Flood-MAR: Research and Data Development

Using floodwaters for managed aquifer recharge (MAR), or Flood-MAR, can support statewide water resilience as part of a portfolio of solutions required by Governor Newsom's Executive Order (EO) N-10-19. Flood-MAR projects can benefit Californians and the environment through improved water supply reliability, flood-risk reduction, drought preparedness, aquifer replenishment, ecosystem enhancement, subsidence mitigation, water quality improvement, working landscape preservation and stewardship, climate change adaptation, recreation, and aesthetics. However, better data, information, tools, and guidance are needed to ensure implemented projects are well formulated, support multiple needs, and promote broader participation by water management sectors and landowners. The Flood-MAR Research and Data Development Plan (R&DD Plan) presents the input of subject matter experts, as part of the Flood-MAR Research Advisory Committee (RAC), necessary to support Flood-MAR projects, while creating more cooperative, informed, and aligned statewide water management.

Flood-MAR Research Advisory Committee

The Flood-MAR RAC is a multidisciplinary group of subject matter experts across 13 research themes. The RAC was tasked to identify the research, data, guidance, and tools necessary to support and expand the implementation of Flood-MAR projects. The 13 themes comprehensively represent the knowledge areas needed to implement Flood-MAR projects. State and non-State co-chairs for each theme led theme-specific subcommittees that include academics, practitioners, nongovernmental organizations, consultants, government agencies, Tribes, and professional associations.

Figure 1. Example Elements of Flood-MAR Projects

Flood-MAR Research and Data Development Plan

The Flood-MAR R&DD Plan presents the work of the Flood-MAR RAC. This Flood-MAR R&DD Plan intends to: (1) guide and support the work and investment of researchers, agencies, and funding entities; (2) guide strategic coordination and funding of Flood-MAR-related efforts; and (3) compile information needed for decision-making, implementation, and management of multi-sector and multi-benefit Flood-MAR projects. The priority actions identified in this plan can be implemented in the near-term and most of the priority actions could be completed within two years. The total estimated cost to complete all the priority actions is $147 million to support research, data and tool development, and provide guidance statewide.
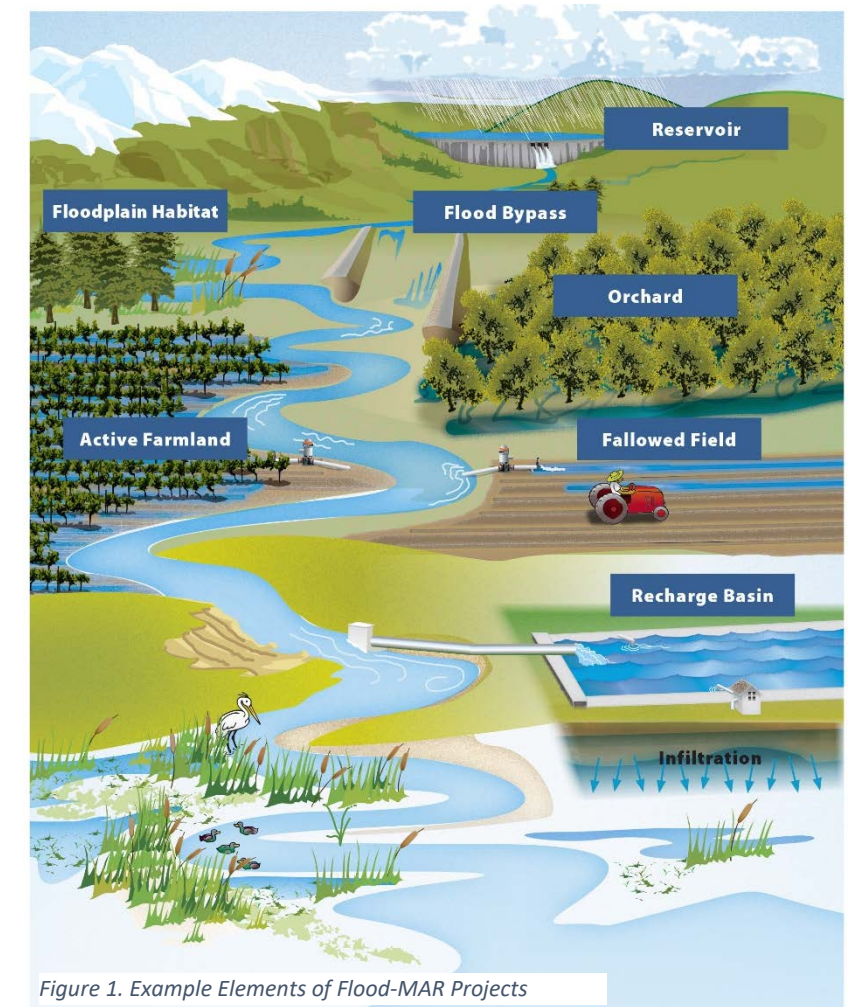
Research Priorities – At a Glance

Below are the top three priority actions for each of the 13 research themes.

Hydrology Observation and Prediction

- Improve comprehensive snowpack monitoring (Airborne Snow Observatory and in situ).
- Conduct inter-model comparison of surface hydrologic models with available historical precipitation products.
- Develop a spatially distributed soil moisture network for upper watersheds.

Reservoir Operations

- Develop improved statewide water accounting to support the kinds of agreements and incentives needed for using floodwaters for managed aquifer recharge (Flood-MAR), Sustainable Groundwater Management Act-related water plans, water markets, and enforcement of surface water rights.
- Extend forecast-informed reservoir operations to include operations for groundwater recharge, particularly for local and regional agricultural field and basin recharge opportunities.
- Analyze reservoir and broader water resources system to assess potential for shifting drought storage from surface water reservoirs to aquifers.

Infrastructure Conveyance and Hydraulics

- Build a standardized statewide geographic information system (GIS) conveyance database of conveyance networks that could be used for Flood-MAR projects.
- Research sediment transport impacts on conveyance networks and streams resulting from increased usage from Flood-MAR operations.
- Develop light detection and ranging (LiDAR), topography, and bathymetry data around potential Flood-MAR project areas that are lacking this data in order to augment the GIS conveyance database.

Crop Systems Suitability

- Perform case studies on agricultural land-based Flood-MAR projects completed to date.
- Initiate and complete research on knowledge gaps of crop systems suitability for MAR in California.
- Develop decision support tool to determine crop suitability for Flood-MAR.

Soils, Geology, and Aquifer Characterization

- Improve subsurface geologic data and provide greater accessibility to useable and better-quality data.
- Improve subsurface hydrologic data and provide greater accessibility to useable and better-quality data.
- Synthesize hydrogeologic data to identify the best locations for recharge.

Land Use Planning and Management

- Document coordination and communication methods occurring between groundwater sustainability agencies and land use planning agencies to develop best practices.
- Identify sources of funding for integrated planning efforts and groundwater management.
- Develop protocols for data consistency for all planning documents.

Water Quality

- Develop a web-based platform to allow public access to a compilation of all existing knowledge identified by the Water Quality Subcommittee.
- Develop guidance and multi-criteria decision-making tools to address water quality issues in Flood-MAR projects.
- Develop better knowledge of water quality issues (sources, conveyance, land use and land use history, naturally occurring contaminants) related to Flood-MAR design and implementation.

Recharge and Extraction Methods and Measurement

- Compile existing MAR projects and associated data.
- Compile pertinent information to determine the efficiency of MAR projects.
- Establish methods and considerations by which floodplains can be used as direct recharge sites and in conjunction with other recharge methods.

Environment – Terrestrial and Riparian/Aquatic

- Develop a tool to calculate groundwater recharge that occurs when floodplains are inundated.
- Develop a map that prioritizes Flood-MAR based on the additional habitat benefits that can be achieved at those sites.
- Map subsurface geology of floodplains to identify areas with the greatest potential for deep aquifer recharge.

People and Water

- Develop an ethical and just framework specifically focused on the Flood-MAR program.
- Develop an engagement best practices document for Flood-MAR.
- Document areas most feasible for recharge with disadvantaged communities that are groundwater dependent and would greatly benefit from Flood-MAR actions.

Economic Analysis

- Develop an economic analysis guidance document for groundwater recharge projects.
- Evaluate economic and other incentives for Flood-MAR implementation.
- Assess groundwater ownership rights and market issues associated with Flood-MAR.

Local, State, and Federal Policies and Legal Considerations

- Refine guidance and provide applicant assistance for beneficial use designations associated with recharge.
- Provide guidance and support for water availability analyses and associated determinations for processing of water rights applications.
- Develop recommendations for environmental permitting refinements and permitting guidance for Flood-MAR project proponents and establish an interagency group (part of the Flood-MAR network) to coordinate refined permit processes with entities seeking permits.

Tool and Application Development

- Conduct cost/benefit analysis, including multi-benefit.
- Identify policy linkages and governance structure.
- Create decision support tools to integrate Flood-MAR disciplines.

More information on Flood-MAR and the complete R&DD Plan can be found at:

https://water.ca.gov/Programs/All-Programs/Flood-MAR