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Abstract

Drought mitigation can be performed through the combined efforts of local and regional management programs and the planning for and implementation of structural and non-structural projects. Given the types of impacts caused by drought, coupled with ever changing water supply and demand factors, existing local and regional management programs may not allow for adequate protection of businesses and individual citizens. Longer range planning and implementation of structural and/or non-structural projects may be needed as conditions change to provide adequate drought protection. This chapter presents a listing of potential structural and non-structural projects that may be considered for drought mitigation.

Introduction

The impacts of drought, while often most detrimental on a local scale, may be best mitigated by regional projects depending on the nature and scale of the impact, the availability/scarcity of water, and the nature and location of the water demand. Projects, in this vernacular, refer to the development or improved use of water supply and/or the management of water demand. To this point, projects can be configured of structural or non-structural “components” or some combination thereof, noting that the creation, evaluation, and ultimately, the implementation of any “water project” in Colorado will likely include the efficient combination of both structural and non-structural project components. This chapter gives a brief overview of the structural and non-structural project components for drought mitigation that may be considered for evaluation and implementation at a local and regional scale in Colorado.

In water resources planning, it is useful to analyze projects not only in their global context, but also to identify the various elements of a project that make it complete. For example, a reservoir project would involve numerous “components” including the reservoir itself, delivery pipelines, and pump stations. The term “project component” is therefore used in this chapter to refer to the various individual actions or activities that can be performed for the mitigation of drought.

Structural Project Components

Large-scale structural projects by their very nature relate to the construction of capital improvements utilizing heavy equipment for clearing and earthwork. Large-scale structural projects that have been constructed in Colorado in past years include dams, pipelines and pump stations, wells, treatment facilities, etc. The common thread associated with these types of “classic” water supply projects is that

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Structural and Non-Structural Project Components for Drought Mitigation

their implementation typically requires considerable planning, permitting, and commitment of financial resources. However, the classic structural water supply projects are, in many cases, the only means available to solve water supply shortages.

Increasingly, various types and levels of concern and objections to classic water supply projects have required water planners and managers to broaden their identification and valuation of alternative means to either expand water supply or reduce water demand. These alternatives include both structural and non-structural project components (non-structural components are presented in the following section). Alternative structural project components, in contrast to traditional large-scale projects, include water reuse and conjunctive use programs, rehabilitation or upgrades to existing structures, and management of water-consuming noxious (phreatophyte) vegetation either along water courses or in forest and recharge areas.

Table 8-1 presents a summary listing of those structural project components that are most applicable to Colorado, both on a local and regional scale. A brief description or definition is provided for each.



Table 8-1: Summary of Structural Project Components Relevant to Colorado

Project Component/Category	Definitions/Examples
New or Upgraded Infrastructure (Supply and Demand Sides)	
Storage for Surface Water	New and upgraded dams, dredging of existing dams, expansion of existing dams
Diversions	New and upgraded channel diversions
Pipelines or Ditches	New and upgraded pipelines, ditches and pump stations, lining of ditches and pipelines
Wells	Installing new wells, deepening wells
Raw Water Treatment	New or upgraded water treatment to achieve required quality standards
Water Distribution Systems	New or upgraded pipelines, transmission mains, and pump stations
Infrastructure Maintenance and Repairs (Supply and Demand Sides)	
Maintenance of Existing Infrastructure	Maintenance to all existing structures
Dam Safety Improvements and Repairs	Improvements and repairs as identified by the State Engineers Office
Water Use Measurement (Demand Side)	
Installation and Maintenance of Water Meters	Measurement of water use/delivery through placement of meters in delivery system or at end-user destinations such as fields and homes
Water Reuse and Conjunctive Use (Supply and Demand Sides)	
Water Reuse Projects	Use of wastewater or reclaimed water from one application for use in another application
Aquifer Storage and Recovery/Conjunctive Use	Underground water storage in a suitable aquifer that is recovered when needed/Combined use of surface and ground water in a coordinated manner
Evapotranspiration Management (Demand Side)	
Phreatophyte Controls	Removal or control of plants such as tamarisk whose roots pull from saturated zone under shallow water table and transpire ground water
Forest Management	Management of forest system with intent of optimizing water supply yield and meeting water quality goals

Although many structural projects are built to increase water supply, many of the structural project components are also used to reduce demand. For example, lining of pipelines and ditches helps to reduce transmission system losses thus reducing system demand. Similarly, water metering which helps to identify system losses, can be used to reduce water demand. Management of phreatophytes and forest growth can also reduce existing water use.

Of course the construction of new dams, the expansion of dams and the repair of old dams will directly increase water supply. Raw water treatment and transmission structures such as pipelines and ditches can increase usable and available water supply; however, improvements in these types of structures can also reduce demand if leaks and inefficiencies are corrected. Regular operations and maintenance programs for infrastructure can also improve efficient use of water and thereby reduce demand or increase supply. Conjunctive use, which mainly addresses the supply side, typically allows for the capture and storage of surplus surface water in underground aquifers for later use when surface water supplies dwindle. Conjunctive use does not necessarily have a demand side benefit.

Water reuse has benefits on both the demand and supply sides. Reuse water can be a supply for numerous non-potable applications such as irrigation water and industrial non-contact water. On the demand side, a water utility or users that utilize reuse water will reduce its demand for raw water, all factors remaining the same.

Although numerous environmental and public impediments impact the viability of structural projects, components of structural projects have the potential to benefit all segments of water users including agricultural, municipal, industrial, environmental, and recreational by providing for availability of water in critical times.

Non-Structural Project Components

In contrast to structural project components, non-structural project components do not necessarily include construction, although limited earthwork or stream restoration may be involved. Non-structural project components include the development and implementation of efficient water supply and demand management tools or methods, allowing water owners, planners and managers flexibility in operating or managing their water resources.

Non-structural project components can be segregated into two areas with respect to Colorado water—those that may require changes to current state law and/or statute and those that may not. The non-structural project components that may require changes to state law



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include those that address the flexible use and management of water rights allowing water users to lease, transfer, and/or augment their water supplies. The non-structural project components that will not necessarily require changes to state law include cooperative agreements, use of existing state and federal programs (e.g., instream flow programs), public education, water conservation and drought planning, and the purchase of water rights.

Table 8-2 presents a summary listing of those non-structural project components that are most applicable to Colorado, both on a local and regional scale. A brief definition is provided for each. Table 8-2 also presents the applicability of individual non-structural project components to the different major segments of water use in Colorado, in that unlike structural project components selected non-structural project components are more applicable to some water users than others.

Discussion

Long-term development, conservation, protection, and management of the State's water resources will require the complimentary combination of structural and non-structural project components into programs that can be facilitated at a regional level and implemented on a local scale. To this point, water planners and managers, as well as policy makers, will need to package water projects based on the type of components required due to technical challenges and public sentiment. The structural and non-structural project components identified in this chapter provide water planners and managers with a wide range of alternatives from which to select in the development of regional and local mitigation of drought. The listed project components also have the ability to provide benefits to multiple water use segments and groups by increasing available water supply, decreasing water demand, or both.



Photo Courtesy of USDA NRCS

Table 8-2: Summary of Non-Structural Project Components Relevant to Colorado

Project Component/Category	Definitions/Examples	Major Water Use Segments			
		Agricultural	Municipal/Industrial	Environmental	Recreational
Those Typically Associated with Legal Agreements					
Water Exchanges	Water taken at a time and place when it would otherwise be out of priority but other water rights that would be injured are satisfied with replacement from another water source	✓	✓	✓	✓
Water Transfers	Reallocation of water from one use to another through sale or lease, can be a permanent or temporary legal arrangement	✓	✓		
Substitute Water Supply Planning	Planning for temporary transfers of water during periods of shortage or while looking for permanent sources	✓	✓		
Interruptible Supplies	Water rights transferred on a temporary basis for specific needs	✓	✓	✓	✓
Dry Year Lease	Water rights temporarily transferred for management of specific hydrologic or climatic conditions	✓	✓		
Other Leases	Legal agreement between water rights holder and new user for a temporary transfer of a predetermined quantity and duration	✓	✓	✓	✓
Operating Agreements	Arrangements among water right holders for changes in call priority and/or quantity	✓	✓	✓	✓
Water Banking	Pooling of surplus water rights for rental to other water users	✓	✓	✓	✓
Water Conservation Easements	A voluntary legal agreement with permanent restrictions on the use of water to protect selected stream uses or segments	✓		✓	
Use of Instream Flow Programs	Acquisition or donation of instream water right for preservation of the environment to a reasonable degree through the CWCBC	✓	✓	✓	✓
Those Not Typically Associated with Legal Agreements					
Public Education and Awareness	Programs designed by water managers to increase knowledge of water issues to promote efficient water use	✓	✓	✓	✓
Water Conservation Planning and Implementation	Establishment of a plan to increase productivity of water supply and use and implementation of prescribed measures	✓	✓		
Water Conservation Monitoring and Measurement Methods	Techniques for quantitative and qualitative tracking of the effectiveness of water conservation measures	✓	✓		
Water Supply Master Planning	Planning for water supply needs and management	✓	✓	✓	✓
Drought Planning	Establishment of a drought response plan detailing measures to mitigate the impacts of drought and emergency response	✓	✓	✓	✓