Alternative: Manage Drought

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1. Summary of the Alternative

About 75 percent of the demand in the Jemez y Sangre region is currently met with surface water supplies, which are highly variable. When drought conditions occur, the available surface water is not sufficient to meet all of the current demands. As population and water use increase in the future, even greater discrepancies between supplies and demands are expected. Localities that rely on groundwater can also benefit from drought planning, because the demand for groundwater supplies increases when precipitation is low.

The historical record shows a recurring cycle of drought. Though it is difficult to predict the timing of droughts, it is certain that droughts will occur within the Jemez y Sangre region over a long-term planning horizon. Given this certainty, advance planning should be undertaken to avoid a crisis management situation during future droughts. A proactive planning approach to drought management is beneficial for all impacted parties. The drought management alternative consists of developing a drought management plan that will enable the region to be prepared for droughts when they do occur. Drought planning should be a foundation for all water systems, particularly those dependent on surface water for supply. Drought management does not reduce the regional demand or the projected discrepancy between supply and demand but should, however, allow communities to function well during a drought.

Some of the most important actions that can be undertaken to prepare for drought include improving storage capacity and reducing demand through efficiency and conservation. The technical feasibility of these measures is discussed in white papers on reservoir storage (DBS&A, 2002d), aquifer storage and recovery (DBS&A, 2002c), reduction of conveyance losses (DBS&A, 2002a), and demand reduction (conservation) (DBS&A, 2002b). This paper focuses on the issues involved with development of a drought management plan that addresses actions to be undertaken during various stages of drought.

Drought management plans typically include the following:

- A drought task force or other set of responsible parties is designated to oversee declarations of drought conditions and implementation of drought mitigation measures.

- “Triggers” are selected to identify various stages of drought (i.e., mild, moderate, severe). Triggers include indices that categorize levels of drought based on climatic and streamflow conditions.

- Specific mitigation measures that are to be undertaken during each drought stage are identified. Mitigation measures can include standard drought ordinances that define water restrictions, or they may include broader measures such as leasing of supplies during droughts.

Drought management can be undertaken at a regional level through cooperative agreements, or it may be undertaken by individual counties, municipalities, Acequias, Pueblos, or irrigation districts within the region. Drought planning that addresses both local and regional mitigation efforts will be most effective.

2. Technical Feasibility

This technical feasibility analysis describes the steps in developing a drought plan that encompasses monitoring, communication, and mitigation measures. In developing drought plans within the region, it is important to consider that water use during times of drought is subject to a prior appropriation system. Thus more senior water rights holders, such as the Pueblos within the region, may not need to implement mitigation measures such as water conservation to the same degree that more junior users would need to.

2.1 Drought Task Force

As noted in Section 1, the first step in developing the drought plan is to determine who within the region will be involved in development and implementation of the plan. Many drought plans rely on a task force with representatives from various water user groups such as Acequias, municipalities, counties, and irrigation districts. If drought planning is conducted by individual municipalities, Acequias, Pueblos, or irrigation districts, an employee and/or group of water users may administer the drought plan. Generally a designated municipality, agency or contractor will work with the drought task force to develop the drought plan.

2.2 Drought Triggers

Typically, standard measures such as the Palmer Drought Severity Index (PDSI), the Surface Water Supply Index (SWSI), or the Standard Precipitation Index (SPI) are used to define various stages of drought. These indices are discussed in Sections 2.2.1 through 2.2.3. Additional possible triggering parameters are discussed in Sections 2.2.4 and 2.2.5.

2.2.1 Palmer Drought Severity Index

The PDSI is an empirically derived meteorological index based on the water balance equation (i.e., precipitation is equal to evapotranspiration plus runoff and groundwater or soil moisture recharge plus or minus any change in soil moisture storage). It is computed with several formulas that incorporate precipitation and temperature data along with the available water content of a local soil type to define the terms of the water balance equation. The difference between a monthly precipitation amount and the climatically appropriate precipitation for existing conditions is multiplied by a climatic weighting factor that allows the index to have a comparable significance from location to location. The climatically appropriate precipitation and climatic weighting factors are derived from historical records. Human impacts such as irrigation usage and reservoir storage amounts are not considered.

The PDSI roughly varies between –6.0 and +6.0; values of +4.0 or more and –4.0 or less represent extreme conditions, while values close to zero represent normal conditions:

- + 4.00 or more: Extremely wet
- +3.00 to +3.99: Very wet
- +2.00 to +2.99: Moderately wet
- +1.00 to +1.99: Slightly wet
- +0.50 to +0.99: Incipient wet spell
- +0.49 to –0.49: Near normal
- –0.50 to –0.99: Incipient dry spell
- –1.00 to –1.99: Mild drought
- –2.00 to –2.99: Moderate drought
- –3.00 to –3.99: Severe drought
- –4.00 or less: Extreme drought

Weekly PDSI values for every climate division in the United States are computed by the Climate Prediction Center and are available from the National Oceanic and Atmospheric Administration's (NOAA) Drought Information Center at http://www.drought.noaa.gov.

Since its development in 1965, the PDSI has been widely used to gauge drought conditions, but it has been found to have several limitations. Some of these are related to arbitrary and simplified assumptions used in the computation of the water balance terms and the exclusion of snowfall and snow cover in the index. Researchers have suggested that the PDSI is designed for agriculture and does not accurately represent hydrological impacts from longer droughts. It also does not work well in areas with extreme variability in rainfall and runoff. Nevertheless, its frequent computation on a climate division basis and ready availability make it a useful component of drought monitoring when used in conjunction with other analyses of precipitation conditions and water supply availability.

2.2.2 Surface Water Supply Index

The SWSI was originally developed to complement the PDSI for monitoring moisture conditions in the state of Colorado. Whereas the PDSI is basically a soil moisture index for regions with consistent hydrologic conditions, the SWSI is an indicator of surface water conditions for areas in which mountain snow pack is a major component. The four parameters incorporated in the

SWSI are snow pack, streamflow, precipitation, and reservoir storage. During the winter, only snow pack, precipitation, and reservoir storage are used to compute the index, while during the summer, streamflow is used instead of snow pack.

Typically determined on a monthly basis, each parameter value is normalized (divided by the long-term average), and its probability of non-exceedance is determined by frequency analysis. Each term's probability of non-exceedance is multiplied by a weighting factor that accounts for the proportional contribution of each component to the surface water in a particular basin. The sum of the weighted components is centered on zero (by subtracting 50 percent) and divided by 12 to compress the scale to a range of –4.2 to +4.2, similar to the PDSI.

- + 4: Abundant supply
- +2: Near normal
- –1: Initiation of drought conditions
- –2: Moderate drought
- –3: Severe drought
- –4: Extreme drought

Besides Colorado, other states that have used the SWSI for drought monitoring include Oregon, Montana, Idaho, and Utah.

SWSI values are computed on a monthly basis by the Natural Resources Conservation Service (NRCS). Current SWSI values for the major New Mexico river basins are available on NRCS's web site (http://www.nm.nrcs.usda.gov/snow/forecast), along with basin outlook reports that include details on snow pack conditions and reservoir storage. This information is provided for January through May only.

2.2.3 Standardized Precipitation Index

In technical terms, the SPI for a given historical precipitation record represents the number of standard deviations away from the mean for an equivalent normal distribution with a mean of zero and standard deviation of one. Advantages of the SPI are that it can be computed for any single site with a long-term precipitation record and it can be determined for multiple time scales, typically 1, 3, 6, 12, 24, and 48 months. The application of this index to multiple climate station sites allows for a more localized definition of drought conditions than the more regional-scale PDSI and SWSI. Similarly to the PDSI and SWSI, the index is centered on zero, but extreme conditions occur at values above +2 and below –2.

- +2 or more: Extremely wet
- +1 to +1.99: Moderately to very wet
- 0 to +0.99: Near normal
- 0 to –0.99: Mild drought
- –1 to –1.49: Moderate drought
- –1.5 to –1.99: Severe drought
- –2 or less: Extreme drought

A drought event is defined as a period in which the SPI is continuously negative and reaches a value of –1.0 or less. The drought begins when the SPI first falls below zero and ends with a positive value of SPI following a value of –1.0 or less.

The ability to express conditions at multiple time scales allows the index to reflect the impact of drought on the availability of different water resources. The SPI also facilitates the definition of conditions where, for example, it is possible to simultaneously experience wet conditions on a short time scale but dry conditions on a long-term time scale. An emerging drought will first appear in short time scales, and if dry conditions persist, the drought will be reflected in longer time scales. Short-term wet periods can mask a long-term drought condition for some components of water supply, but will not appreciably affect water supply components that are responsive to longer-term conditions. For example, soil moisture conditions reflect precipitation deficits on a short time scale, while groundwater, streamflow, and reservoir storage are responsive to longer-term deficits. Thus a short-term drought would impact dryland farming conditions, but may have little effect on urban water supplies or irrigated agriculture. The use of several time scales assists in recognizing an emerging drought early on, in monitoring drought magnitudes over longer time periods that impact surface water supplies, and in anticipating an end to a drought as wetter conditions occur.

The Western Regional Climate Center computes the SPI on a monthly basis for every climate division (http://www.wrcc.dri.edu). A computer code also is available to calculate the SPI for individual sites (Guttman, 1999). DBS&A has compiled this code to run on a personal computer.

2.2.4 Reservoir Storage Levels

As an alternative to the basin-wide SWSI estimates provided by the NRCS, a more localized assessment of surface water conditions may be useful to local communities that are dependent on surface water supplies. In such cases, local reservoir storage levels may be used to define triggers for various response actions. For example, progressively greater water use restrictions might be implemented as reservoir storage drops below certain levels, such as 40 percent, 30 percent, or 20 percent of capacity. These levels would be set by the locally responsible parties who administer the drought plan based on historical usage patterns.

2.2.5 Groundwater

Some communities, notably the City of Albuquerque, have elected to use groundwater pumping rates as a drought indicator. Although Albuquerque now relies exclusively on groundwater pumping for its supply, the City plans on switching to a combined surface water-groundwater supply system soon, to reduce groundwater pumping to sustainable levels and preserve the aquifer as a drought reserve. The City anticipates that during drought conditions, per capita water use may increase and surface water may not be fully available, two conditions that when combined would result in increased groundwater pumping both to meet increased demands and to make up for decreased surface water supplies. The increased pumping represents borrowing from the drought reserve and thus serves as a metric for determining the severity of the drought conditions.

Tiered water use restrictions can be implemented to reduce over-pumping during droughts. For example, either numerical limits or type of use restrictions (e.g., no car washing) can be required to correspond to various stages of drought.

2.2.6 Drought Stages

The indices discussed in Sections 2.2.1 through 2.2.4 are used to identify various stages of drought, typically three to six divisions, with mitigation measures (Section 2.3) being implemented for each drought stage. An example of the triggers and drought stages from the *New Mexico Drought Plan* (New Mexico Drought Planning Team, undated) is shown in Table 1. Statistical analyses and correlation of the available indices to historical data are required to determine the appropriate drought triggers for any given region. Analysis of historical streamflow data is also useful in evaluating historical drought conditions. Analysis of low flow conditions within the region has been completed by Duke Engineering & Services (DE&S, 2002). Thorough technical analysis of streamflow probabilities reported by DE&S and other available data will be required to accurately determine which triggers are appropriate for the Jemez y Sangre region.

2.3 Drought Mitigation

Once the drought stages and corresponding triggers are identified, mitigation measures for each stage are identified. The technical feasibility of implementing mitigation measures is specific to the measures undertaken. Mitigation measures that may be considered in the Jemez y Sangre region include both short-term supply measures, such as leasing arrangements, and demand reduction measures.

Leasing of water rights can be arranged between willing participants with OSE approval. For example, a municipal user could lease agricultural water rights for use only during certain conditions, which could be set to correspond to specified drought triggers. Typically the agricultural user would be compensated for the value of the crop not planted. Water rights leasing requires OSE approval, and is subject to protest based on impairment and/or public welfare. Technical analysis of potential impairment issues would most likely be required to obtain OSE approval. In emergency situations, the OSE may expedite approval of a lease, as long as notice requirements have been met and no protests were filed against the transfer. However, if other water users protest the transfer, then the process can take from 6 months to 2 years; hence effective drought mitigation requires that the arrangements be in place before the water is needed during drought conditions.

Table 1. Drought Stage Triggers

Drought Status	Characteristics for a Single Climate Region
Normal	• PDSI between –0.9 and + 5.0 • 6-month SPI positive
Advisory (approaching or experiencing incipient drought)	• One month or 4 week running average PDSI is between –1.0 and –1.9 but period of less than –1.0 does not exceed 2 months. • 6-month SPI declining and less than 0.25 for 2 consecutive months.
Alert (mild drought)	• PDSI is between –1.0 and –1.9 for greater than 2 months or between –2.0 and –2.9 for 1 month. • 6-month SPI between 0 and –0.99.
Warning (moderate drought)	• PDSI is between –1.0 and –1.9 for 9 months or more, between –2.0 and –2.9 for at least 2 months, or –3.0 or less for at least 1 month. • 6-month SPI declining and between -1.00 and -1.49.
Emergency (severe to extreme drought)	• PDSI is between –2.0 and –2.9 for 9 months or more, between –3.0 and –3.9 for at least 2 months, or –4.0 or less for at least 1 month. • 6-month SPI declining and less than –1.5.
Emergency (drought receding)	• After severe to extreme drought criteria have been met, PDSI improves to greater than –2.0 for 2 consecutive months. • 6-month SPI turns in positive direction for 2 consecutive months.
Warning (drought receding)	• After criteria for moderate or worse drought have been met, PDSI improves to greater than –1.5 for 2 consecutive months. • 6-month SPI rising in positive direction and between –1.00 and –1.49 for 2 consecutive months.
Alert (drought receding)	• After criteria for mild or worse has been met, PDSI improves to greater than –1.0 for 2 consecutive months. • 6-month SPI rising in positive direction and between 0.0 and –0.99 for 2 consecutive months.
Advisory (drought receding)	• After criteria for mild or worse drought have been met, PDSI improves to greater than or equal to zero, and the 10-month running total of the PDSI is less than –10.0. • 6-month SPI is above zero.

Source: Drought Planning Team, Undated, Section 6D, Table 4 (http://weather.nmsu.edu/drought/monitoringD.htm).

PDSI = Palmer Drought Severity Index SPI = Standardized Precipitation Index

In selecting mitigation measures, planners need to consider the priority of existing water rights. For example, some Acequias within the region that are upstream of Pueblos with senior water rights have agreed to discontinue their water use during drought conditions, thus allowing the priority users to receive the water during drought conditions.

Examples of some existing mitigation measures from the cities of El Paso and Santa Fe are shown in Table 2.

Table 2. Examples of Drought Stages and Mitigation Measures

Drought Stage [a]	Mitigation Measures
El Paso	
1	Voluntary conservation
2	• One day per week landscape irrigation • No golf course irrigation • No new landscaping
3	No new customers
All	Surcharges to recover lost revenue
Santa Fe	
1	Voluntary conservation
2	• Irrigation three days per week • Unessential uses (e.g., car washing) prohibited
3	• Irrigation one day per week • No new planting
4	• All outdoor use prohibited, except watering of large trees two days per month • No water on construction sites

[a] Stages 1 through 4 represent mild (Stage 1) to most severe (Stage 2) conditions

Long-term conservation measures help to reduce demand at all times, and hence are helpful for reducing demand during all stages of drought. Conservation measures are discussed in a separate white paper (DBS&A, 2002b). Many water conservation measures can be adopted on a permanent basis, or water managers may choose to implement conservation measures only during drought conditions. The decision on whether to implement permanent or short-term measures is based on political feasibility, water pricing issues, and the availability of the supply.

Some examples of mitigation measures focusing on demand reduction that may be most feasible for the Jemez y Sangre region, listed by category of customer group, and the stages of drought at which these measures might be applied are listed below.

- Residential

  - Disseminate educational information (how to save water at home) through billing inserts and local media, including TV, newspapers, and radio. Include weather/drought updates (e.g., drought conditions are worsening) and suggestions for saving water (e.g., take shorter showers, find leaks, use a soil probe to monitor moisture in the garden soil, use a pool cover to reduce evaporation, etc.). (Stages 1 through 4)

  - Require home water audits, either offered free by the agency or paid with a surcharge on the water bill for conservation. These could be either targeted to highest users and/or offered to all customers. Such an audit would look for leaks and inefficiencies in inside use and would check irrigation system and automatic controller schedules. The customer would receive notes or a form that describes findings and suggests tips for saving water, including how often to water the landscaping. (Stages 2 through 4)

  - Request all water users to reduce their use by a designated percentage from previous years (with the percentage increasing as drought triggers occur). (Stages 1 through 4)

  - Enact a water rate surcharge for any water use that is higher than the previous year's rate of use or higher than a specified reduction level. Implementation of the surcharge would require a software upgrade, bill notation, and/or separate letter to all customers showing the previous use and the target reduction. The increased surcharge should be based on something tangible, such as the cost to purchase new water or the cost of conservation. (Stages 3 and 4)

- Business (commercial/industrial)

  – Disseminate educational information on how to save water in commercial/industrial settings (low-flow plumbing, process water uses, leak identification, cooler tower use, landscape efficiency, etc.). (Stages 1 through 4)

  – Implement water audit program, which may take a couple of forms. For example, the program could require self-performed water audits (commercial sites), done with an agency-developed reporting form but paid for by the business. Such audits would be viewed as voluntary but with consequences if not performed. Another option would be required efficiency audits with completed efficiency forms sent to the water agency. This means that the business must pay for their own water audit, repair leaks, and report that they have done so to the water purveyor or face a surcharge until it is completed. (Stages 2 through 4)

- Business-specific recommendations (Stages 1 through 4)

  – Hotels: Laundry restriction program, price incentive on low-flow plumbing retrofits, ornamental landscape water budgeting, restaurant audit (sinks, washers, etc.)

  – Offices: Plumbing audit, repairs, and reporting; landscape water budgeting

  – Manufacturing: Site audit that identifies various water uses and recommends water savings that still maintain business/production levels

  – Service businesses (restaurants, car washes, laundromats, etc.): Site water audit and use reduction plan/efforts

Businesses generally would not be asked to reduce water compared to previous years (in order to maintain business levels). However, they would be asked to incur the costs to retrofit with low-flow plumbing and make other efficiency upgrades (cooling towers, etc.), and they may be asked to replace high water use landscapes with xeriscaping or face some type of surcharge or tax. Pricing incentives could also be incorporated in the fee structure to drive positive and long-term savings actions and yet not interrupt business activities. It is important to not develop drought plans that reduce both business and, in turn, jobs in order to save water. Instead a plan should focus on being more efficient with water while maintaining jobs, providing the local politicians with a good marketing tool, and increasing the likelihood of gaining support from the business community.

Additional mitigation measures for landscaping with dedicated meters include:

- Require site water budgets (based on local evapotranspiration and standardized use/efficiency levels) for all landscaping with dedicated meters. Water budgeting can be performed by the commercial user following a form developed by the water agency. This water budget will determine what type of landscape is present, how efficient the irrigation system is, how much water the site needs, and what plants should be saved (i.e., watered) in case of more severe drought and increasing water restrictions. A site report should be filed, using the provided forms, that identifies such items as highest value plantings (i.e., trees, other), site practices, and acres. (Stages 1 through 3)

- Alter the time of day that watering occurs to moderate morning “peak” problems. (Stages 1 through 4)

- Require all irrigation system leaks to be repaired before continued water use is allowed. (Stages 2 and 3)

- Use soil probes, read meters weekly, chart and monitor water use. (Stages 1 through 3)

- Reduce water use to a designated percentage of previous average use. (Stages 2 through 4)

- As the drought severity increases, require that high water use landscapes or irrigation systems be replaced with xeriscapes and/or drip irrigation (require evapotranspiration controller technology) to be able to continue to irrigate. (Stages 3 and 4)

- Provide some incentive for installing landscape conservation measures and technologies (rain shut-off devices, rain collection systems, evapotranspiration controllers, xeriscapes or turf removals, etc.) (Stages 1 through 4 and before and after droughts)

- Ban lawn watering (allow tree and shrub irrigation). Make some provision for public play fields and schools; however no public ornamental turf should be irrigated during stage 3 and 4 to show that government is willing to do at least as much as it asks the private sector and households to do. (Stage 4)

The potential measures described above place the burden of cost on the various users. The public agency role can be to provide detailed information and education and, in some programmatic ways, to provide financial incentives (such as incentive rates or drought surcharges). Some type of revenue generation for drought plan implementation can be incorporated into water billing rates, some portion of which could be used to develop educational materials and forms before a drought happens so that a drought plan can be quickly implemented.

3. Financial Feasibility

Development of drought monitoring and mitigation plan(s) for the region would cost approximately $100,000 to $200,000, depending on the level of detail that is included in the plan. Costs would cover items such as the technical analysis required to define drought triggers and facilitation of meetings for plan development.

Once the plan is developed, additional costs would be required to implement the plan. Staff time from various agencies and water user groups would be required for participation on a task force and implementation of mitigation measures. Costs for mitigation measures would vary depending on the measures chosen. Many of the demand reduction measures listed in Section 2.3 can be implemented at a relatively low cost. Voluntary restrictions will require funding for public education, and mandatory water restrictions will require funding for monitoring and enforcement in order to be effective. Potential costs associated with emergency water rights leasing ideally should be addressed during the planning phase, as advance arrangements with water rights purveyors are likely to be more cost-effective than last-minute deals made under stressful circumstances.

Water providers must also plan to address lower revenues resulting from water use restrictions. Tiered pricing or penalties for overuse may help to recoup lost revenue.

4. Legal Feasibility

A precise legal analysis would require knowledge of exactly what drought measures were contemplated. As a general proposition, courts will accord significant leeway to governments that are doing the best they can to address a difficult drought situation. Temporary moratoria or limitations on new development, or on high-water uses or similar measures, will likely be allowed, as long as the system imposed appears to be a rational attempt to deal with the situation. Indeed, all of the measures described in this paper should, if implemented carefully and rationally, pass legal muster. However, if any such actions cause people to go out of business or otherwise cause a huge devaluation of private property, a court might require that just compensation be paid. Similarly, if the drought plan appears to treat different classes of people very differently with no solid rational basis, then such a plan might be struck down.

With respect to limitations on exercise of water rights, such limitations must be consistent with the State Water Code, which establishes a priority water rights system. Otherwise, if exercise of water rights is prohibited or restricted to levels below the historical level of use, compensation could be required. Moreover, if a local government attempted to prohibit water rights users from exercising those rights, even if compensation were provided, such action might be found to be preempted as an interference into the arena of State Engineer authority. These provisions apply to all water rights, including domestic well rights.

Although it has only rarely happened in the past, it is likely that severe droughts in the future will prompt senior water rights holders to seek priority administration of water rights by the State Engineer or by the water rights adjudication court in an area where there is an adjudication court. What that would mean is that the State Engineer or the court would order enough junior water users to cease their diversions to supply water to all the more senior water rights holders. To date, we are unaware of the State Engineer carrying out priority administration of water rights except where such administration has been authorized by a court in an adjudication. Indeed, the Carlsbad Irrigation District has been asking the State Engineer for priority administration since 1976, so far without success. During the 1996 drought, some downstream pueblos filed motions in federal court against upstream junior water users as part of the adjudication, seeking priority administration. The filings prompted water rights owners to negotiate agreements for water management during that drought.

Many people, including the State Engineer, have argued that the State Engineer cannot administer priorities unless and until adjudication of the relevant water rights is complete. Others have argued the opposite. The issue is complex. Since adjudications in this region are unlikely to be completed for many more years, the issue will probably come to a head during the next serious drought, when senior water rights owners seek priority administration. In such a circumstance, if either a court or the State Engineer commence priority administration, there will probably be lots of litigation concerning which rights can be shut off and which cannot.

As the recent debate over possible priority administration of the Pecos River confirms, priority administration would likely cause major economic disturbance, especially to municipalities and other holders of junior water rights. This should serve as a major incentive for governmental entities to do everything possible to either plan to reduce water use during drought (thus reducing or avoiding the need for a priority call) or make plans for how to cope if there is a priority call and junior water rights are shut off.

5. Effectiveness in Either Increasing the Available Supply or Reducing the Projected Demand

Developing a drought management plan will not result in any direct increase in the water supply. The primary benefit of developing the drought plan is to identify ahead of time drought mitigation measures and parties responsible for implementing those measures. To the extent that the plan incorporates water conservation measures, which may be set to correspond to various stages of drought, significant water savings could be realized. Savings resulting from water conservation measures realized by various communities are 23 percent in Albuquerque, 30 percent in Tucson, 25 percent in Los Angeles, 27 percent in Austin, 54 percent (landscape use only) in Irvine (DBS&A, 2002b), and 22 percent in Santa Fe.

6. Environmental Implications

The impacts resulting from drought management vary depending on the drought mitigation measures chosen by the region when developing a specific plan. To the extent that water conservation measures are part of the drought plan, a positive environmental impact would generally be realized. Voluntary and mandatory conservation measures can help to sustain limited water supply resources during periods of drought, resulting in positive environmental effects such as the maintenance of river flow, which benefits wildlife and riparian habitat. Other mitigation measures, such as transfer of agricultural water to urban areas during times of drought, may result in more varied impacts. Allowing farmland to be fallow during drought seasons should not have a long-term environmental impact.

The most serious environmental impact due to drought is loss of streamflow and subsequent impacts on the riparian habitat. If there is no drought plan, generally all of the flow from the rivers will be diverted by the most senior users. Development of the drought plan would enable the region to address minimum streamflow conditions, but only if the group designated to develop the plan includes that as a priority.

7. Socioeconomic Impacts

Planning for how water will be allocated during drought conditions should result in a positive socioeconomic impact as compared to facing drought conditions with no regional plan in place. The development of the drought plan will enable the various user groups to discuss drought allocation policies when emergency conditions are not present and thus time is available for greater public participation.

Conversely, if drought restrictions are set up that affect some user groups more than others, there may be a concern about socioeconomic impacts to that user group. To avoid such impacts, a drought plan must be based on accurate data regarding community water use patterns across the different types of water user groups. Failure to do so runs the risk of not only selecting ineffective mitigation measures, but of public opposition to drought management efforts due to an inequitable focus on business sectors or users who may not be the largest or most inefficient water users. However, selective targeting of specific user groups may be difficult to avoid since fairness and water use efficiency are not necessarily compatible goals. Public education is therefore important to foster community support for such restrictions.

8. Actions Needed to Implement/Ease of Implementation

The following actions would be required to develop and implement a drought plan for the region:

- Convene a meeting of water users/stakeholders to determine who would be interested in participating in developing a regional plan or in developing their own drought plan.

- Conduct technical analyses to evaluate the correlation between historical data and drought triggers and to define appropriate triggers.

- Conduct an analysis of drought vulnerability in relation to priority dates of water rights.

- Evaluate drought vulnerabilities during a potential priority administration of the Rio Grande.

- Evaluate and adopt mitigation measures. A series of meetings would be required to develop consensus on appropriate mitigation measures.

9. Summary of Advantages and Disadvantages

The advantages of drought management planning are:

- Allows public input into development of drought planning measures
- Relatively inexpensive to complete
- Prepares the region for addressing drought conditions

The disadvantages include:

- Does not result in any new supply
- May encounter public opposition regarding water restrictions
- May result in inequities that target some user groups over others

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