# LANDSCAPE IRRIGATION WITH WATER OF ELEVATED SALINITY

## Guides for Planners, Managers and Supervisors

### Synopsis

Because of the increasing costs of securing potable water, there is increasing pressure to utilize nonpotable water for irrigating large urban landscapes, such as golf courses, parks, school grounds, and apartment complexes. This article will explain potential landscape damage associated with salts, and practical ways to reduce the problems through improved planning and landscape management practices.

1

Wastewater Treatment Plant

### Benefits of Using Nonpotable Water

The use of saline water or reclaimed municipal effluent with elevated salinity for irrigation helps conserve potable water which is a scarce commodity in most communities in the Southwest. Reuse of treated municipal effluent for irrigation is especially attractive from the view of urban water management, primarily because municipal effluent can be used safely for irrigation after a cost-effective secondary treatment (Photo 1). Once landscape management practices are adjusted to salty nature of the irrigation water, our experience has shown that landscapes can be sustained without notable ill-effects (Photo 2 and 3).

The real incentive on the part of users comes from cost-saving. Water prices usually range from $1.60 to $2.00 per 100 cf. This means that if potable water is used for irrigation, it costs $2,780 to $3,580 annually to maintain one acre of turf at a typical water application of 48 inches per year. The use of reclaimed water or saline water directly from the well can substantially lower the water bill. In the case of El Paso, the water bill can be reduced to $850 per acre at the current price of 49¢ per 100 cf. of reclaimed water. This means a potential saving in water bill by $1,900 to $2,730 annually for maintaining one acre of turf. This saving is usually more than what is required to upgrade landscape management to control potential salt problems.

2

Golf course using Reclaimed Water

3

Park using Reclaimed Water

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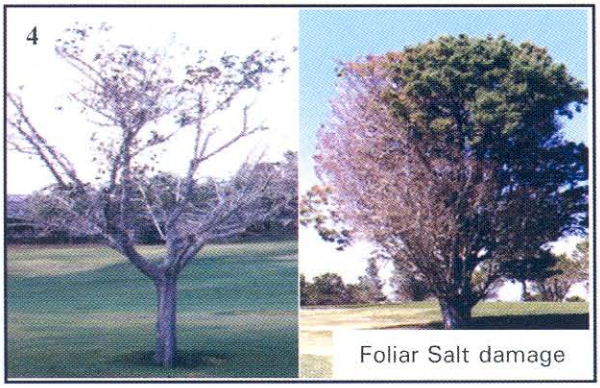
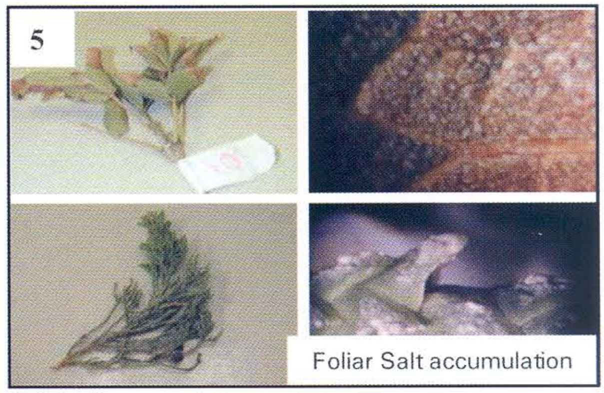
Word processing by Luis E. Sayago, Student Technician. Supported in part by the Rio Grande Initiative.

## Potential Problems and Remedies

There are three types of landscape degradation caused by salts; foliar salt damage, soil salinization, and soil sodification. None of these potential problems may appear if a site consisting of permeable soils with good drainage is managed properly. High salinity of irrigation water usually affects the landscape when the plants used are highly salt-sensitive, or the soil conditions and/or management practices are poor.



4 Foliar Salt damage



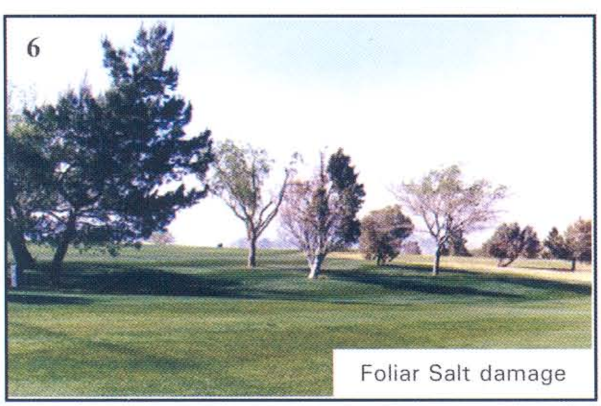
5 Foliar Salt accumulation

### Foliar Salt Damage

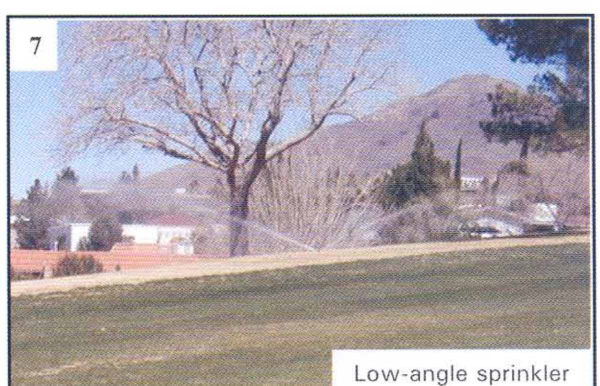
The first type of salt damage is the foliar damage caused by frequent overhead sprinkling, such as daily irrigation. Plant leaves absorb salts through leaf tissue, just as readily as they do through roots. Foliar damage usually increases with increasing frequency of irrigation, and salinity (or more precisely, Na and Cl concentrations) of irrigation water. Under daily light irrigation, sensitive plants can defoliate when the Na or Cl concentration of sprinkler water reaches about 200 mg $L^{-1}$, and at 300 to 350 mg $L^{-1}$, most broadleaf trees and some cypress are usually damaged severely (Photo 4). Light daily sprinkler irrigation can cause salt accumulation on leaves (Photo 5).

The actual plant damage caused by overhead sprinkling is highly plant species-dependent (Attachments 1 and 2). In general, broadleaf trees are sensitive to this form of damage, whereas Junipers, and Pines are more tolerant (Photo 6). If overhead sprinkling is continued for several seasons, broadleaf trees can be severely damaged. Leaf damage shown in Photo 4 and 6 was photographed after three years of overhead sprinkling with salty water (1200 ppm).

Remedies to this problem include the use of low angle or under-canopy sprinklers (Photo 7), or partial circle sprinklers with tube feeders extended to the trees or shrubs which otherwise may receive the direct hit of sprinkler streams. Drifts from sprinklers usually do not cause severe leaf damage in dry climate, as the drifts evaporate faster than the leaf can absorb salts. Another measure, although not as effective as modifying the irrigation system, is to extend irrigation intervals as long as possible, and/or irrigate only during night hours when stomata are closed. For additional information, refer to Publication 3 shown at the end of this article.



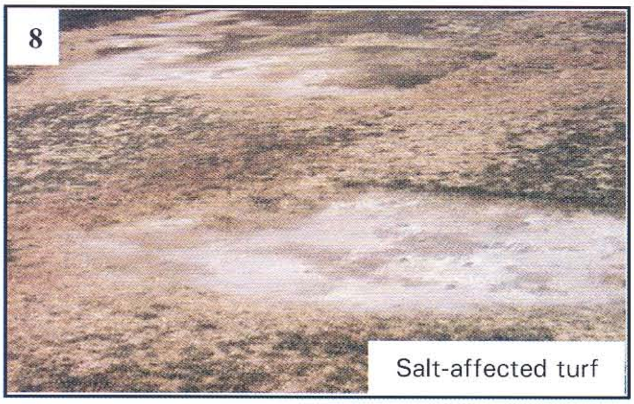
6 Foliar Salt damage



7 Low-angle sprinkler

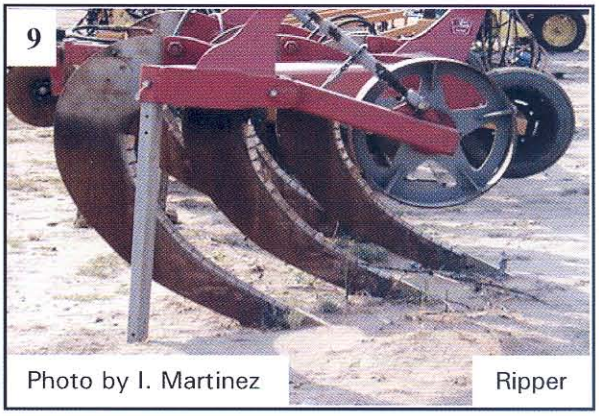
## Soil Salinization

The second type of salt problems is referred to as soil salinization; the process of excessive salt accumulation in the surface soils. This process usually begins with the reduction in water infiltration and/or drainage. Water infiltration into clayey soils is inherently slow, and becomes nearly zero with compaction, thus leading to salt accumulation. In Aridisols developed in upland areas of the Southwest, the presence of caliche (calcium carbonate) is a frequent (but not universal) cause of poor infiltration and/or drainage, thus leading to salt accumulation (Photo 8). A practical way to correct this problem is to break the caliche layer with a subsoiler such as shown in Photo 9. If there are established trees, a different type of equipment would be better suited. The presence of a high water table can also create salt problems by limiting drainage. It may require a drainage system or a layer of gravel placed beneath the topsoil for intercepting upward capillary flow.



8 Salt-affected turf

Another factor which causes soil salinization is poor soil and irrigation management. The most common problem is soil compaction. If the soil is sandy or loamy, the compaction problem can be managed by the use of an aerifier, followed by topdressing with sand. Clayey soils require a heavy-duty aerifier, and topsoiling with sandy soil or removal of a substantial portion of the clay soil using an extra-heavy core remover prior to placing sand. Additional details on soil handling can be found in Pub. 1, and the guideline for irrigation scheduling to control soil salinization in Pub. 2. Light daily irrigation commonly used at golf courses is a pretext for soil salinization. Plant selection must be made by considering their salt tolerance (Attachments 3 and 4).

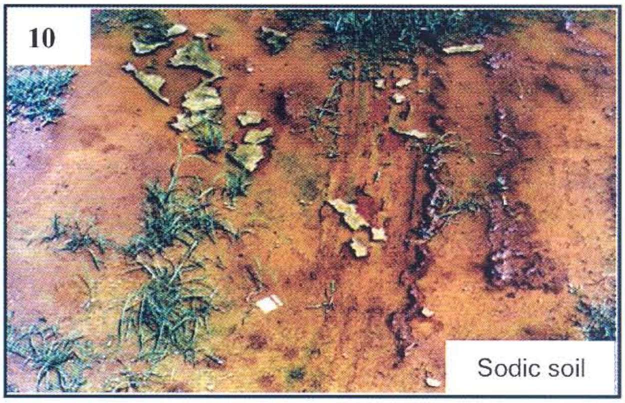


9 Photo by I. Martinez Ripper

## Soil Sodification

Soil sodification is a process by which sodium (Na) accumulates in the cation exchange sites of clay minerals. High levels of exchangeable Na are known to cause soil aggregate break-down and disperse soil particles when the soil is irrigated with water of low salinity or following rain. Entisols developed from river sediments are especially susceptible to this form of soil structural degradation (Photo 10), whereas Aridisols containing high levels of caliche are usually not, especially when saline water is used for irrigation. High salinity of soil solutions counteracts against the dispersive effect of Na. Likewise, sand or caliche is immune to the dispersive effect of Na.

Gypsum application has been a common method of reducing soil sodicity and improving water infiltration during salt leaching irrigation in Entisols. Aerification and/or topdressing with sand are alternatives. Soil textural modification is a permanent measure. Keeping soil salinity at an elevated level is another method of reducing Na problem. For details, refer to Publication 1.



10 Sodic soil

## Check Lists for Large Scale Projects

■ A critical item for saline water irrigation

■ **Assessment of Management Capability**

The most critical step toward a successful use of salty water for irrigation is to assess the landscape management capability of water users. If the capability is low, water providers and users must develop plans to improve the capability, which may include subcontracting of landscape management.

□ **Water Quality Testing and Appraisal**

Quality of water used or to be used for irrigation should be tested for salinity, sodicity, and phytotoxic elements such as Boron (B), initially monthly or weekly. In the case of treated municipal effluent, the State Law requires analyses of other constituents. Review applicable state code, e.g., TAC210 in the case of Texas. Appraisal of suitability for irrigation can not be made until soil and plant resources survey is completed.

□ **Water Use or Need Estimate**

This step is needed not only for a permit application for reuse of reclaimed water, but also for providing baseline data needed for interpreting soil salinity data. The monthly water use by various landscape plants are available from various sources, including those reported in the Attachment of Publication 2.

■ **Soil Survey and Suitability Appraisal**

This step is critical for appraising soil suitability for irrigation with salty water. The primary parameters to be tested include texture, salinity, sodicity, the topsoil depth, the depth to petrogenetic pans (such as a layer of caliche) or to water tables, plus description of typical soil profiles. Soil improvement measures should also be outlined.

■ **Plant Resources and Irrigation Survey**

The plant species and irrigation methods used must be surveyed so as to assess the potential for both foliar salt damage and plant damage caused by an increase in salinity.

■ **Landscape and Maintenance Plan**

This plan should be developed by water users and must contain irrigation plans mandated by state and local codes such as the use of purple pipes and measures to reduce runoff/standing water or soil salinity. Modification of irrigation systems to reduce foliar salt damage must be a part of the plan.

□ **Permit Application**

The use of reclaimed municipal effluent for irrigation requires the state permit covered under TAC Chapter 210. The information can be down-loaded from the website of applicable state agencies. In addition, selection of landscape plans can be subjected to local ordinances and codes.

■ **Preparation of User Agreements**

This is another critical step to ensure successful use of nonpotable water and to minimize legal complication. User Agreements should contain stipulations to address potential landscape maintenance shortfalls, and the measures needed to ensure beneficial use and regulatory compliance.

□ **Inspection and Monitoring**

Site inspection is usually needed for enforcing the state regulations and the measures agreed to implement in the user agreement. Water use, salinity of water supply, soil salinity, and landscape conditions are the main items for monitoring.

### Lists of Additional Publications


1. Soil Resources of El Paso: Characteristics, Distribution and Management Guidelines, (Texas A&M Univ. Agr. Res. Ctr. at El Paso, Sep. 2000).
2. El Paso Guidelines for Landscape Uses of Reclaimed Water with Elevated Salinity (Texas A&M Univ. Agr. Res. Ctr at El Paso, Sep. 2001).
3. Foliar salt damage of landscape plants induced by sprinkler irrigation (Texas Agr. Expt. Sta./Texas Water Resources Inst. March 2002).
4. Appraising Salinity Hazard of Reclaimed Water for Irrigating Urban Landscape (In press).