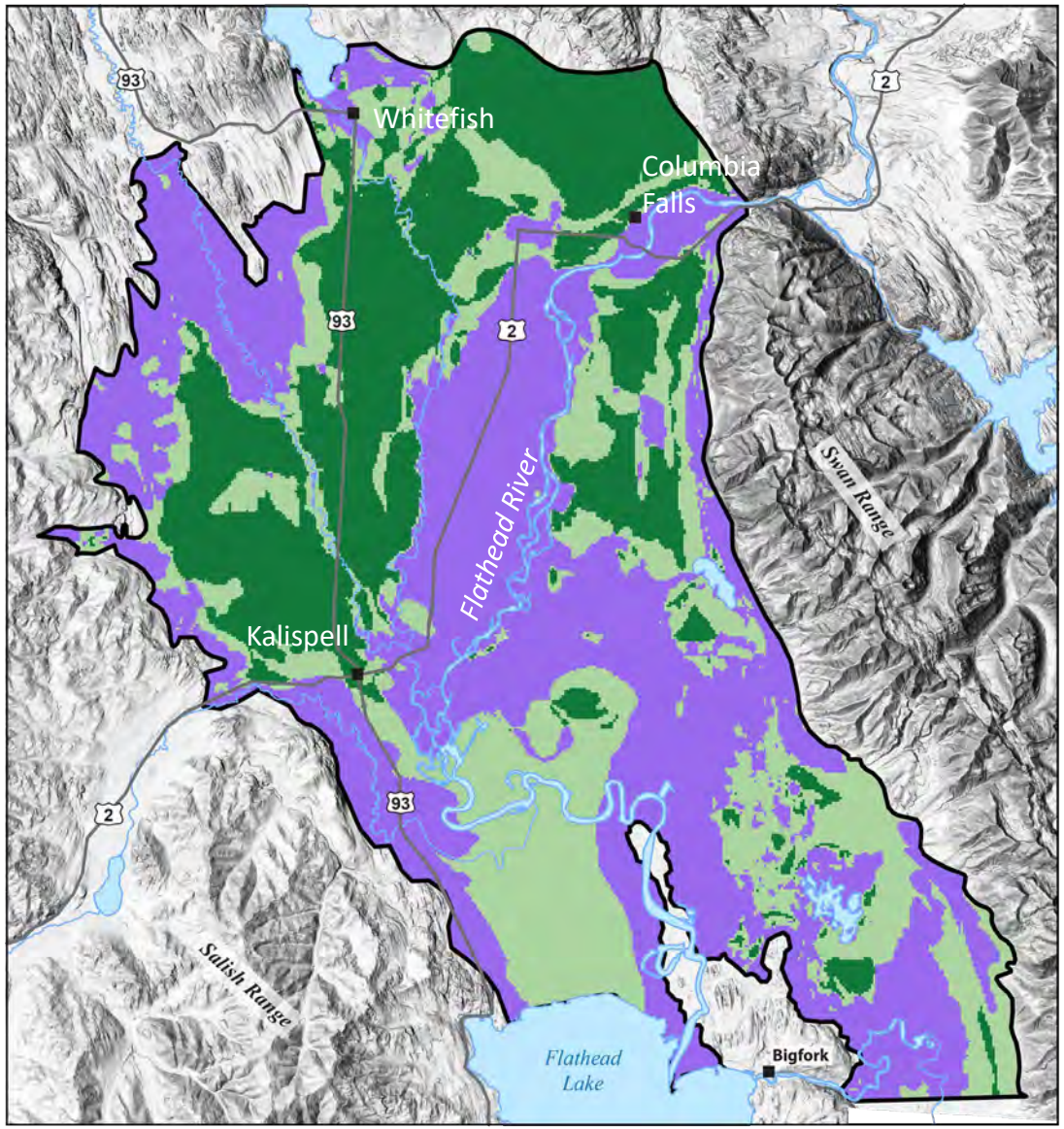
222,000 acres analyzed

26% High
(~59,000 acres)

28% Medium
(~63,000 acres)

45% Low
(~100,000 acres)

- Thick aquifer
- Greater drawup
- Moderate to thick confining layer

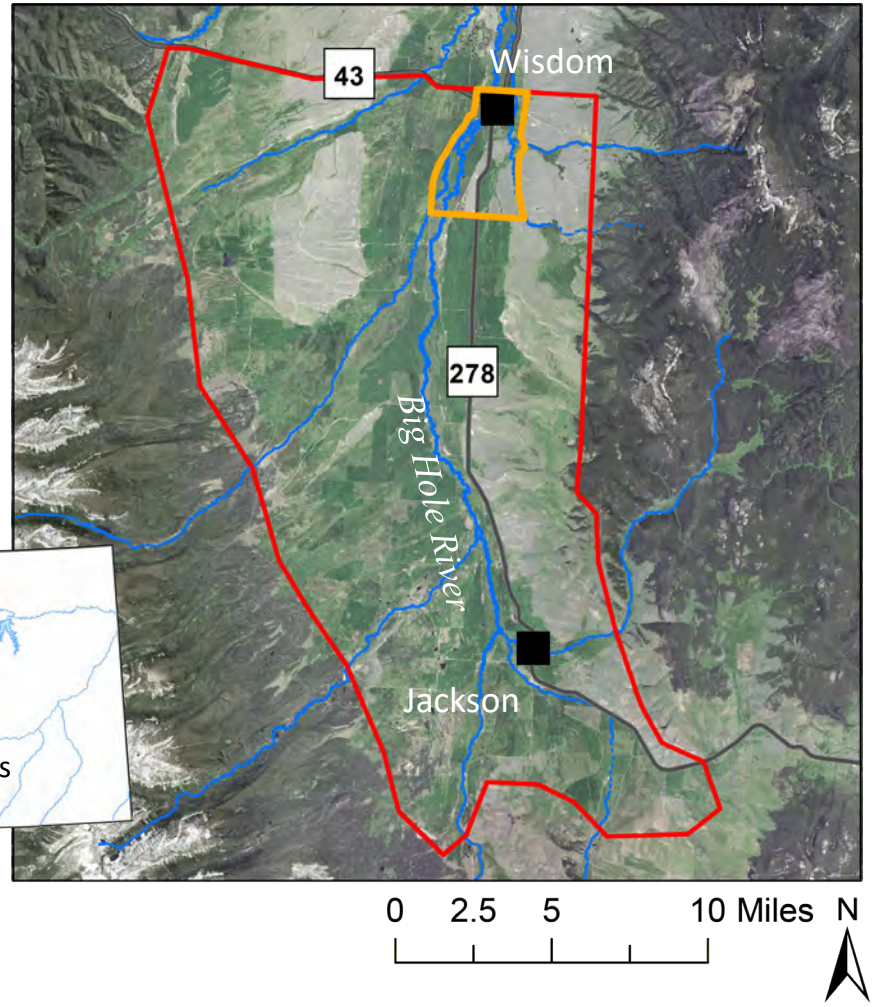


Provisional information not for distribution

Big Hole River

Enhancing River Flow

Andy Bobst
Cole Denver
Ann Hanson



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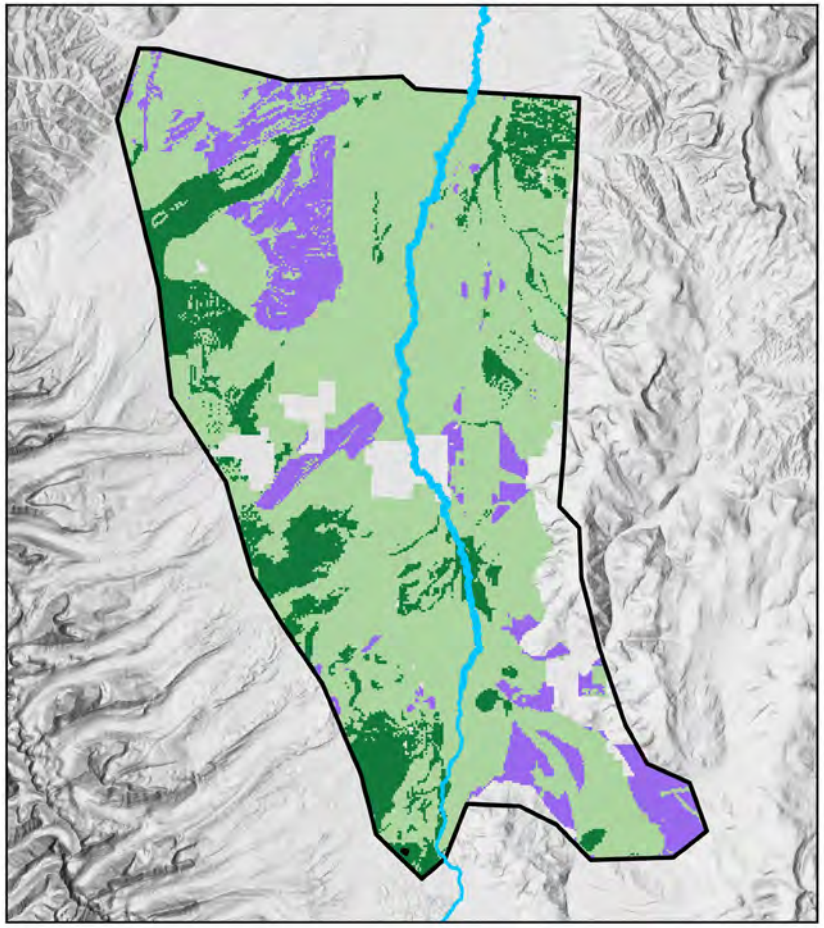
Is MAR is a viable option for mitigating low flow conditions that threaten fisheries, agriculture, and the recreational industry?

Capture high spring flows when water is available to recharge groundwater and subsequently augment low summer season flows.

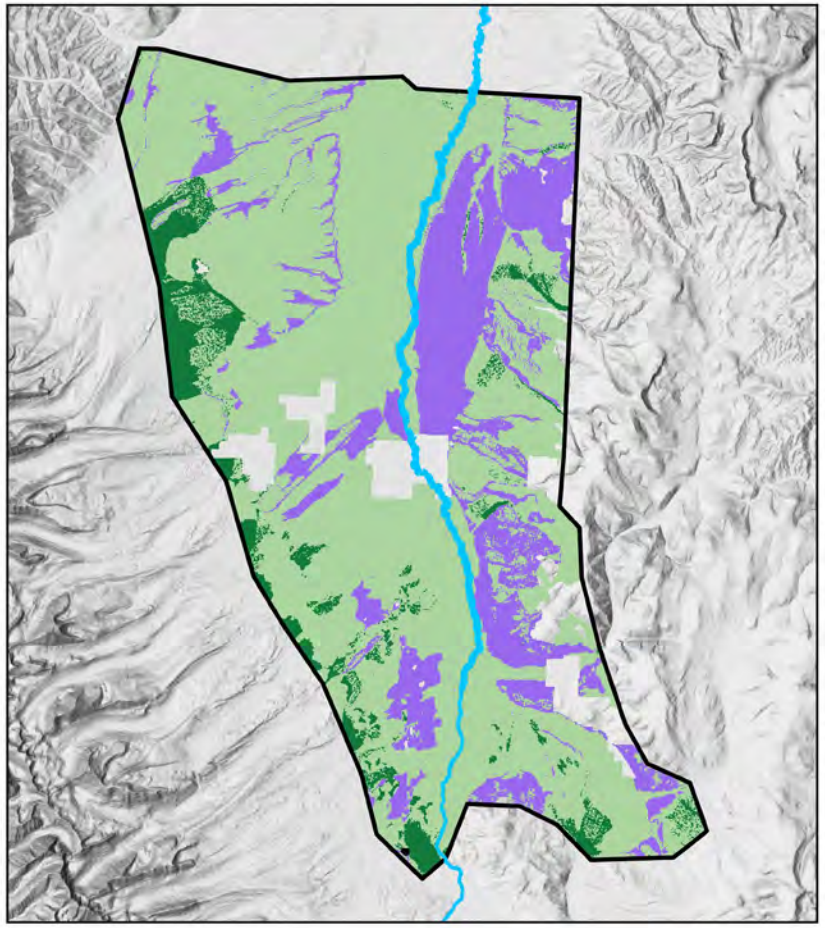
Proposed by the Big Hole Watershed Committee

Surface infiltration

State-Wide Analysis



Focus Analysis



Suitability

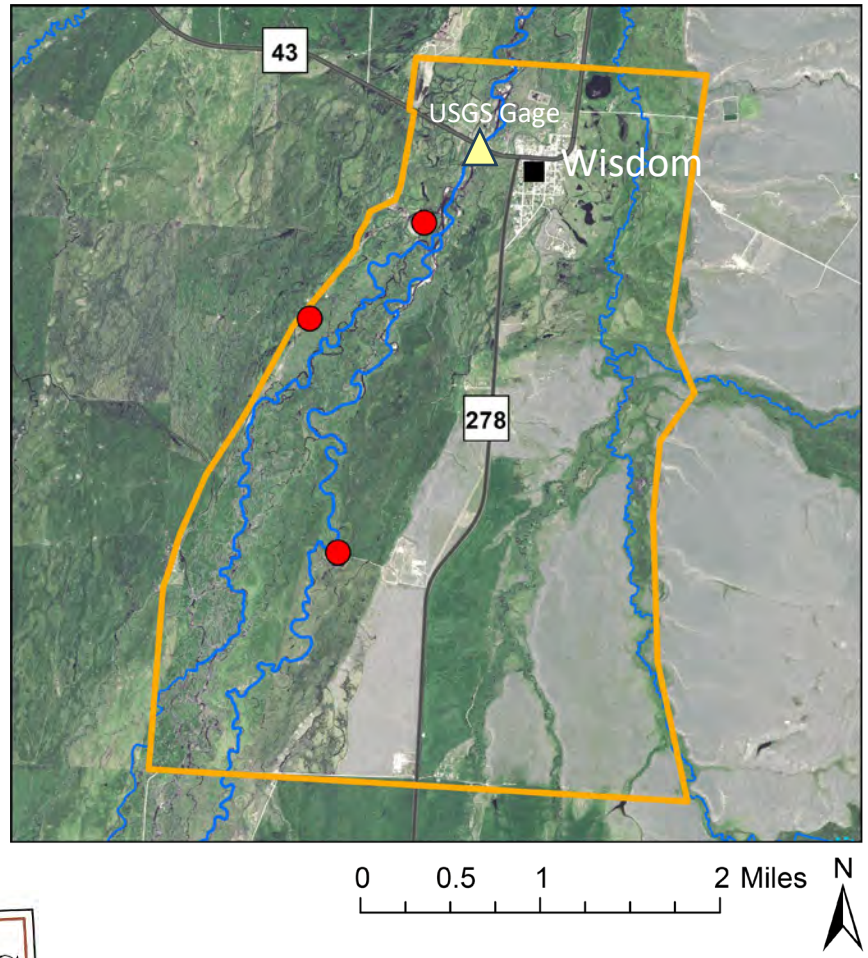
High (>75 and ≤100) Medium (>50 and ≤75) Low (≤50)

0 2.5 5 10 Miles N

Provisional information not for distribution

ASR

Exploratory drilling



- Willing landowner
- Above the Wisdom USGS stream gage
- Approximately 12 miles downstream until the next headgate

Moving Forward

First-level screening tool

- ✓ Do your homework

ASR Potential

- ✓ Publish results for the Flathead Valley
- ✓ Gallatin Valley
- ✓ Overall potential in select basins

Focused area suitability

- ✓ Detailed GIS evaluations, select areas