Climate Resilient Mitigation Activities
Aquifer Storage and Recovery

Purpose

The President's 2015 Opportunity, Growth, and Security Initiative (OGSI), Executive Order 13653 Preparing the United States for the Impacts of Climate Change, the President's 2013 Climate Action Plan, FEMA's Climate Change Adaptation Policy, and the 2014-2018 FEMA Strategic Plan, all identify the risks and impacts associated with climate change on community resilience to natural hazards, and direct Federal agencies to support climate resilient infrastructure.

FEMA is encouraging communities to incorporate methods to mitigate the impacts of climate change into eligible Hazard Mitigation Assistance (HMA) funded risk reduction activities by providing guidance on Climate Resilient Mitigation Activities. FEMA has developed initial guidance on Climate Resilient Mitigation Activities including green infrastructure methods, expanded ecosystem service benefits, and three flood reduction and drought mitigation activities: Aquifer Storage and Recovery (ASR), Floodplain and Stream Restoration (FSR), and Flood Diversion and Storage (FDS).

FEMA encourages communities to use this information in developing eligible HMA project applications that leverage risk reduction actions and increase resilience to the impacts of climate change.

Project Description

Aquifer Storage and Recovery is capturing water when it is abundant such as a rainy season or during spring snow melts, storing the water in the subsurface in brackish aquifers, and recovering the water when needed. There are two types of aquifers, confined and unconfined. A confined aquifer is a closed system and, for these projects, can only be recharged using an injection well. Project design includes a "mixing zone" which is created between the injected water and native groundwater to ensure variations in water quality are managed safely and effectively.

An unconfined aquifer can be recharged either by using an injection well or by allowing surface water to infiltrate and seep into the aquifer. Through infiltration, the surface water helps replenish groundwater supplies; the surface water mixes with native groundwater, and slowly flows through the aquifer. The appropriate method of recharge, and source and treatment of water added to the aquifer should be based on specific site conditions and may include drinking water, raw and/or partially treated surface water, and, infrequently, raw groundwater or reclaimed water. Communities can recover the stored water from the aquifer by using a well and use the water as a freshwater supply.

Project Design and Implementation Considerations

ASR projects provide several advantages as a method to increase water supply for drought mitigation. Since ASR is a subsurface storage technology, it is more resilient and protected than alternative and more traditional storage technologies such as reservoirs or surface impoundment. The stored water in an ASR system is

protected from evaporation, pollutants, and extreme weather events. Unlike reservoirs or other surface storage, there is no potential for levee failure and downstream flooding. ASR also can be used to protect freshwater supplies along coastal areas as a barrier or protection for saltwater intrusion driven by sea level rise.

Appropriate site selection and the availability of an aquifer to a community are key items to evaluate when considering an ASR project for drought mitigation. Appropriate siting of the project and the specific site conditions will impact the project design, source of water for re-charge, method of injecting/infiltrating the water, and efficiencies in recovering the water. Advances in hydro-geologic assessment techniques have made it easier to ensure proper selection of the project site and water storage zones in the aquifer.

Another challenge to address during the project identification and planning phase, is to identify potential contaminants to the underground water supply. Contaminants found in the aquifer walls such as arsenic can leach into the stored water. The community should have a plan for managing potential leaching or contamination. For example, when extracted the recovered water may be mixed with another water source such as treated, potable water to reduce the contaminant ratio to safe drinking water standards. Please note that the project application must address all potential impacts to environmental resources, including water quality, and provide the information necessary for FEMA to ensure compliance with environmental requirements. FEMA recommends that communities consult with technical experts in developing an ASR project to ensure the project is in an appropriate site and necessary methods and measure are in place to preserve water quality standards.

Project Benefits and Cost Effectiveness

The primary benefit of an ASR project is to enhance or increase water supply for drought mitigation. The stored water can be pumped out of the aquifer (recovered), treated, and utilized as a freshwater supply when additional water supply is needed such as during periods of drought. Communities may use aquifers for both annual water resource management or longer term water supply for more extreme needs. For example, they can recover only a portion of the stored water for use during high demand times or seasonal dry periods and preserve a significant quantity of water in the aquifer for using during a drought. ASR systems can take advantage of the flexibility in using multiple types of source water and be designed and operated to help mitigate the effects of increased demand and drought in a variety of communities with differing water resources.

At a minimum, the project application would need to identify the increased water supply capacity the ASR project would provide in relation to the population that will be supported in a drought and during the project's useful life. A recurrence interval for drought periods will need to be identified to use the FEMA BCA Tool. Estimating the probability of a drought can be difficult due to historical data gaps and variance in annual weather patterns/precipitation. There is not currently a single methodology to establish a recurrence interval for drought. Rather, FEMA encourages communities to use the best available data to document a recurrence interval. In addition to regional or local sources of historical drought periods, federal agency resources that provide drought related resources with information that could support a recurrence interval are listed in the Climate Change, Drought Information, and HMA Resources section.

An ASR project may be designed in a way that also provides flood risk reduction. If a flood mitigation component can be demonstrated, the methodologies in the current FEMA BCA Tool can be used to evaluate the cost effectiveness of the overall project. There may be additional benefits provided by an ASR project if it can demonstrate a reduction in subsidence and reduce structural damage to homes and properties in the vicinity.

Ecosystem services are beneficial goods and services provided by nature for people. Every landscape yields a variety of ecosystem services, presenting an opportunity for mitigation actions that provide multiple ecosystem services benefits. FEMA is building on the existing ecosystem services that can be used for acquisition/open space projects to allow more ecosystem service benefits for climate resilient activities. FEMA will be providing more guidance on the ecosystem service benefits that can be used in evaluating the cost effectiveness of these mitigation projects in 2016.

Environmental and Historic Preservation Considerations

As part of eligibility review, FEMA is required to ensure that all HMA projects are compliant with environmental and historic preservation (EHP) requirements. This includes, but is not limited to, the processes and requirements established by the National Environmental Policy Act, Endangered Species Act, National Historic Preservation Act, Coastal Barrier Resources Act, and any other applicable laws, Executive Orders, Federal regulations or requirements. More detailed information on the EHP review process and requirements can be found in the HMA Guidance in the FEMA Library.

Project applications must include the necessary data and information for FEMA to conduct the appropriate EHP review. Due to the underground storage nature of ASR projects, the project application should addresses issues and methods to monitor and protect the stored water from potential contaminants. This includes consideration of the impacts, if any, of the injected water on native water quality, and potential sources of contamination from the injected water or leaching from the aquifer walls into the underground water supply. FEMA, in consultation with appropriate Federal and State agencies, will use the information provided in the application to ensure compliance with EHP requirements. This may include demonstrating methods to incorporate public participation in the review process and/or mitigate any EHP impacts resulting from the mitigation action.

ASR projects will need to be considered for compliance with the Underground Injection Control (UIC) Program regulated by the Environmental Protection Agency (EPA). The UIC Program is "responsible for regulating the construction, operation, permitting, and closure of injection wells that place fluids underground for storage or disposal." More information on the UIC standards and processes can be found on the EPA website at http://water.epa.gov/type/groundwater/uic/index.cfm.

Climate Change, Drought Information, and HMA Resources

U.S. Drought Portal which includes the National Integrated Drought Information System (NIDIS)
http://www.drought.gov/drought

NASA Gravity Recovery and Climate Experiment (GRACE) provides satellite data on aquifer water levels
http://www.nasa.gov/mission_pages/Grace

U.S. Department of Agriculture Disaster and Drought Information
http://www.usda.gov/wps/portal/usda/usdahome?navid=DISASTER_ASSISTANCE

Hazard Mitigation Assistance Guidance and Addendum (February 27, 2015)
https://www.fema.gov/media-library/assets/documents/103279

U.S. Global Change Research Program conducts a National Climate Assessment every four year
http://www.globalchange.gov

NOAA Climate.gov provides science and information for a climate-smart nation and houses the National Drought Monitor
https://www.climate.gov

Information Requests and Questions

FEMA encourages communities to work with their State or Tribal Hazard Mitigation Office in identifying and developing Climate Resilient Mitigation Activity projects. States and federally-recognized tribes should contact their FEMA Region Office with questions. Questions can also be submitted by email to FEMA-HMA-Grants-Policy@fema.dhs.gov.