

CITY OF LOUISVILLE, COLORADO
DROUGHT MANAGEMENT PLAN



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INTRODUCTION

This drought management plan is a guide for the City of Louisville for the varying degrees of drought experienced with the normal variations of weather patterns. The purpose of this document is to identify the conditions, which formally place the City in a designated level of drought and predetermine the general responses appropriate for given drought conditions. It also establishes the general framework for when drought conditions require special communications with residents and the type of information to be communicated.

DEFINING A DROUGHT

Defining a drought is somewhat difficult given the degrees to which droughts occur. In general, a drought is an event of unknown duration whereby available water is significantly less than a community is normally accustomed to. Droughts can be defined two ways, 1) the duration in which normal water supplies do not materialize, and 2) the extent or amount of deficiency in normal precipitation from a historic average.

Colorado has historically seen cycles of above and below average precipitation. Even though these variations are a part of the natural weather cycle, they still present a risk to our quality of life. The impact of a drought can be social, environmental, and economic. However, a drought's impact can be mitigated through good planning and preparedness.

LOUISVILLE'S WATER SUPPLY SYSTEM

The City of Louisville was founded in 1878. For a number of years the community's water system was based solely on Louisville Reservoir, which was constructed in the late 1890's. During the 1950's drought, the community realized this facility could not handle residents' needs for water during dryer weather cycles. Therefore, in the mid 1950's, the City constructed a steel pipeline to divert water from South Boulder Creek at Eldorado Springs to Louisville Reservoir. In addition, the City embarked on a program of acquiring additional water rights to supplement its water supply. As the community grew, additional efforts were taken to enhance the reliability and quantity of water available to Louisville. These efforts included obtaining a contract right to store water in Marshall Lake, a major reservoir in the Louisville area, and constructing Harper Lake Reservoir in 1985. In the 1990's, after a number of years of significant growth, the City realized the community's water supply could not be reliably obtained solely from South Boulder Creek and Marshall Lake. Therefore, the City of Louisville joined the Northern Colorado Water Conservancy District (NCWCD), allowing access to Colorado Big Thompson (C-BT) and Windy Gap water resources. Since that time, NCWCD has been the primary focus of the City's ongoing efforts to provide additional water supplies. As of 2012, the City's water rights portfolio is valued at over \$110 million.

WATER AND WEATHER

In Colorado, weather plays a significant role in determining the amount of water available for municipal use. It is relatively easy to project water needed for a given development or recreational facility. It is much more difficult to integrate the effect of variations in weather on

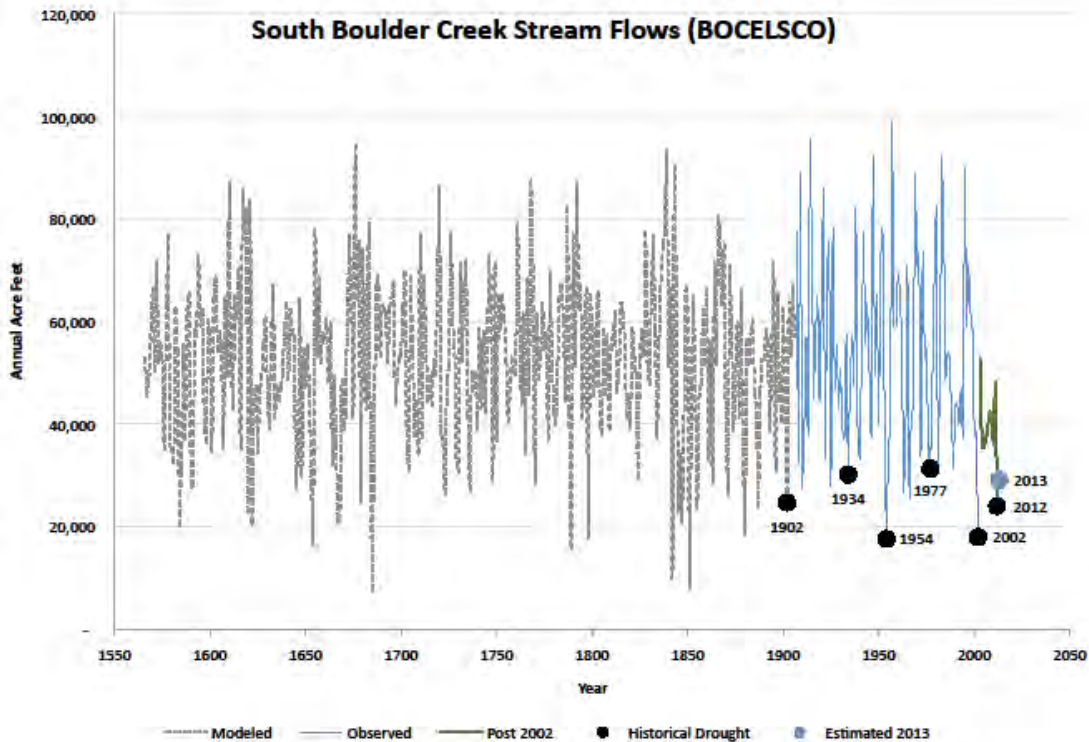
the total amount of water available to Louisville. Approximately half the water in Louisville is used for landscape irrigation. The other half is used for indoor domestic, industrial, and commercial purposes.

HOW RELIABLE SHOULD A WATER SUPPLY BE?

In 1992, the City adopted the Raw Water Master Plan with Council selecting a drought event of 24 months with a 50-year reoccurrence interval as the event the water system should withstand. However, the 2003 Raw Water Master Plan update suggested that what was believed to be a 50-year drought in 1992, is closer to a 25-year drought. To eliminate confusion, the City's design drought is based on the event that occurred from January of 1953 to December of 1954.

For reference, the 2002 drought event was more severe than the selected design drought. In fact, the 2002 drought was considered, until recently, to be a 1 in a 300-year drought event within the local water supply basin. This means the 2002 event was well outside any reliability criteria established for Louisville's water supply system. In spite of this, the City was able to supply sufficient water quantity to satisfy essential health and safety needs, as well as maintain landscape materials in the community. Figure 1 shows flows in South Boulder Creek during various historic drought events.

FIGURE 1 – HISTORIC SOUTH BOULDER CREEK FLOWS



Information from the National Oceanic and Atmospheric Administration (NOAA) suggests that climate change associated with global warming may result in more frequent and prolonged drought events in the future.

DROUGHT RESPONSE PLAN

When Louisville is facing a drought event, the City should be prepared to implement an appropriate predefined drought response plan. However, determining when a drought has begun can only be done in hindsight and determining when a drought will end is only possible if one can predict the future. Using historical information regarding drought events, stream run-off, and related factors is the only way to prepare appropriate projections to be incorporated into an overall drought response plan.

DROUGHT INDICATORS

It should be kept in mind that a drought will likely begin with a small event and become more severe. Droughts may last a month or several years. With this plan, the City should be able to escalate the drought severity ratings as a drought continues. When projecting water supply for Louisville, one typically looks at the critical period of March, April and May. Historically this is the time when the reservoirs approach their lowest level, while at the same time, snow pack measurements provide reasonable projections for runoff for the coming season. The amount of water in storage and the projected amount of available runoff determines the City's ability to meet water demands.

At best, drought indicators are only a guideline. It takes detailed analysis and extensive experience to understand within a given set of circumstances the amount of water likely to be available to the community. In many cases, the same amount of snow pack can have significantly different runoff patterns resulting in large variations in the amount of useable water.

Numerical indicators alone, such as the amount of water currently in storage, are not always accurate indicators of a drought event. When used in conjunction with more predictive indicators, such as projections for the amount of water stored as snow pack, numeric indicators are more realistic. Confidence in the projections of the water supply will vary throughout the year, with the projections being most reliable during the late Spring when quotas are set and the runoff is more predictable, to the least reliable in November, when only the amount of water in storage is known. A quota is an amount of water the City is able to obtain from a share of a storage water right. These amounts are set depending on needs of share holders and availability of water. Therefore, the City established a predictive tool incorporating both numerical and predictive indicators to determine when the City's water supply may not meet the demand.

A Water Supply Index (WSI) is utilized to compare water storage amounts, projected supplies, and demands for the City. The basic form of the WSI is as follows:

$$WSI = \frac{Supply}{Demand} = \frac{Carryover_{(last)} + SBCdirects + NCWCD + Marshall}{Demand - (Carryover_{(next)})}$$

Where the Supply and Demand components are defined as follows:

Supply

Carryover_(last) = the volume of water in local storage carried over from the last year.

SBCdirects = projected total direct diversions from South Boulder Creek in the current year. Prior to the actual runoff the projected flows are based on historic relationships between snow pack and stream runoff.

NCWCD = projected or actual water available from the Northern Colorado Water Conservancy District for the current year including, Colorado-Big Thompson (C-BT) and Windy Gap allocations.

Marshall = projected or actual storage water in Marshall Lake for the current year from the yields of the City's shares in Farmers Irrigation and Reservoir Company (FRICO) and South Boulder & Coal Creek Irrigating Ditch Company (SB&CCD)

Demand

Demand = projected City water usage for the current year.

Carryover_(next) = targeted amount of carryover water in local storage determined necessary to reasonable buffer the City for the next year.

The WSI equation results in an index that will indicate the expected amount of water available to meet current demands. A WSI of one (1.0) on April 1st would mean that the supply would meet the demand, including designated reserves. A value greater than or less than one would mean that there is either an excess or a shortage of water, respectively.

The WSI can be used to indicate the potential severity of a water shortage and how the City should respond. A WSI in the range of 0.95 to 0.85 would trigger a Stage I response. The trigger for a Stage II response would be a WSI between 0.85 and 0.75. A WSI between 0.75 and 0.65 would indicate a Stage III drought and a WSI less than 0.65 would trigger a Stage IV response. Other factors may influence the level of response and vary from the response dictated by the WSI. The WSI will tend to fluctuate over the year, with the highest values just after spring runoff and the lowest values in November before snowpack is known. The WSI can also fluctuate rapidly over the course of a month in response to precipitation events.

DROUGHT STAGES

In order to quantify drought events, a relationship between water reduction and the severity of the drought event has been developed, the WSI. If this calculation indicates water supply for a drought stage is less than required, the City would enter the next level of drought response. The following guidelines will be utilized to indicate the drought event under existing conditions and the corresponding target conservation amounts. This relationship is also shown by Figure 2. The guidelines will be adjusted as demand increases and additional water resources are acquired.

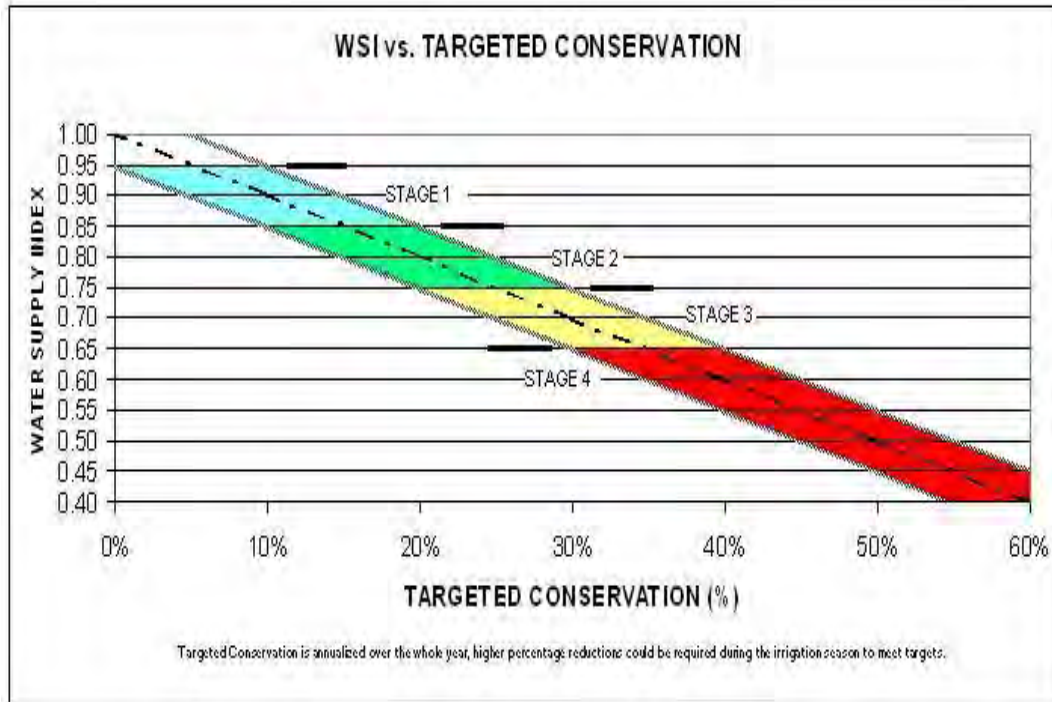
Stage I – Any individual or a combination of factors in WSI result in a supply shortage of 10 percent. (WSI .95-.85)

Stage II - Any individual or a combination of factors in WSI result in a supply shortage of 20 percent. (WSI .85-.75)

Stage III - Any individual or a combination of factors in WSI result in a supply shortage of 30 percent. (WSI .75-.65)

Stage IV - Any individual or a combination of factors in WSI result in a supply shortage of 40 percent. (WSI .65 and less)

FIGURE 2 –TARGETED CONSERVATION



DROUGHT RESPONSE STRATEGIES

There are two primary approaches for responding to a drought. One is to increase water supply and the other is to reduce demand. Each option presents uniquely different opportunities and challenges to managing a water supply during a drought. For Louisville, the opportunity to increase supply has somewhat limited options. It is possible to lease surplus water from other communities or agricultural users to meet short-term deficiencies during a drought. However, this option will be fairly expensive and may not materially improve water supply in a time of diminished yields. Given that the more extreme a drought, the greater the competition for the available water, it is unlikely that options for additional supplies will result in significant changes to the City’s water supply. Therefore, the focus of the Drought Management Plan is on reduction of water usage consistent with the drought event being experienced. Each stage of a drought is associated with a targeted reduction of water usage.

This Drought Management Plan is based on the premise that more water can be saved during the summer months than the winter months, given the winter months reflect a non-irrigation usage necessary for public health and safety. The plan utilizes a variety of measures, including watering restrictions of public and private landscaping, providing incentives for installation of low flow plumbing fixtures, and increasing the cost of water with escalating drought severity to

generate reductions in water usage necessary to balance supply and demand. The City’s possible responses to the drought stage indentified by the WSI are identified in the following table.

TABLE 1 – DROUGHT RESPONSE PLAN SUMMARY

Drought Stage	Conservation Goal (annual reduction target)	Main Focus-Private Citizens & Businesses	Main Focus-City Agencies
Stage I Moderate	10%	Voluntary conservation measures, which may include: <ul style="list-style-type: none"> ➤ Eliminate sloppy irrigation practices and unnecessary outdoor usage. ➤ Discourage changes to higher water use landscapes. ➤ Highlight City’s water efficiency rebate program. ➤ Work with large water users to identify possible means for reducing usage. 	<ul style="list-style-type: none"> ➤ Provide water wise information and education to general public. ➤ City departments will establish reduction targets and indentify ways to meet targets.
Stage II Serious	20%	Voluntary and mandatory measures implemented at discretion of the City Manager or designee. Measures may include: <ul style="list-style-type: none"> ➤ Limit irrigation to specific day and/or hours. ➤ Keep the following vegetation alive: Trees, Shrubs, Vegetable Gardens, Flower Gardens, and Lawns. ➤ Discourage washing sidewalks, driveways, streets, and other water intensive uses. ➤ Postpone new landscaping and discourage changes to higher water use landscapes. ➤ Implement surcharges as necessary to encourage water conservation and maintain economic stability of the utility. 	<ul style="list-style-type: none"> ➤ Provide for public education and outreach. ➤ Keep the following vegetation alive: Trees, Shrubs, Flower Gardens, and Turf (<i>Prioritize playing fields for use and watering, keep unused playing fields alive</i>) ➤ All public pools remain open ➤ City street sweeping, which uses minimal amounts of water for dust suppression would continue. ➤ Utilize Reuse water where available. ➤ Additional resources for irrigation system audits.
Stage III Severe	30%	Mandatory measures implemented at discretion of the City Manager or designee. Measures may include: <ul style="list-style-type: none"> ➤ Restrict irrigation to keeping the following vegetation alive: trees, shrubs and vegetable gardens. ➤ Implement water rate surcharges to strongly encourage conservation and stabilize water revenue. ➤ Through city ordinance, provide incentives for large water users to install water efficient fixtures. 	<ul style="list-style-type: none"> ➤ Provide for public education and outreach. ➤ Restrict turf irrigation including parks, golf courses, and other public facilities. ➤ Keep the following vegetation alive: trees, shrubs and Turf (<i>playing fields and other where possible</i>) ➤ Determine on case-by-case basis if public pools will open. ➤ Fully utilize Reuse water where

		<ul style="list-style-type: none"> ➤ A targeted reduction of indoor only taps of up to 5%. 	available.
Stage IV Extreme	50%	<p>Mandatory measures implemented at discretion of the City Manager or designee. Measures may include:</p> <ul style="list-style-type: none"> ➤ Prohibit use of all outdoor watering except to sustain some mature trees, but recognize there may be a major die-off of lawns, trees, and shrubs. ➤ Prohibit filling of private swimming pools, hot tubs, ornamental fountains, and other option water features. ➤ Moratorium on new water taps until water supply improves. ➤ Implement water rate surcharges to very strongly encourage conservation and stabilize water revenue. ➤ A targeted reduction of indoor only taps of up to 10%. 	<ul style="list-style-type: none"> ➤ Provide for public education and outreach. ➤ Prohibit unnecessary water usage. ➤ Sustain some mature trees, but recognize there may be a major die-off of turf, trees, and shrubs. ➤ Close public swimming pools and other water using facilities such as the Recreation Center.
Drought Stage	Conservation Goal (annual reduction target)	Main Focus-Private Citizens & Businesses	Main Focus-City Agencies

EXPLANATION OF DROUGHT WATER RATE SURCHARGES

At times, voluntary and mandatory restrictions may not result in the necessary reductions in water usage to weather a drought. In those situations surcharges may be applied to the higher tier water rates to strongly encourage a reduction in water usage necessary to meet City drought goals. This section describes how those surcharges may apply to different utility customers.

SINGLE-FAMILY RESIDENTIAL ACCOUNTS

The amount of water allocated per single-family equivalent tap is based on historical usage less the water savings needed to maintain adequate reserves. For example, from 1999 to 2003, an average single-family residential account usage was approximately 5,200 gallons per month during the October through March time period. During the summer the average usage was approximately 11,000 gallons per month, with a peak average of 17,000 gallons in July. Each single-family residential account will be provided the first usage tier surcharge free, regardless of drought severity. Water consumed beyond the first tier may be billed with surcharges as shown in Table 2 – Residential Surcharge Rates.

TABLE 2 – RESIDENTIAL SURCHARGE RATES

STAGE I - MODERATE		STAGE II - SERIOUS		STAGE III - SEVERE		STAGE IV - EXTREME	
Consumption	Surcharge	Consumption	Surcharge*	Consumption	Surcharge*	Consumption	Surcharge*
0-5,000	None	0-5,000	None	0-5,000	None	0-5,000	None
5,001-20,000	None	5,001-12,000	2	5,001-10,000	2 ½	5,001-15,000	5
20,001-30,000	None	12,001-20,000	5	10,001-20,000	6	15,001-20,000	10
30,001-40,000	None	20,001-30,000	6	20,001-30,000	12	20,001 & over	20
40,001-50,000	None	30,001 & over	8	30,001 & over	18	N/A	N/A
50,001 & over	None	N/A	N/A	N/A	N/A	N/A	N/A

*Surcharge is a multiple of the tier rate.

NON RESIDENTIAL ACCOUNTS

Commercial, industrial and multifamily accounts are allocated water based on their tap size, with the first tier of any non residential account not being subject to surcharges, regardless of drought severity. Water consumed beyond the first tier will be billed with surcharges shown in the following table.

TABLE 3 – NON RESIDENTIAL SURCHARGE RATES

TAP SIZE	STAGE 1		STAGE 2		STAGE 3		STAGE 4	
	Consumption	Surcharge	Consumption	Surcharge	Consumption	Surcharge	Consumption	Surcharge
¾"	0-20,000	None	0-20,000	None	0-20,000	None	0-20,000	None
	20,001-30,000	None	20,001-30,000	6	20,001-30,000	9	20,001-30,000	15
	30,001-40,000	None	30,001-40,000	8	30,001-40,000	12	30,001-40,000	20
	40,001-50,000	None	40,001-50,000	10	40,001-50,000	15	40,001 and over	25
	50,001 and over	None	50,001 and over	20	50,001 and over	20	40,001 and over	25
1"	0-40,000	None	0-40,000	None	0-40,000	None	0-40,000	None
	40,001-60,000	None	40,001-60,000	6	40,001-60,000	9	40,001-60,000	15
	60,001-80,000	None	60,001-80,000	8	60,001-80,000	12	60,001-80,000	20
	80,001-100,000	None	80,001-100,000	10	80,001-100,000	15	80,001 and over	25
1.5"	0-80,000	None	0-80,000	None	0-80,000	None	0-80,000	None
	80,001-120,000	None	80,001-120,000	6	80,001-120,000	9	80,001-120,000	15
	120,001-160,000	None	120,001-160,000	8	120,001-160,000	12	120,001-160,000	20
	160,001-200,000	None	160,001-200,000	10	160,001-200,000	15	160,001 and over	25
	200,001 and over	None	200,001 and over	20	200,001 and over	20	160,001 and over	25
2"	0-160,000	None	0-160,000	None	0-160,000	None	0-160,000	None
	160,001-240,000	None	160,001-240,000	6	160,001-240,000	9	160,001-240,000	15
	240,001-320,000	None	240,001-320,000	8	240,001-320,000	12	240,001-320,000	20
	320,001-400,000	None	320,001-400,000	10	320,001-400,000	15	320,001 and over	25
	400,001 and over	None	400,001 and over	20	400,001 and over	20	320,001 and over	25

3"	0-320,000	None	0-320,000	None	0-320,000	None	0-320,000	None
	320,001-480,000	None	320,001-480,000	6	320,001-480,000	9	320,001-480,000	15
	480,001-640,000	None	480,001-640,000	8	480,001-640,000	12	480,001-640,000	20
	640,001-800,000	None	640,001-800,000	10	640,001-800,000	15	640,001-800,000	25
	800,001 and over	None	800,001 and over	20	800,001 and over	20	640,001 and over	25
4"	0-640,000	None	0-640,000	None	0-640,000	None	0-640,000	None
	640,001-960,000	None	640,001-960,000	6	640,001-960,000	9	640,001-960,000	15
	960,001-1,280,000	None	960,001-1,280,000	8	960,001-1,280,000	12	960,001-1,280,000	20
	1,280,001-1,600,000	None	1,280,001-1,600,000	10	1,280,001-1,600,000	15	1,280,001 and over	25
	1,600,001 and over	None	1,600,001 and over	20	1,600,001 and over	20	1,280,001 and over	25
6"	0-1,280,000	None	0-1,280,000	None	0-1,280,000	None	0-1,280,000	None
	1,280,000-1,920,000	None	1,280,000-1,920,000	6	1,280,000-1,920,000	9	1,280,000-1,920,000	15
	1,920,000-2,560,000	None	1,920,000-2,560,000	8	1,920,000-2,560,000	12	1,920,000-2,560,000	20
	2,560,000-3,200,000	None	2,560,000-3,200,000	10	2,560,000-3,200,000	15	1,920,000-2,560,000	20
	3,200,000 and over	None	3,200,000 and over	20	3,200,000 and over	20	2,560,000 and over	25

Surcharges would not apply to indoor only multi-family accounts, but those accounts would be expected to achieve up to a 5% annual usage reduction, based on a 5-year running average, during a Stage III drought. A Stage IV drought would mandate up to a 10% annual indoor usage reduction, based on a 5-year running average. City staff will evaluate accounts that do not meet reduction goals and determine if enforcement actions are necessary.

Commercial and industrial customers, excluding multi-family and irrigation accounts, use water differently from residential customers and may need some accommodation and flexibility in how they respond to needed reductions in use. These customers may petition the City's Economic Development Department for an accommodation to the drought response outlined in this plan, if the customer can demonstrate that the water use is essential to their manufacturing or industrial process and that requested drought response (i.e. restrictions, surcharges, etc.) would cause decline in production, downsizing of workforce, or similar economic hardship. The accommodations must be flexible enough to promote water savings while addressing diverse customer needs and support drought restrictions. As a condition of any accommodation the applicant will be required to separate indoor and irrigation usage by obtaining a separate irrigation tap, which will be subject to surcharges, etc. The customer shall be solely responsible for site improvements such as new meter pits, piping, any necessary connections to the customer's irrigation system or the City's water main, as well as any associated inspection fees, review fees, and permits.

During a Stage III drought, commercial indoor usage only accounts would be expected to achieve up to a 5% annual usage reduction, based on a 5-year running average. A Stage IV drought would mandate up to a 10% annual indoor usage reduction, based on a 5-year running average. City staff will evaluate accounts that do not meet reduction goals and determine if enforcement actions are necessary.

CITY RESPONSIBILITIES DURING ALL DROUGHT EVENTS

During all drought events, the City will strive to be a resource for its residential, commercial, industrial, and irrigation customer alike. The level of effort in education, public outreach, incentive programs, etc. will be commensurate with the severity of the drought, public response and needed reductions. These efforts may include the following items:

PUBLIC PARTICIPATION

To gain public involvement, information should be disseminated to the public as to why the community is at a given drought level response. There should also be the ability for the public to comment during a drought so residents know their concerns and problems are being considered. Typical methods of receiving public comments should be public meetings, phone calls, emails, and other.

PUBLIC INFORMATION

A good communication effort can significantly improve public acceptance and therefore actual water savings targeted by the drought plan. During a drought, it is important to frequently convey information to the public regarding what is happening, why it is happening, and the impact to individuals. This communication component is critical regardless of the severity of the drought. However, it is likely that as the drought becomes longer and more severe, that communication frequency and the quantity of information disseminated will increase. The following activities are anticipated to be needed at increasing levels of effort during and as a drought increases in severity.

- Keeping City Council apprised on the status of the drought, drought strategies implemented and their effects.
- Designate a spokesperson or persons who will be the primary contact with media and the community.
- Implement internal communication protocol to ensure the information request and service request outside the established program are conveyed to the right staff members.
- Identify the frequency and type of information disseminated on a routine basis.
- Enhance the City's web page to provide real time and daily information regarding water usage and water savings.
- Provide utility customers with tips, information and links to other available resources for achieving different levels of conservation.

ACKNOWLEDGEMENT OF PUBLIC VERSUS PRIVATE STANDARDS

The drought response plan provides for the utilization of a scarce resource in a manner benefiting the majority and may need to accommodate a different watering standard for public property versus private. Even priority of uses within public facilities will need to be established. This concept provides for a higher allowance of water usage for public property, which is shared by all. During the most severe drought this type of approach prioritizes which public property has the highest use value and serves the most residents.

EQUITY

Drought response and measures will strive to insure that inconvenience, discomfort, and sacrifice is shared in an equal manner across all customers. It is important to acknowledge conservation may not be exactly equal by customer class but is done to reflect the values of the community by utilizing water in a way that is important to the total community. This equity concept would

address the relative value of water used by individual residents for landscaping purposes compared to community facility uses such as golf courses, parks, and pools and similar facilities.

FLEXIBILITY

Responding to a drought requires water use restrictions, but hopefully not to the point where individual customers can't decide how best to use their water. Frequently, water customers prefer to be told the quantity of water they can use in a given time period instead of the uses they are allowed to apply it to. This allows them to direct water to their highest priority uses. It is likely that in the most serious or extreme cases of drought flexibility will be reduced given the critical nature of the water supply. Enforcement actions, if needed, should be applied equally to all customers.

VISIBILITY

The drought management plan should be highly visible within the community. Aspects of a visible program include feedback on how well conservation measures are working, frequent reports on whether water supplies are more or less plentiful than predicted, and sharing of the concerns or problems residents are experiencing as part of the plan.

STAFFING AND RESOURCES

As a drought develops it is likely that additional resources will be needed to implement the various components of a Drought Management Plan. This will likely occur during times when revenue is declining because of an anticipated watering reduction. It is also expected that existing staff will be assigned temporary drought responsibilities in order for the various actions to be undertaken in a reasonable time frame. Temporary reassignment of staff or the procurement of additional staff resources to deal with the drought will be utilized in order to:

- Implement the desired communication and public relations program for given level of drought.
- Prioritize staff assignments to include assisting residents with private irrigation system leak detection, irrigation system operations, and other drought related activities.
- Developing "exception" criteria to deal with hardships and health and safety issues.

Additionally, a city drought management team may be established to address the following:

- Consistency and leadership role on City water usage.
- Coordination and consistency of information (i.e. Finance Department for utility billing, Parks and Recreation Department on park usage and impact, Public Works personnel at the water treatment plant and Administration).