

# **A Guide to Landscaping with Available Water in Emigration Canyon**

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## **Dedication**

This booklet is dedicated to the memory of Richard Clark, an Emigration Canyon visionary who worked tirelessly and selflessly for the protection and preservation of the canyon's natural features and beauty.

As a trustee of the Emigration Canyon Improvement District, Richard was an initiator and advocate of landscape water conservation awareness.

## **Introduction**

Emigration Canyon is a closed watershed in a mountainous, semi-desert environment. The rain and snow that fall below its rim drains toward its mouth either on the surface or underground. The native plants, human residents, and residential landscapes that occupy the canyon have only this amount of water to work with to sustain their lives.

This booklet assumes three premises -

- there is water available,
- the amount of water available is finite,
- and, there is enough if we use it wisely.

Most of our annual allotment of water comes in the form of snowfall during the winter and spring months. Our peak demands for water come during the summer months while we irrigate our residential landscapes. The purpose of this booklet is to discuss the ways in which landscape water resources can be used wisely and conserved, and to demonstrate different ways in which specific water volumes can be used to irrigate different landscape types.

As a general guide to what type of plantings can be established to live naturally with available annual water (and without irrigation once established) we will direct the reader to observe and understand the native plant communities that are indigenous to the different parts of the canyon. Perhaps one of the best landscaping strategies is to protect and preserve as much as possible the vegetation on undisturbed lands. Once the indigenous plants are removed it is a struggle to revegetate the disturbed lands again with plants capable of living within the modest budgets of available water.

It is not the purpose of this booklet to dictate plant selections or choose aesthetics for individual landscapes. These decisions are up to the homeowner. What we will try to do is guide homeowners toward selection of plants that will use minimal amounts of water once established and demonstrate how to develop pleasing landscapes within the water budgets available to us. It is our hope that by providing this information we can help homeowners choose successful landscape plants that will not perish when available water is limited.

## Emigration Canyon Water Use

### Water volumes -

7.48	gallons / cu. ft.
43,560	sq. ft. / acre
325,829	gallons / acre foot
244,372	gallons / .75 acre foot
97,749	gallons / .30 acre foot

### How much water is available for landscape use?

The Emigration Improvement District has recently undertaken extensive hydrologic surveys to determine how much extractable underground water is available in an average year. Using this amount as a basis and dividing by the number of homes (and projected building sites) in the canyon, an average water allocation per home has been established. This average amount is .75 acre feet, or 244,372 gallons per home per year for all indoor and outdoor use. This is the amount available to all homes using EID leased water rights and to all homes on the Freeze Creek Water Company system serving Emigration Oaks. Salt Lake County and Utah State codes specify that .45 acre feet, or 146,623 gallons/year, is dedicated for indoor use. This leaves .30 acre feet, or 97,749 gallons/ year available for outdoor landscape use.

### How far will 97,749 landscape gallons/year go?

According to the Utah State Engineer's Office, 4 acre feet of water/year are required to irrigate one acre of landscape in our area. Our average home allotment of .30 acre feet/year will then irrigate an average of 3,267 square feet of landscape area. This average figure needs to be considered as a relative amount rather than as an absolute amount. Depending on the type of plant materials chosen, the type of water delivery system installed, and the carefulness of irrigation, the amount of irrigated landscape could be considerably larger or smaller than this average amount.

The typical irrigation season for Emigration Canyon is May through October with higher water consumption rates in June, July, and August than in May, September, and October. If water use were constant during these six months, 16,291 gallons would be available for the landscape each month, or 543 gallons per day, or 3,801 gallons per week. **That is enough water to run a single typical sprinkler head delivering 15 gallons per minute for 36 minutes each day for six months, or 5 sprinkler heads for 36 minutes once a week.** That's not a lot of water.

## **Landscape Plan Examples**

The following pages show four examples of landscape plans using different water consuming or water demanding plantings along with a projected annual water requirement for each of the examples.

Each of the examples assumes the same lot size of about an acre, the same footprint for home, patio, walk, and driveway hardscapes, and the same area of undisturbed native landscape. In each example, the amount of area landscaped is 21,725 square feet.

**Example 1** shows a high water consumption yard -

6,700 sq. ft. of Kentucky Bluegrass lawn requiring 2 waterings per week

15,025 sq. ft. of water demanding trees, shrubs, perennials, and ground covers requiring one watering per week

**water need estimate - 462,675 gallons of water per year**

**Example 2** shows a low water consumption yard -

no lawn

21,725 sq. ft. of drought tolerant and native plants using one watering per month

**water need estimate - 87,973 gallons of water per year**

**EXCESSIVE WATER CONSUMPTION  
462,675 GALLONS PER YEAR**

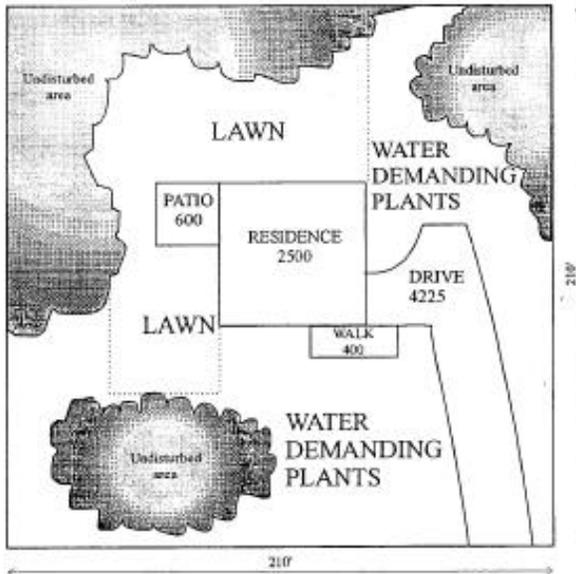
**Example 1**

Landscape Plan For  
One Acre Lot (approximate).

210' X 210' = 44,100 sq. ft.  
Built = 7,725 sq. ft.  
Undisturbed= 14,650 sq. ft.  
Area To Landscape: 21,725 sq. ft.

WATER-DEMANDING  
LAWN = 6,700 sq. ft.  
WATER-DEMANDING  
PLANTS\* = 15,025 sq. Ft.

\*Trees, Shrubs,  
Perennials and  
Ground Cover



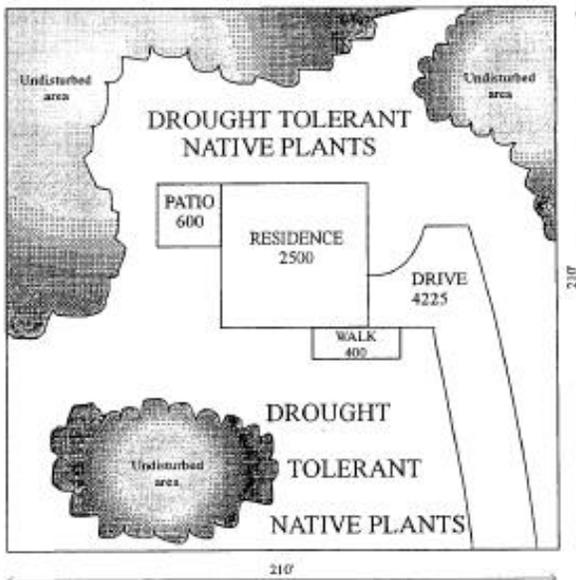
**LOW WATER CONSUMPTION  
87,973 GALLONS PER YEAR**

**Example 2**

Landscape Plan For  
One Acre Lot, (approximate).

210' X 210' = 44,100 sq. ft.  
Built = 7,725 sq. ft.  
Undisturbed= 14,650 sq. ft.  
Area To Landscape = 21,725 sq. ft.

LAWN = 0 sq. Ft.  
DROUGHT TOLERANT AND  
NATIVE PLANTS = 21,725 sq. Ft.  
(AFTER ESTABLISHMENT)



**Example 3** shows a medium water consumption yard -

2,500 sq. ft. of drought tolerant lawn (not Kentucky Bluegrass) requiring one  
one watering per week

19,225 sq. ft. of drought tolerant plants using one watering per month

**water need estimate - 118,927 gallons of water per year**

**Example 4** shows a medium water consumption yard -

900 sq. ft. of Kentucky Bluegrass lawn requiring two waterings per week

600 sq. ft. of water demanding trees and shrubs requiring one watering per week

20,225 sq. ft. of drought tolerant and native plants using one watering per month

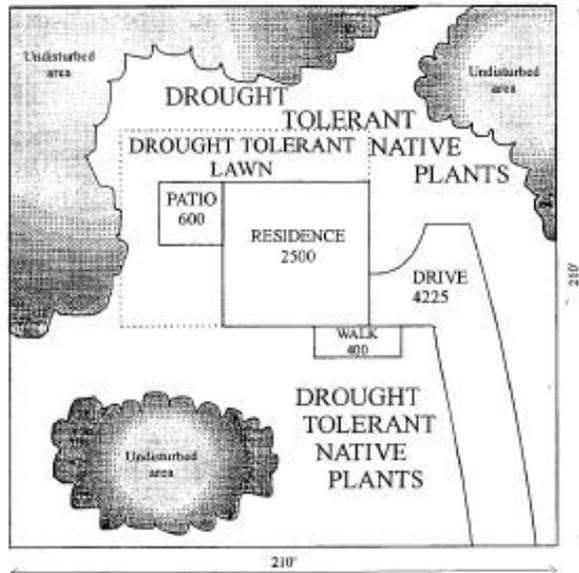
**water need estimate - 121,472 gallons of water per year**

**Example 3**  
 Landscape Plan For  
 One Acre Lot, (approximate).

210' X 210' = 44,100 sq. ft.  
 Built = 7,725 sq. ft.  
 Undisturbed = 14,650 sq. ft.  
 Area To Landscape = 21,725 sq. ft.

DROUGHT TOLERANT  
 LAWN = 2,500 sq. Ft.  
 DROUGHT TOLERANT AND  
 NATIVE PLANTS = 19,225 sq. ft.

**MEDIUM WATER CONSUMPTION  
 118,927 GALLONS PER YEAR**

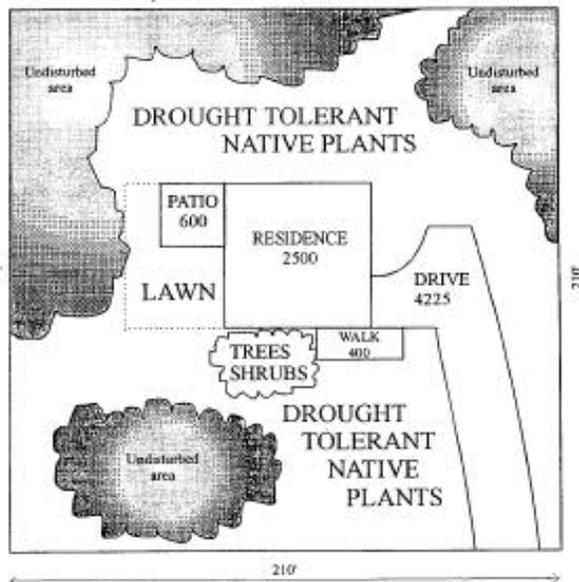


**MEDIUM WATER CONSUMPTION  
 121,472 GALLONS PER YEAR**

**Example 4**  
 Landscape Plan For  
 One Acre Lot, (approximate).

210' X 210' = 44,100 sq. ft.  
 Built = 7,725 sq. ft.  
 Undisturbed = 14,650 sq. ft.  
 Area To Landscape = 21,725 sq. ft.

WATER DEMANDING LAWN = 900 sq. ft.  
 WATER DEMANDING TREES  
 AND SHRUBS = 600 sq. ft.  
 DROUGHT TOLERANT AND  
 NATIVE PLANTS = 20,225 sq. ft.



## **How much water is needed to keep plants alive and healthy?**

Different plants require different amounts of water.

A carpet of Kentucky Bluegrass lawn in our area requires the distribution of 2 inches of water/week, or 1.25 gallons/square foot/week. With an average availability of 3,801 gallons/week it would be possible to keep a 3,040 sq. ft. lawn (approximately 55' x 55') alive and healthy. Most lawns actually consume far more water than this because of a tendency by homeowners to overwater them, often giving them twice or four times what they actually need.

The plants that grew on the site of your home before your home was built required no additional irrigation to maintain their health. Between these two examples of Kentucky Bluegrass and native vegetation are numerous choices of plant materials that will survive in our climate, requiring widely varying amounts of water to maintain their lives.

All plants require water to lubricate the mechanics of their physiology and to fuel the photosynthetic splitting of oxygen and hydrogen atoms that stores the sun's energy for their growth. Different plants have evolved and adapted to different climatic conditions. Plants that have evolved in areas of plentiful water do not need to concern themselves with gathering scarce water through deep root systems or with miserly retaining their water from evaporation into the atmosphere. Plants that have evolved in the dry summer zones such as ours have developed strategies to collect water from deep in the ground through extensive root systems and to conserve as much water as possible from unnecessary evaporation.

Kentucky Bluegrass lawns are great examples of plants with shallow root systems and high evaporation.

The Gambel Oaks that are native to our canyon are great examples of plants with deep root systems and low evaporation. The plants that grow beneath the oaks are great examples of plants that have adapted to the hot dry summers by living in the shade of the oaks and thus conserving their water. In a natural setting these communities of plants interact with each other to utilize the available water and sunlight and support each other's lives.

When we remove these native plant communities to build homes we create a disturbed building site and need to make choices about how to revegetate it. These are the landscaping decisions that face us and need to be balanced by available water.

There are great numbers of plant materials that can survive in our climate with little or no additional water once they are established. In a following section we will identify these plants (grasses, flowers, shrubs and trees) and suggest their relative and proportional water needs once established. There are also great numbers of plant materials that will survive in our climate only with the continuous application of water. Some species of plants require much more water than others. Several years of irrigation is typically required to firmly establish plants on bare sites, regardless of whether they will require future water for their long term survival or not.

It is possible to nurture a disturbed site into a pleasing landscape that uses little water once established or it is possible to create a landscape that can only survive if it receives large amounts of scarce water. The difference lies in intention, planning, and the choices made.

## Emigration Canyon Native Plant Communities

Native plant communities are assortments of native plants that live together in relationship with each other in the natural landscape without application of irrigation water. Their sources of water are the natural precipitation and the available groundwater. As available water changes with elevation, exposure of slope, soil types, and relationship to drainages, the plant communities change.

There are four easily identifiable native plant communities in Emigration Canyon -

- the sagebrush, grasslands, and oak plant community
- the maple forest plant community
- the fir and aspen plant community
- and the riparian (steamside) plant community.

Knowing and understanding these different plant communities is key to understanding what types of water conserving plant materials will adapt to the landscape with minimal application of irrigation water. The plant listings following the plant community descriptions are species that have been located in their respective communities in Emigration Canyon. These are the predominant and obvious plants. This is not a comprehensive listing of every native plant existing in the canyon.

Because many of the native plants in Emigration Canyon appear in more than one plant community, it is important to look at multiple species of plants, present and absent, to establish the type of community at any particular location. As an example Chokecherry, or *Prunus virginiana*, and Serviceberry, or *Amelanchier alnifolia*, appear in all four plant communities. In the following lists, plants that appear in more than one plant community are identified with an asterisk.

In each plant community there is a plant species whose presence is a dominant identifier of that plant community. In the following plant lists these dominant identifying species are listed in boldfaced type.

Because descriptions, photographs and illustrations of these plants have been published so well elsewhere, no attempt is made to do so in this guide. If you are interested in knowing these plant species, please refer to-

- *Utah's Intermountain Wildflowers* - by Dixie Rose
- *Trees of Utah and the Intermountain West* - by Michael Kuhns
- *Mountain Plants of Northeastern Utah* - by Berniece Anderson and Arthur Holmgren

(other references are also listed at the end of this guide)

## **The sagebrush, grasslands, and oak plant community**

This plant community is the driest of the four plant communities and dominates much of the canyon. It is characterized by perennial grasses, and perennial flowering plants that are green in the spring and then dry out into brown hillsides in the summer, as well as sagebrush and Gambel Oak. The sagebrush, grasslands and oak community is found in the lower elevations of the canyon on all exposures and on south facing exposures further up the canyon, all the way to the top of Lookout Peak, the highest point in Emigration Canyon.

Notably absent from the plant listings in the grasslands plant community are most native grass species. Prior to settlement of the Salt Lake Valley, Emigration Canyon was rich in dense fields of native grasses. The majority of these grasses native to Emigration Canyon are no longer present due to abusive grazing practices in the past that have eliminated them. Emigration Canyon was heavily grazed for over 100 years. For over 50 years, 100,000 to 200,000 sheep annually trailed through Emigration Canyon on their way to summer ranges at higher elevations. Each herd passing through leisurely grazed in the canyon for 5 - 7 days during transit from the mouth of the canyon to Little Mountain Pass. Additional flocks grazed in the upper areas of the canyon for the entire summer. Cattle also grazed heavily throughout the canyon during the summer months. In his book, *Our Renewable Lands* (written in 1961 by University of Utah Professor of Botany, Walter Cottam) Mr. Cottam spends a chapter discussing the elimination of native grasses in Emigration Canyon, the consequent erosion problems, and shows photographs of a barren landscape completely void of perennial plants and grasses.

Most of the grass species present in the canyon today have been introduced through intensive seeding to revegetate denuded hillsides and help control the massive, resultant erosion problems. These grass varieties have invaded the entire canyon ecosystem and established themselves so extensively that they appear as though they were native to the area. The original native grasses have been almost entirely replaced with non-native grasses.

Because of its huge range in area, elevation, and exposure, and because of the sunlight on open slopes, this plant community has much more diversity of species than the other three plant communities.

One of the dominant identifying species of this plant community, Gambel Oak, also appears in the maple forest plant community and in the riparian plant community. Only in the sagebrush, grasslands, and scrub oak plant community does Gambel Oak form in pure stands that cover the hillsides. In the riparian and maple forest plant communities, Gambel Oak often appears in large size, but not expansive and unbroken in its coverage of hillsides.

Rocky dry slopes - subsection of sagebrush, grasslands and oak community

***Artemisia tridentata***

*Castilleja linariifolia*

*Chrysothamnus nauseosus*

*Euphorbia robusta*

*Frasera speciosa*

*Fritillaria atropurpurea*

*Iris missouriensis*

*Mentzelia laevicaulis*

*Oenothera caespitosa*

*Penstemon whippleanus*

*Pinus flexilis*

***Quercus gambelii***

\*

*Sedum lanceolatum*

*Verbascum thapus*

**Big Sagebrush**

Narrowleaf Indian Paintbrush

Rabbitbrush

Rocky Mountain Spurge

Monument Plant

Leopard Lily

Western Sweet Flag

Blazing star

Tufted Evening Primrose

Whipple Penstemon

Limber Pine

**Gambel Oak (in large, pure stands)**

Sedum

Common Mullein

Open slopes - subsection of sagebrush, grasslands, and oak community

*Acer grandidentatum*

*Agoseris glauca*

*Agropyron spicatum*

*Amelanchier alnifolia*

*Achillea millefolium*

*Allium acuminatum*

***Artemisia tridentata***

*Balsamorhizza macrophylla*

***Balsamorhizza sagittata***

*Calochortus nuttallii*

*Cercocarpus ledifolius*

*Crepis acuminata*

*Delphinium nuttallianum*

*Dicentra uniflora*

*Erigeron canadensis*

*Eriogonum umbellatum*

*Erysimum asperum*

*Erythronium grandiflorum*

*Fritillaria pudica*

*Geranium viscosissimum*

*Gilia aggregata*

*Gutierrezia sarothrae*

*Hackelia patens*

*Hedysarum boreale*

*Helianthella uniflora*

*Hydrophyllum occidentale*

*Iliamna rivularis*

***Juniperus osteosperma***

*Lathyrus brachycalyx*

Bigtooth Maple \*

Mountain Dandelion

Bluebunch Wheatgrass

Serviceberry \*

Common Yarrow\*

Wild Onion\*

**Big Sagebrush**

Cutleaf Balsamroot

**Arrowleaf Balsamroot**

Sego Lily

Curl-leaf Mountain Mahogany \*

Long-leaved Hawksbeard

Low Larkspur\*

Steer's Head

Fleabane

Sulphur Flower

Western Wallflower

Glacier Lily

Yellow Bell

Sticky Geranium\*

Scarlet Gilia

Broom Snakeweed

Wild Forget-Me-Not

Sweet Vetch

Little Sunflower

Waterleaf\*

Mountain Globemallow\*

**Utah Juniper**

Purple Peavine\*

<i>Lathyrus pauciflorus</i>	Longtooth Sweetpea
<i>Lupinus argenteus</i>	Silvery Lupine
<i>Mahonia repens</i>	Creeping Oregon Grape*
<i>Mertensia ciliata</i>	Mountain Bluebells*
<i>Opuntia polycantha</i>	Prickly Pear
<i>Penstemon cyananthus</i>	Wasatch Penstemon
<i>Phlox longifolia</i>	Long-leaved Phlox
<i>Physocarpus malvaceus</i>	Ninebark*
<i>Prunus virginiana</i>	Chokecherry *
<i>Purshia tridentata</i>	Bitterbrush
<b><i>Quercus gambelii</i></b>	<b>Gambel Oak (in large, pure stands) *</b>
<i>Rosa woodsii</i>	Woods Rose *
<i>Rumex crispus</i>	Curly Dock
<i>Sambucus caerulea</i>	Elderberry *
<i>Senecio crassulus</i>	Groundsel
<i>Symphoricarpos oreophilus</i>	Snowberry *
<b><i>Wyethia amplexicaulis</i></b>	<b>Mulesear</b>

\* - indicates species that appear in more than one native plant community

**Boldfaced species** - dominant identifying species for Emigration Canyon plant communities

## The maple forest plant community

This plant community arises from, and is adjacent to, the Gambel Oak community as ground water becomes more available. The denser shade provided by the maple groves prevents the ground from drying out as much and helps plants living in this shade retain moisture more readily. The maple forest plant community stretches from the bottoms of hillsides at the lower elevations up to about 8,000' in elevation. In the mid-canyon the maple forests grow on north and east facing exposures and in the bottoms of shallow, side canyon drainages without regular surface water flow. The presence of these maples indicates the presence of more plant-accessable groundwater.

The dominant identifying species of this plant community, Bigtooth Maple, or *Acer grandidentatum*, also appears in the sagebrush, grasslands and oak plant community as well as in the riparian plant community. Only in the maple forest plant community does Bigtooth Maple form into pure stands of large trees. In the Gambel Oak plant community the Bigtooth Maple appears as isolated, small trees. In the riparian plant community it appears as isolated large trees.

<b><i>Acer grandidentatum</i></b>	<b>Bigtooth Maple (in large, pure stands)*</b>
<i>Agastache urticifolia</i>	Horsemint*
<i>Amelanchier alnifolia</i>	Serviceberry *
<i>Ceanothus velutinus</i>	Mountain Lilac *
<i>Galium aparine</i>	Bedstraw
<i>Hydrophyllum fendleri</i>	Fendler's Waterleaf*
<i>Hydrophyllum occidentale</i>	Waterleaf *
<i>Lathyrus brachycalyx</i>	Purple Peavine *
<i>Mahonia repens</i>	Creeping Oregon Grape *
<i>Mertensia ciliata</i>	Mountain Bluebells *
<i>Physocarpus malvaceus</i>	Ninebark *
<i>Prunus virginiana</i>	Chokecherry *
<i>Pyrola secunda</i>	Sidebells Shinleaf
<i>Quercus gambelii</i>	Gambel Oak *
<i>Rosa woodsii</i>	Woods Rose *
<i>Sambucus caerulea</i>	Elderberry *
<i>Smilacina racemosa</i>	False Solomon Seal
<i>Symphoricarpos oreophilus</i>	Snowberry *
<i>Thalictrum fendleri</i>	Meadowrue

\* - indicates species that appear in more than one native plant community

**Boldfaced species** - dominant identifying species for each Emigration Canyon plant community

## The aspen and fir plant community

This plant community occurs as elevation rises, water becomes considerably more available and temperatures are cooler. Occasional pockets of firs or aspens can be found as low as 6,000' on the bottoms of north facing slopes and extend to the top of the canyon at 9,000' where they are found on all exposures except the south facing hillsides.

### ***Abies concolor***

*Acer grandidentatum*  
*Achillea millefolium*  
*Agastache urticifolia*  
*Agoseris glauca*  
*Amelanchier alnifolia*  
*Castilleja miniata*  
*Ceanothus velutinus*  
*Cercocarpus ledifolius*  
*Claytonia lanceolata*  
*Clematis occidentalis*  
*Delphinium nuttallianum*  
*Epilobium angustifolium*  
*Geranium viscosissimum*  
*Hackelia micrantha*  
*Holodiscus dumosus*  
*Hydrophyllum fendleri*  
*Hydrophyllum occidentale*  
*Iliamna rivularis*  
*Juniperus communis*  
*Lathyrus pauciflorus*  
*Lithophragma parviflorum*  
*Mahonia repens*  
*Mertensia ciliata*  
*Orogenia linearifolia*  
*Pachistima myrsinitis*  
*Physocarpus malvaceus*  
*Polemonium foliosissimum*  
***Populus tremuloides***  
*Prunus virginiana*  
***Pseudotsuga menziesii***  
***Pteridium aquilinum***  
*Quercus gambelii*  
*Ribes inerme*  
*Rosa woodsii*  
*Rudbeckia occidentalis*  
*Sambucus caerulea*  
*Smilacina racemosa*  
*Smilacina stellata*

### **White Fir**

Bigtooth Maple\*  
Common Yarrow\*  
Horsemint \*  
Mountain Dandelion  
Serviceberry\*  
Scarlet Paintbrush  
Mountain Lilac\*  
Curl-leaf Mountain Mahogany\*  
Spring Beauty  
Blue Clematis  
Low Larkspur\*  
Fireweed  
Sticky Geranium\*  
Wild Forget-Me-Not  
Bush Oceanspray  
Fendler's Waterleaf\*  
Waterleaf\*  
Mountain Globemallow\*  
Mountain Juniper  
Longtooth Sweetpea  
Woodland Star  
Creeping Oregon Grape\*  
Mountain Bluebells\*  
Turkey Peas  
Mountain Lover  
Ninebark\*  
Leafy Jacob's Ladder  
**Quaking Aspen**  
Chokecherry\*  
**Douglas Fir**  
**Bracken Fern**  
Gambel Oak\*  
Whitestem Gooseberry  
Woods Rose\*  
Western Coneflower  
Blue Elderberry\*  
False Solomon Seal  
Wild Lily-of-the Valley

*Sorbus scopulina*  
*Symphoricarpos oreophilus*  
*Thalictrum fendleri*

Mountain Ash\*  
Snowberry\*  
Meadowrue

\* - indicates species that appear in more than one native plant community

**Boldfaced species** - dominant identifying species for each Emigration Canyon plant community

## The riparian plant community

Riparian plant community arises along the sides of perennial streams from the highest springs in the canyon and along the creeks to the mouth of Emigration Canyon. Easy access to substantial groundwater in this community gives rise to the river birches, cottonwoods, box elders and other water loving vegetation that identify this plant community.

The riparian plant community is typically an extremely narrow ribbon of area in immediate proximity to the perennial streams, merging quickly into the adjacent plant communities with short vertical distance or horizontal distance from the stream.

*Acer glabrum*  
*Acer grandidentatum*  
***Acer negundo***  
*Alnus incana*  
*Amelanchier alnifolia*  
***Betula occidentalis***  
***Cornus stolonifera***  
***Equisetum laevigatum***  
*Heracleum sphondylium*  
*Juniperus scopulorum*  
*Lonicera involucrata*  
*Physocarpus malvaceus*  
***Populus angustifolia***  
***Populus fremontii***  
*Prunus virginiana*  
*Quercus gambelii*  
*Ribes inerme*  
*Rosa woodsii*  
*Rubus parviflorus*  
*Rudbeckia occidentalis*  
***Salix amygdaloides***  
*Sambucus caerulea*  
*Sambucus racemosa*  
*Solidago canadensis*  
*Sorbus scopulina*  
*Symphoricarpos oreophilus*

Rocky Mountain Maple  
Bigtooth Maple\*  
**Boxelder**  
Mountain Alder  
Serviceberry\*  
**Western Water Birch**  
**Red-osier Dogwood**  
**Smooth Scouring Rush**  
Cow Parsnip  
Rocky Mountain Juniper  
Bearberry Honeysuckle  
Ninebark\*  
**Narrowleaf Cottonwood**  
**Fremont Cottonwood**  
Chokecherry\*  
Gambel Oak\*  
Whitestem gooseberry  
Woods Rose\*  
Thimbleberry  
Western Coneflower  
**Peachleaf Willow**  
Blue Elderberry\*  
Red-berried Elder  
Canada Goldenrod  
Mountain Ash\*  
Snowberry\*

\* - indicates species that appear in more than one native plant community

**Boldfaced species** - dominant identifying species for each Emigration Canyon plant community

## **Assessing a site and identifying local plant communities**

By matching the plants in the plant community descriptions and plant list to a site, you can determine what plant community or communities you're present in.

In general as the elevation increases, the temperatures decrease, the season becomes shorter, and the amount of precipitation increases. The combination of these factors generally leave more water available for plants to access in higher elevations.

Other factors affecting water available to plants are the orientation of a hillside, the steepness of a hillside, the relative location on a hillside, and the soil type.

Hillsides on the north side of the canyon with a south facing hillside tend to be the driest sites in their elevation because of the incidence of sunlight striking them most directly. Hillsides oriented westerly are also heavily exposed to the evaporating effects of sunlight. East facing hillsides are impacted less than south or west facing slopes, and north facing slopes are relatively wetter yet because of the light, oblique incidence of sunlight.

In general, the steeper a hillside is, the more readily precipitation and snow melt run off of it, and the less readily it penetrates into the soil for plant access.

Sites located at the bottom of a hillside tend to be richer in water access than the areas above them as the groundwater that flows down the hillside slows down in its migration and concentrates at the foot of the hill.

All four plant communities are natural responses to the available water resulting from the composition of the above listed factors. To some degree the boundaries of the plant communities are blurred and overlapping. It would not be at all uncommon for two different plant communities to exist in a single yard or homesite. In assessing a site, it is as important to observe the dominant plant species that are absent as it is the ones present. Along Emigration Creek, a narrow riparian area borders and blends into oak and maple communities adjacent to the riparian community. Part of a yard might be riparian and another part might be oak or maple community as the distances and elevation from the creek change.

Plant material from any of these communities will survive in the driest sites if enough water is applied. A good example of this is the abundant popularity of aspens in Salt Lake Valley. They do well if given plenty of water. The native plant community in Salt Lake Valley in 1850 was one of grasses and sagebrush. The big difference between Salt Lake Valley and Emigration Canyon in terms of landscape planning now, is the huge importation and distribution of water from the Wasatch canyons, the Uintah mountains, and the Colorado river basin. Take away this water and not only the aspen, but most of the valley's vegetation would perish.

Emigration Canyon on the other hand does not import water from anywhere else and must live within its natural water budget or suffer groundwater shortages because there is only a finite amount of water available.

It is always a temptation to plant lush water loving plants from an alpine or riparian habitat on a dry, south facing hillside to soften the site and make it friendlier for human habitation. This can be done, but only at the cost of perpetual application of water. If access to water is limited, selection of these plants on a dry site may not be a wise decision.

By using the native plant communities in local sites as a guide to available ground water, homeowners can choose landscape plants that will survive in their yards with minimal application, or no application, of water once they are well established. By choosing landscape plants that are not compatible with available groundwater, homeowners commit themselves to an ongoing application of water. This is a choice that needs to be made individually on the basis of how much water is available to sustain a landscape planting. Shallow rooted plants such as Kentucky Bluegrass will require virtually the same amount of water in all plant community areas because their roots are not deep enough to access water, even in the areas of available groundwater.

## **Exotic plant material**

Landscape plants are divided into two categories, native and exotic. Plants native to Emigration Canyon have been discussed and listed in the previous section.

Exotic plants are plants that are not native to the local area and have been introduced from the geography of their origin. For the purpose of this water conservation guide, we are considering every plant material not native to Emigration Canyon as exotic. This exotic category would then include plants native to Asia as well as plants native to Southern Utah. For example, almost all of the landscape plant material in Salt Lake Valley is considered exotic.

Exotic plants can be water loving or water conserving. Like the native plants of Emigration Canyon, other plant materials from other places have adapted well to dry climates. Many of these plants will, like the plants in the native communities, survive well once established, with minimal application of water. Exotic plants that grow in non-native locations without application of water are said to have “naturalized”. Many of the perennial grasses in Emigration Canyon are naturalized exotic species that grow everywhere and appear to be native. Plants that are capable of naturalizing are ones that can adapt to the conditions of the local plant communities. There are many of these types of plants available for landscape use.

## Plant Recommendations

If the water available for landscape planting is .30 acre feet, or 97,749 gallons/year, a homeowner might choose to irrigate a 55' x 55' area (3,040 square feet) in lawn or to plant 20 times that area in water conserving plants, or any number of combinations in between. It is possible to landscape large areas with minimal water, or small areas with maximum water. The difference is in choice of plant materials.

The native plants included in the following lists are those that are available either as container stock from nurseries or as seed from seed companies. Also included in this section are exotic plants that would thrive in Emigration Canyon and their relative water consumption.

Because the descriptions of water conserving plants are well documented in other publications, this landscaping guide does not describe or identify the plant materials recommended. For good descriptions, illustrations, and photographs of these plants we refer you to several of these publications -

- *Xeriscape Plant Guide*, by Denver Water (Denver, Colorado Water Board)
- *Water-wise Landscaping*, by Terry Keane
- *Western Garden Book*, by Sunset Books

### Key to the recommended plant lists

S - the sagebrush, grass, and gambel oak plant community

M - the maple plant community

A - the aspen and fir plant community

R - the riparian or streamside plant community

(Plant communities as defined in this guide - multiple letters in the plant listing indicate that this plant is located in more than one plant community.)

E - plants exotic to Utah

U - native to Utah, but exotic to Emigration Canyon

Watering Requirement Guide (once established)

0 - no irrigation required

1 - one irrigation per month

2 - two irrigations per month

3 - one irrigation per week

4 - two irrigations per week

5 - heavy irrigation required outside of riparian areas

(These water requirement guides are applicable to plants that are established outside of their native plant communities. Native plants established in their native plant community should require no irrigation, or minimal irrigation, once established.)

## Recommended trees native to Emigration Canyon

Botanical Name	Common Name	Plant Community	Watering Need
<i>Abies concolor</i>	White Fir	A	2
<i>Acer glabrum</i>	Rocky Mountain Maple	R	1
<i>Acer grandidentatum</i>	Bigtooth Maple	S M A R	1
<i>Acer negundo</i>	Boxelder	R	5
<i>Alnus incana</i>	Mountain Alder	R	5
<i>Amelanchier alnifolia</i>	Serviceberry	S M A R	1
<i>Betula occidentalis</i>	Western Water Birch	R	5
<i>Cercocarpus ledifolius</i>	Curleaf Mountain Mahogany	S A	0
<i>Juniperus communis</i>	Mountain Juniper	A	1
<i>Juniperus scopulorum</i>	Rocky Mountain Juniper	R	1
<i>Juniperus osteosperma</i>	Utah Juniper	S	0
<i>Pinus flexilis</i>	Limber Pine	S	1
<i>Populus angustifolia</i>	Narrowleaf Cottonwood	R	5
<i>Populus fremontii</i>	Fremont Cottonwood	R	5
<i>Populus tremuloides</i>	Quaking Aspen	A	3
<i>Prunus virginiana</i>	Chokecherry	S M A R	1
<i>Pseudotsuga menziesii</i>	Douglas Fir	A	2
<i>Quercus gambelii</i>	Gambel Oak	S M A R	0
<i>Salix amygdaloides</i>	Peachleaf Willow	R	5
<i>Sorbus scopulina</i>	Mountain Ash	R	2

## Recommended exotic trees

Botanical Name	Common Name	Plant Community	Watering Need
<i>Acer ginnala</i>	Amur Maple	E	2
<i>Celtis occidentalis</i>	Common Hackberry	E	1
<i>Catalpa speciosa</i>	Western Catalpa	E	2
<i>Elaeagnus angustifolia</i>	Russian Olive	E	0
<i>Juniperus chinensis</i>	Chinese Juniper	E	1
<i>Picea pungens</i>	Colorado Spruce	U	2
<i>Pinus aristata</i>	Bristlecone Pine	U	1
<i>Pinus edulis</i>	Pinyon Pine	U	1
<i>Pinus nigra</i>	Austrian Pine	E	2
<i>Pinus mugo</i>	Mugo Pine	E	1
<i>Pinus ponderosa</i>	Ponderosa Pine	U	1
<i>Pinus sylvestris</i>	Scotch Pine	E	2
<i>Salix matsudana</i>	Globe Willow	E	5
<i>Salix babylonica</i>	Weeping Willow	E	5
<i>Sorbus aucuparia</i>	European Mountain Ash	E	2

### Recommended shrubs native to Emigration Canyon

Botanical Name	Common Name	Plant Community	Watering Need
<i>Artemisia tridentata</i>	Big Sagebrush	S	0
<i>Ceanothus ledifolius</i>	Mountain Lilac	M A	2
<i>Chrysothamnus nauseosus</i>	Rabbitbrush	S	0
<i>Cornus stolonifera</i>	Red-osier Dogwood	R	5
<i>Holodiscus dumosus</i>	Bush Oceanspray	A	0
<i>Lonicera involucrata</i>	Bearberry Honeysuckle	R	2
<i>Pachistima myrsinitis</i>	Mountain Lover	A	2
<i>Physocarpus malvaceus</i>	Ninebark	S M A R	2
<i>Purshia tridentata</i>	Bitterbrush	S	0
<i>Ribes inerme</i>	Whitestem gooseberry	R	2
<i>Rubus parviflorus</i>	Thimbleberry	R	2
<i>Rosa woodsii</i>	Woods Rose	S M A R	1
<i>Sambucus caerulea</i>	Elderberry	S M A R	2
<i>Sambucus racemosa</i>	Red-berried Elder	R	5
<i>Symphoricarpos oreophilus</i>	Snowberry	S M A R	0

### Recommended exotic shrubs

<i>Arctostaphylos uva-ursi</i>	Kinnikinnick	U	2
<i>Berberis thunbergii</i>	Japanese Barberry	E	2
<i>Caryopteris x clandonensis</i>	Blue Mist Spirea	E	2
<i>Cercocarpus montanus</i>	Mountain Mahogany	U	0
<i>Chaenomeles japonica</i>	Flowering Quince	E	2
<i>Cowania mexicana</i>	Cliffrose	U	0
<i>Cotoneaster acutifolius</i>	Peking Cotoneaster	E	2
<i>Cotoneaster apiculata</i>	Cranberry Cotoneaster	E	2
<i>Cotoneaster dammeri</i>	Bearberry Cotoneaster	E	2
<i>Cotoneaster divaricatus</i>	Spreading Cotoneaster	E	2
<i>Ephedra viridis</i>	Mormon Tea	U	0
<i>Fallugia paraadoxa</i>	Apache Plume	U	0
<i>Forshythia x intermedia</i>	Forsythia	E	2
<i>Juniperus spp.</i>	Juniper	E	1
<i>Lonicera tartarica</i>	Tartarian Honeysuckle	E	2
<i>Perovskia atriplicifolia</i>	Russian Sage	E	2
<i>Pinus mugo 'pumilio'</i>	Dwarf Mugo Pine	E	1
<i>Potentilla fruticosa</i>	Potentilla	U	2
<i>Prunus besseyi</i>	Western Sand Cherry	E	1
<i>Prunus x cistena</i>	Purple Leaf Sand Cherry	E	2
<i>Rhus glabra</i>	Smooth Sumac	U	0
<i>Rhus glabra 'cismontana'</i>	Dwarf Smooth Sumac	U	0
<i>Rhus trilobata</i>	Oakleaf Sumac	U	0
<i>Rhus typhina</i>	Staghorn Sumac	U	1
<i>Rosa foetida</i>	Austrian Copper	E	2
<i>Rosa rugosa</i>	Rugosa Rose	E	2
<i>Symphoricarpos alba</i>	Snowberry	E	1

### Recommended exotic shrubs – continued

Botanical Name	Common Name	Plant Community	Watering Need
<i>Syringa sp.</i>	Lilac	E	2
<i>Yucca baccata</i>	Banana Yucca	E	0
<i>Yucca filamentosa</i>	Adams Needle Yucca	E	0

## Recommended perennials native to Emigration Canyon

Botanical Name	Common Name	Plant Community	Watering Need
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### (Plants available from nurseries)

<i>Geranium viscosissimum</i>	Sticky Geranium	S A	2
<i>Iris missouriensis</i>	Western Sweet Flag	S	1
<i>Mahonia repens</i>	Creeping Oregon Grape	S M A	1
<i>Penstemon cyananthus</i>	Wasatch Penstemon	S	0

### (Seeds available)

<i>Agastache urticifolia</i>	Horsemint	M A	1
<i>Balsamorhizza macrophylla</i>	Cutleaf Balsamroot	S	0
<i>Balsamorhizza sagittata</i>	Arrowleaf Balsamroot	S	0
<i>Calochortus nuttallii</i>	Sego Lily	S	0
<i>Castilleja miniata</i>	Scarlet Paintbrush	A	0
<i>Castilleja linariifolia</i>	Narrowleaf Indian Paintbrush	S	0
<i>Delphinium nuttallianum</i>	Low Larkspur	S A	2
<i>Eriogonum umbellatum</i>	Sulphur Flower	S	0
<i>Fritillaria pudica</i>	Yellow Bell	S	0
<i>Gilia aggregata</i>	Scarlet Gilia	S	0
<i>Heliantha uniflora</i>	Little Sunflower	S	0
<i>Iliamna rivularis</i>	Mountain Globemallow	S A	1
<i>Lupinus argenteus</i>	Silvery Lupine	S	3
<i>Mentzelia laevicaulis</i>	Blazing Star	S	0
<i>Oenothera caespitosa</i>	Tufted Evening Primrose	S	0
<i>Penstemon chippleanus</i>	Whipple Penstemon	S	0

### (seeds available)

<i>Polemonium foliosissimum</i>	Leafy Jacob's Ladder	A	2
<i>Pyrola secunda</i>	Sidebells Shinleaf	M	1
<i>Solidago canadensis</i>	Canada Goldenrod	R	2
<i>Wyethia amplexicaulis</i>	Mulesear	S	0

### Recommended exotic perennials

<i>Achillea filipendula</i>	Coronation Gold Yarrow	E	1
<i>Aegopodium podagraria</i>	Bishop's Weed	E	2
<i>Ajuga reptans</i>	Bugleweed	E	2
<i>Alcea rosea</i>	Hollyhock	E	2
<i>Anemone pulsatilla</i>	Pasque Flower	E	1
<i>Arabis caucasica</i>	Rock Cress	E	2
<i>Artemisia schmidtiana</i>	Silver Mound	E	2
<i>Asclepias tuberosa</i>	Butterfly Flower	E	2
<i>Aster frikartii</i>	Aster	E	2
<i>Aurinaria saxatilis</i>	Basket of Gold	E	2

## Recommended exotic perennials - continued

Botanical Name	Common Name	Plant Community	Watering Need
<i>Cerastium tomentosum</i>	Snow in Summer	E	2
<i>Chrysanthemum parthenium</i>	Feverfew	E	1
<i>Coreopsis grandiflora</i>	Coreopsis	E	2
<i>Echinacea purpurea</i>	Purple Coneflower	E	1
<i>Gaillardia x grandiflora</i>	Blanket Flower	E	2
<i>Hemerocallis hybrids</i>	Daylily	E	2
<i>Kniphofia uvaria</i>	Red Hot Poker	E	2
<i>Linum lewisii</i>	Blue Flax	U	0
<i>Oenothera missouriensis</i>	Missouri Evening Primrose	E	2
<i>Papaver nudicaule</i>	Iceland Poppy	E	2
<i>Papaver orientale</i>	Oriental Poppy	E	2
<i>Parthenocissus quinquefolia</i>	Virginia Creeper	E	2
<i>Penstemon barbatus</i>	Penstemon	E	2
<i>Penstemon pinifolius</i>	Pine-leaved Penstemon	E	2
<i>Penstemon strictus</i>	Penstemon	E	0
<i>Phlox subulata</i>	Creeping Phlox	E	2
<i>Ratibida columnifera</i>	Prairie Coneflower	E	0
<i>Rudbeckia fulgida</i>	Black-eyed Susan	E	2
<i>Salvia officinalis</i>	Garden Sage	E	2
<i>Santolina chamaecyparissus</i>	Santolina	E	1
<i>Sedum acre</i>	Utah Sedum	E	1
<i>Sedum spectabilis</i>	Autumn Joy	E	1
<i>Sedum spurium</i>	Dragon's Blood	E	1
<i>Sempervirens tectorum</i>	Hens and Chicks	E	1
<i>Stachys byzantia</i>	Lambs Ears	E	2

### Exotic perennial bulbs

Most bulbs are highly drought resistant, hardy, and require little or no maintenance.

## Grasses

Many varieties of grasses are available by seed and a few are available from nurseries in containers. In many ways, grasses (once established) make ideal, low maintenance, drought resistant ground covers. As was previously mentioned, much of the canyon was once predominantly rich grasslands prior to extended periods of overgrazing.

### Recommended grasses native to Emigration Canyon

Botanical Name	Common Name	Plant Community	Watering Need*
<i>Agropyron smithii molle</i>	Western Wheatgrass	G	0
<i>Agropyron spicatum</i>	Bluebunch Wheatgrass	G	0
<i>Deschampsia caespitosa</i>	Tufted Hairgrass	R	3
<i>Elymus condensatus</i>	Great Basin Wildrye	G	0
<i>Oryzopsis hymenoides</i>	Indian Rice Grass	G	0

### Recommended exotic grasses

<i>Agrostis alba</i>	Redtop	U	3
<i>Andropogon gerardii</i>	Big Bluestem	E	0
<i>Bouteloua gracilis</i>	Blue Grama	E	0
<i>Buchloe dactyloides</i>	Buffalo Grass	E	0
<i>Calamagrotis acutiflora</i>	'Karl Foerster's'	E	2
<i>Chasmanthium latifolia</i>	Northern Sea Oats	E	3
<i>Dactylis glomerata</i>	Orchard Grass	E	3
<i>Elymus giganteus</i>	Giant Wild Rye	E	0
<i>Elymus glaucus</i>	Blue wild Rye	U	3
<i>Erianthus ravannae</i>	Ravenna Grass	E	3
<i>Festuca arundinacea</i>	Tall Fescue	U	3
<i>Festuca ovina glauca</i>	Blue Fescue	E	2
<i>Festuca ovina</i>	Sheep Fescue	U	0
<i>Festuca rubra</i>	Creeping Red Fescue	U	3
<i>Lolium perenne</i>	Perennial Ryegrass	N	2
<i>Miscanthus sinensis</i>	Maidenhair Grass	E	3
<i>Molena caerulea</i>	Varigated Moor Grass	E	3
<i>Pennisetum alopecuroides</i>	Fountain Grass	E	2
<i>Phalaris arundinacea picta</i>	Ribbongrass	U	2
<i>Phleum pratense</i>	Timothy	E	3
<i>Poa compressa</i>	Canadian Bluegrass	E	0

\* (Watering Requirement Note: 0 - Once established these grasses will survive without supplemental water, however to stay green through the hot summer months they need to be watered deeply twice per month.)

## **General Landscape Notes**

### **Irrigation**

Landscape irrigation systems come in many forms but essentially fall into two categories, sprinkling systems and drip systems. Sprinkling systems broadcast water over the landscape, covering it with water. Drip systems on the other hand place specific amounts of water at particular planting sites, such as at a tree or shrub.

Sprinkling systems have the advantage of broad coverage of areas, but the disadvantage of shallow water penetration and high evaporation of applied water. It is the ideal way to irrigate a lawn. A consequence of broad water coverage in non-lawn areas is the encouragement of weeds by supplying them unintentionally with water. Sprinkling systems can often deliver water too fast to a landscape for water penetration into the soil, resulting in water run-off.

Drip systems have the advantage of water conservation by supplying only the desired plants with water and allowing for deep penetration (by slow application) of the water into the soil and plant root zones with relatively little loss to evaporation. The disadvantage to drip systems is that all plants need to be individually plumbed into the drip system. For establishing trees and shrubs the drip type system is extremely beneficial for the plant's health and appearance. Drip systems easily permit heavy and light watering of plants by varying the quantity of emitters on each plant or by adjusting the flow of water through the emitter.

Regardless of whether a drip or sprinkler system is used, the installation of timers is beneficial to calibrate the amount of water applied to the specific needs of the plants being irrigated. As well as wasting water, overwatering plants can often do as much harm to their health as under watering them.

### **Soil amendments**

In most parts of Emigration Canyon the topsoil is extremely thin. Once a site is disturbed, the topsoil is typically lost and poor subsurface soils composed of rocks and clay are the ones exposed for revegetation of the landscape. Enriching the soil with amendments such as compost or composted manure, creates a much more hospitable environment for the establishment of plant materials. While seemingly expensive and bothersome to do, amending the soil is actually quite cost effective when the success or failure of expensive plants is considered.

To improve your soil, add compost and mulch first. Besides adding nutrients, these amendments add organic matter which improves drainage, allows the soil to hold moisture better, and creates spaces for air circulation and beneficial bio-activity. Depending on the quality of compost you use, you may be able to eliminate the need for other fertilizers entirely. Improving the physical condition of your soil will also make any fertilizers you use more efficient. Avoid fertilizing in cold weather. The microorganisms that break fertilizer down are inactive at low temperatures, so it won't be very effective. The fertilizer may even wash away and pollute groundwater. Blood

meal, cottonseed meal, fish meal and fish emulsion, bone meal, rock dust and kelp, green manures and animal manures are some fertilizers that build healthy soil.

## **Mulching**

Mulching involves the application of a layer of dead organic matter on top of the soil and around the plantings. Examples of mulch materials include - compost, bark, straw, chipped branches, and dead leaves. Organic mulch slowly releases important nutrients like nitrogen and calcium into the soil, so you can reduce fertilizer use.

Mulching accomplishes several important functions. It keeps the sun from directly hitting the soil and drying it out, conserving the water for the plants. Mulch acts as a layer of insulation for plants' roots - improving their chances of survival during heat waves and cold snaps. It also deprives unwanted plants of the sunlight necessary for their growth and makes their removal much easier.

Spreading a 2-inch layer of mulch around your plants can reduce the amount of water your garden needs by as much as 50%. Mulching keeps surface soil loose which is much better for plant roots. Because you water less, the soil surface is less likely to become compacted by overwatering. Mulch also protects topsoil from damage due to heavy rains. Compost is by far the best form of mulch available. It's rich in nutrients, and can hold up to ten times its weight in water. Like soil amendments, mulching is a cost effective way to enhance the survival of plantings.

## **Conservation of water quality**

In addition to the conservation of water quantity, conservation of water quality is also important. Ground water moves slowly, but once contaminants are introduced they are impossible to remove. The most important aspect of preservation of groundwater quality is to avoid contaminating the watershed in the first place.

Groundwater is contaminated when pollutants seep in from poorly constructed septic systems, runoff from fertilized areas, application of herbicides, insecticides, and fungicides, and when homeowners dump chemicals down the drain or on the ground. About 1/3 of the nitrogen added to gardens and landscapes as fertilizer ends up polluting surface and groundwater.

Home gardeners as a group use an estimated 5-10 times more toxic chemicals on ornamental plants and lawns than farmers use on agricultural crops. These products leach into groundwater. This can be reduced by avoiding over-fertilization and utilizing safer pest-control methods. Avoiding the use of highly soluble fertilizers, which leach easily into surface and ground water, helps prevent pollution. If you need to use fertilizers, use a "slow release" fertilizer variety.

Although pesticides are designed to eliminate specific "target" pests, they often poison birds and other wildlife. And, ironically, because they kill beneficial predator insects as well as pests, pesticides often wind up encouraging more pests instead of eliminating them. Most importantly, pesticides are seeping into

groundwater and contaminating drinking water. Pesticides are a significant threat to human health.

There are effective alternatives to chemical pesticides. Managing soil properly to help prevent plants from being susceptible to pests and diseases, and growing plants that attract beneficial insects will help. Including native plants in your landscape helps to reduce diseases and insect infestations.

**Recommended references for general and water conserving landscaping**

*Gardening for the Earth*, by The EarthWorks Group and Kevin Raftery  
*Water-wise Landscaping*, by Terry Keane

## **Conclusion**

Residents of Emigration Canyon have limited access to water for landscaping purposes. By understanding the native plant communities in your area you can understand the availability of ground water to support different types of landscape vegetation. By selecting plants compatible with the available ground water, landscaping choices can be made that will survive on the water naturally available.

Grow native plants in your landscape. Plants native to Emigration Canyon that are already adapted to our climatic extremes and periodic alterations, will generally maintain their attractive appearance and survive with little maintenance. Avoid disturbing existing vegetation as much as humanly possible, as it is extremely difficult to replace.

As periodic droughts intensify our concerns for water, landscapes that conserve water will increasingly be seen as intelligent investments in the land. Water conserving landscapes save not only on water costs but also on landscape maintenance costs and the ability to survive drought conditions.

Selecting plants that are not compatible with the available ground water will result in a perpetual and excessive use of limited water. If the canyon water supply is ever metered and controlled, plants requiring more water than what is available to them will perish.

Making wise, water conserving plant choices at the beginning of a landscape installation will save money, water, and probable loss of plants during a periodic, but predictable time of drought. Making a conversion from a water intensive landscape to a water conserving landscape will initially cost more than the savings in water, but will over time, more than pay for itself in savings.

The purpose of this guide is to bring awareness to the fact that -

- there is water available,
- the amount of water available is finite,
- and, there is enough if we use it wisely.

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