

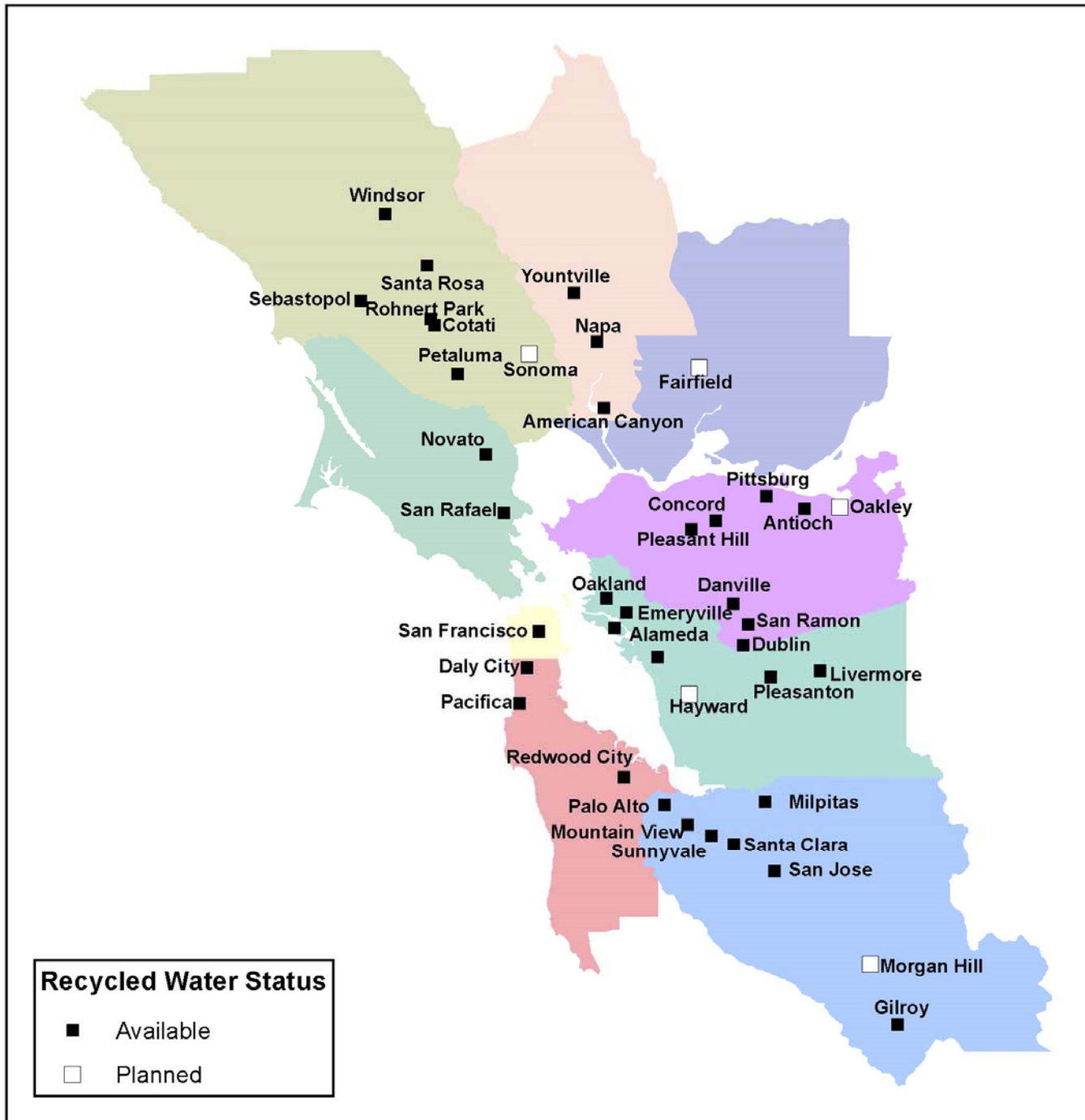


# Using Recycled Water to Irrigate Bay Area Landscapes

Nelda Matheny  
HortScience, Inc.

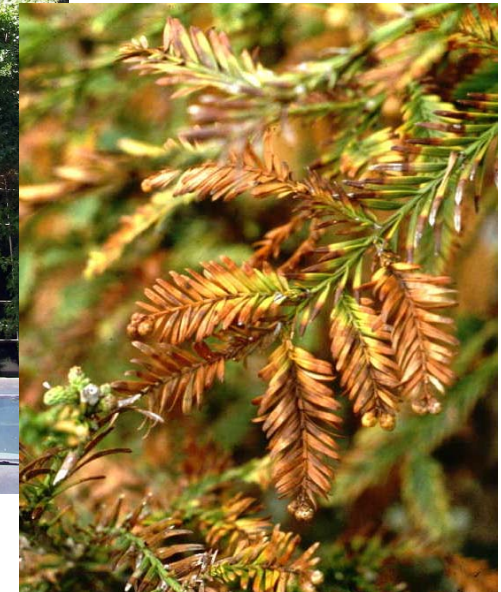
ABAG Workshop  
July 9, 2015

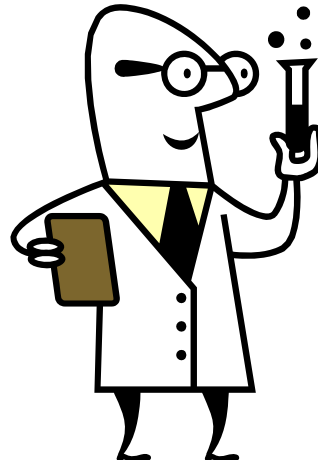
325 Ray St.  
Pleasanton CA 94566  
Nelda@hortscience.com





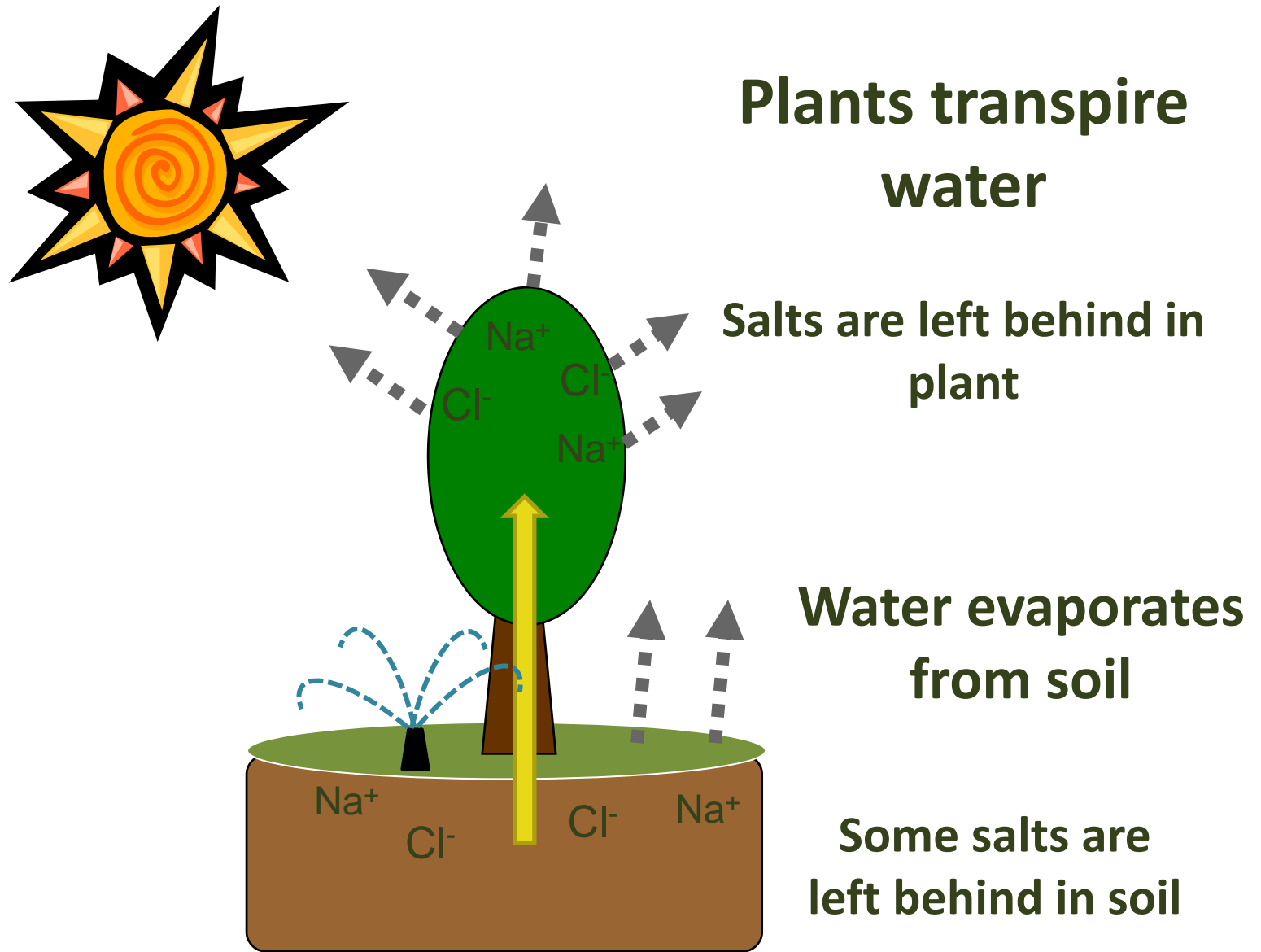
Too much salt may damage sensitive plants  
and degrade soils

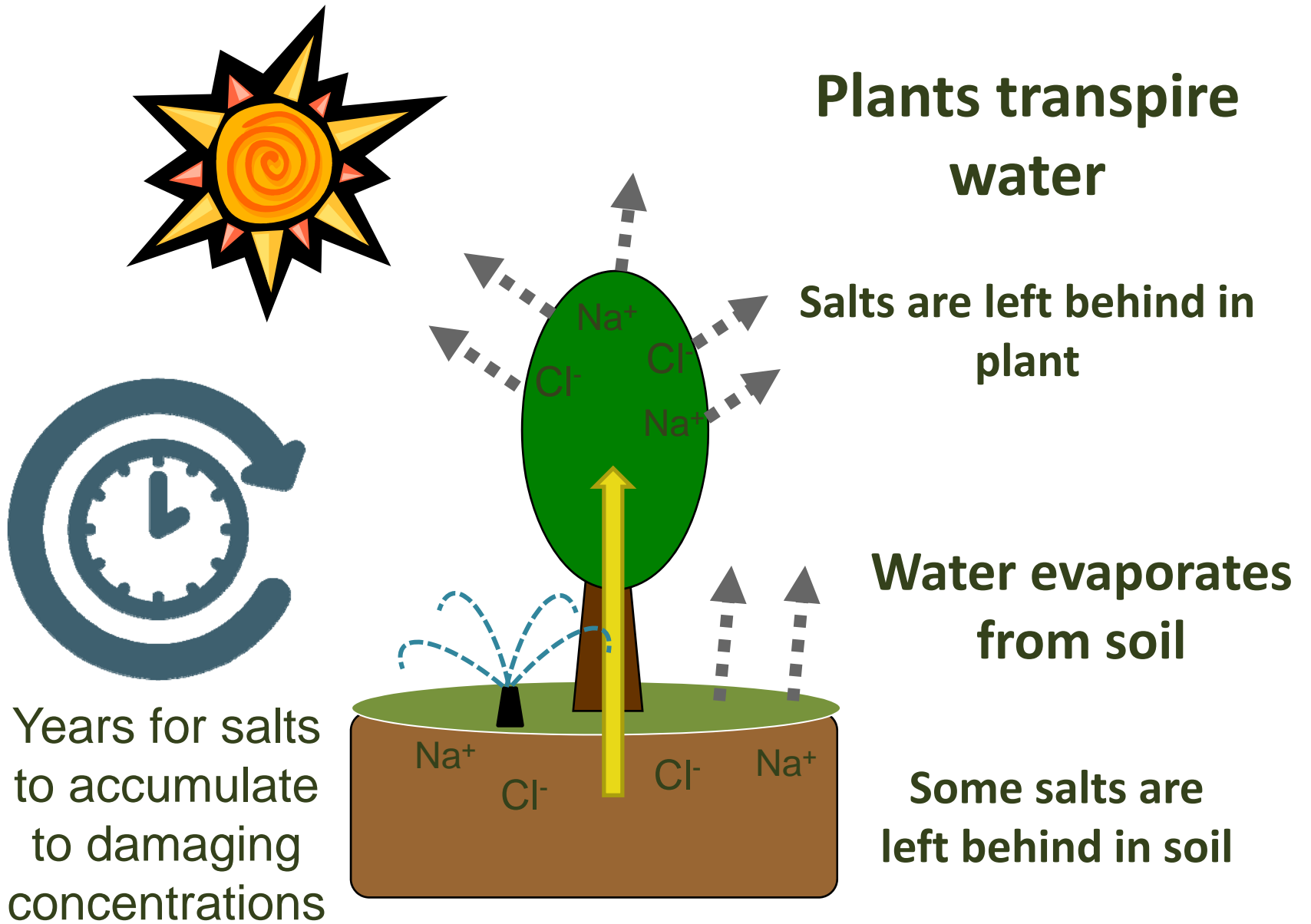




A (very) brief  
science lesson









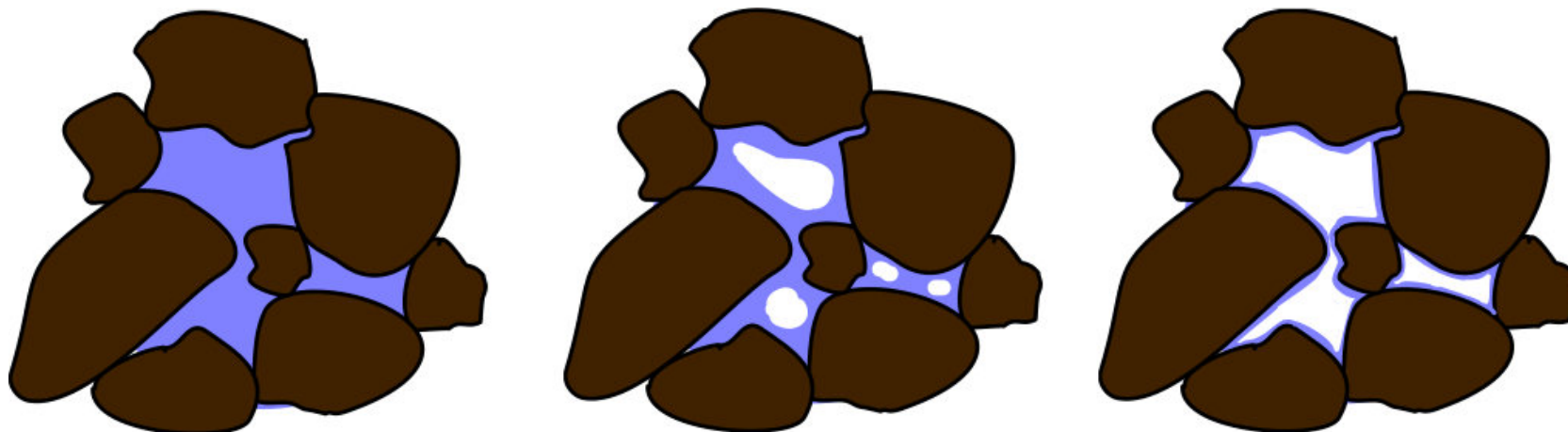
# Salt concentration varies with soil moisture





## Water in the soil solution

**As soil dries, the salts become more concentrated.**

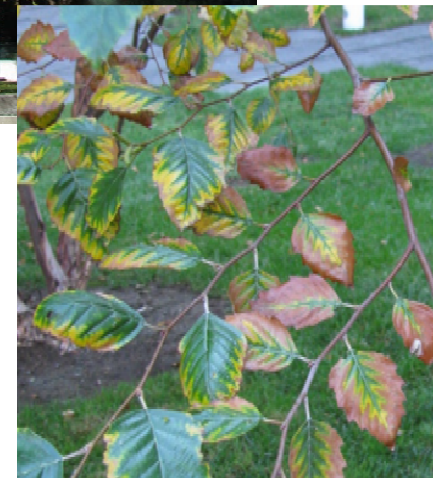






## Water + heat + salt stress

- Degree of symptoms worse when plant heat and water stressed.



River birch





# Water deficit may look like salt damage







# Water deficit may look like salt damage



## Foliage Analyses

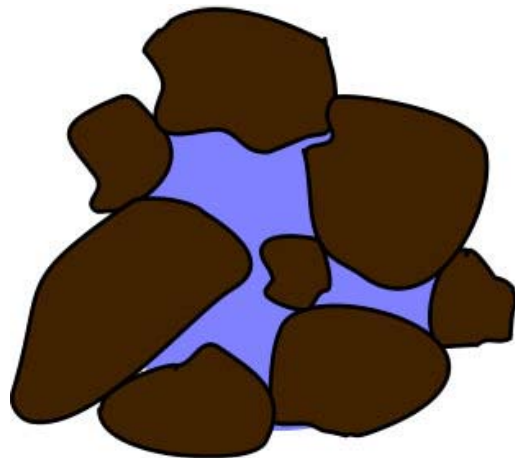
Na %	1.32	0.77	0.13
Cl, ppm	3200	1600	1500



Salinity is measured as electrical conductivity (EC)

Soil salinity

$EC_e$



Water salinity

$EC_w$



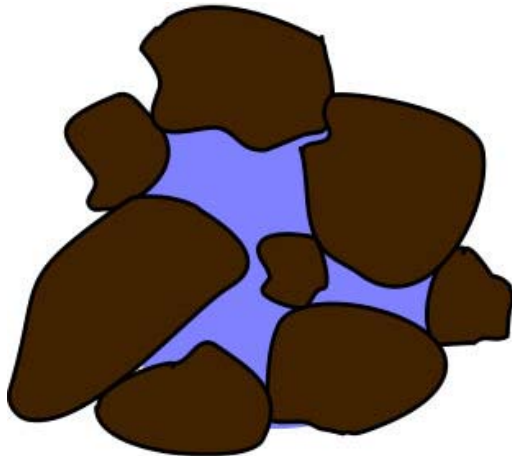




Salinity is measured as electrical conductivity (EC)

Soil salinity

$EC_e$



Water salinity

$EC_w$

Total Dissolved Solids

TDS

$1.0 EC_w = 640 TDS$



Specific ions are very important!

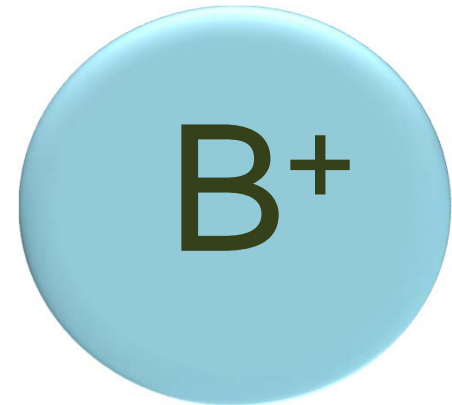
Chloride



Sodium



Boron





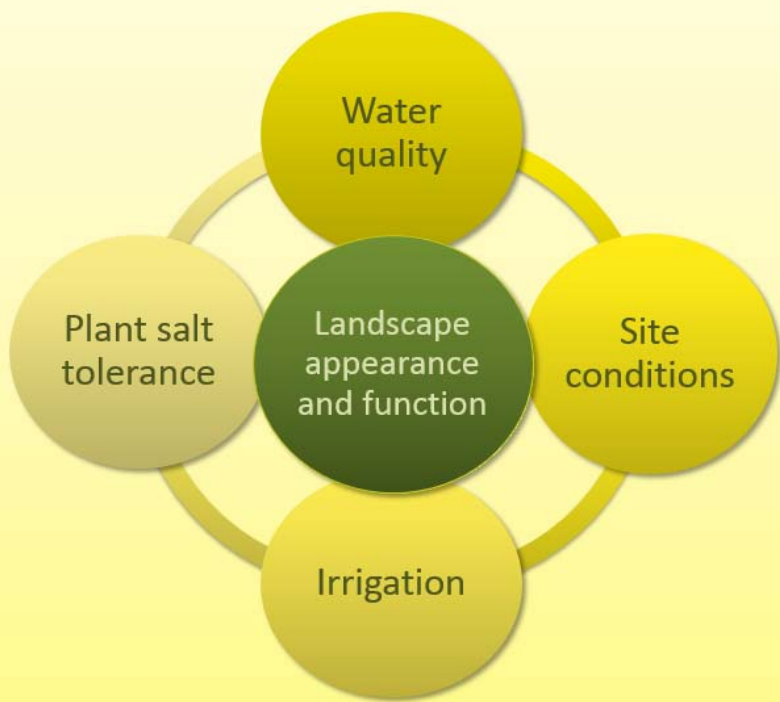
# Bicarbonate affects equipment & pH



+











# 1. Water quality





## S.F. Bay Area Recycled Water Quality

Parameter	Range in concentration	
	Annual average	Annual maximum
pH	6.8-7.8	7.1-8.8
EC <sub>w</sub> (dS/m)	0.44-0.95	0.68-1.66
Sodium (mg/l)	75-211	117-220
Chloride (mg/l)	64-315	182-328
Bicarbonate (mg/l)	132-292	172-390
SAR	3.6-5.6	4.0-6.0
Boron (mg/l)	0.3-1.0	0.4-1.8

Data compiled from agency reports; primarily from 2011



# Water Quality Categories

Parameter	Category 1	Category 2	Category 3	Category 4
EC <sub>w</sub> dS/m	<1.0	1.0-1.3	1.3-2.5	>2.5
Boron mg/l	<0.5	0.5-1.0	1.0-2.0	>2.0
Chloride mg/l	<120	120-200	200-350	>350
Sodium mg/l	<70	70-150	150-200	>200



# Water Quality Categories

Parameter	Category 1	Category 2	Category 3	Category 4
EC <sub>w</sub> dS/m	<1.0	1.0-1.3	1.3-2.5	>2.5
Boron mg/l	<0.5	0.5-1.0	1.0-2.0	>2.0
Chloride mg/l	<120	120-200	200-350	>350
Sodium mg/l	<70	70-150	150-200	>200

Good

Fair

Moderate

Poor





# S.F. Bay Area Recycled Water Quality Categories

- $EC_w$  (ds/m)
- 1 <1.0
  - 2 1.0-1.3
  - 3 1.3-2.5
  - 4 >2.5





## 2. Plant salt tolerance

- Low



- Moderate



- High





## 3. Site conditions

- **Soil texture**
  - Problems more likely on clayey than sandy soil.
- **Soil salinity, pH**
  - Problems more likely if start with saline, high pH soil.
- **Drainage**
  - Can't manage salts if site doesn't drain.

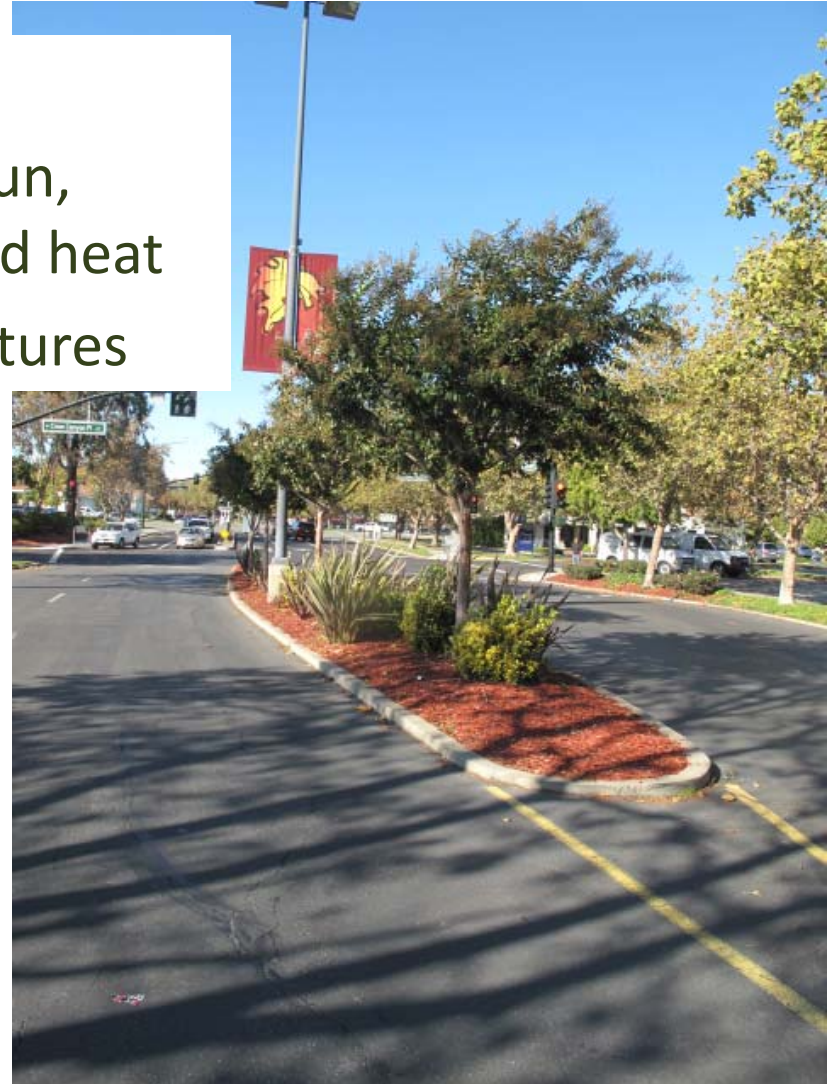






### 3. Site conditions

- ET demand
- Exposure to sun, wind, reflected heat
- High temperatures







## 4. Irrigation

- Delivery system
- Is foliage wetted?
- How much and how often water applied





# Introducing RW into existing landscape

- Conduct site assessment
- Establish soil salinity threshold
- Adjust maintenance practices
- Monitor plants and soils





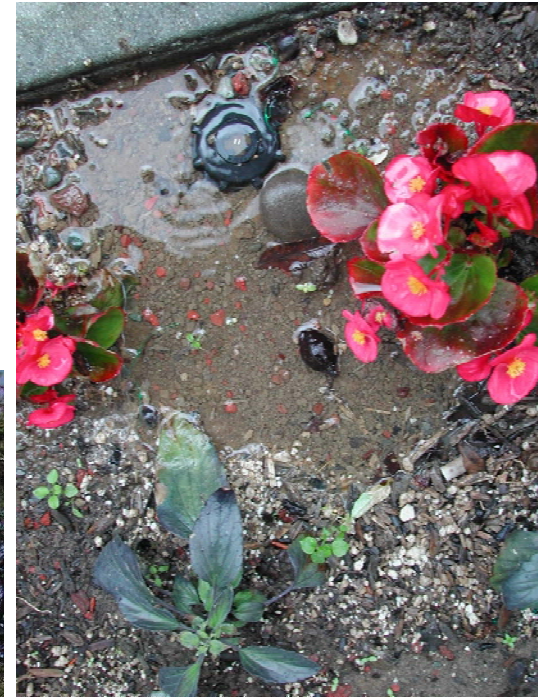
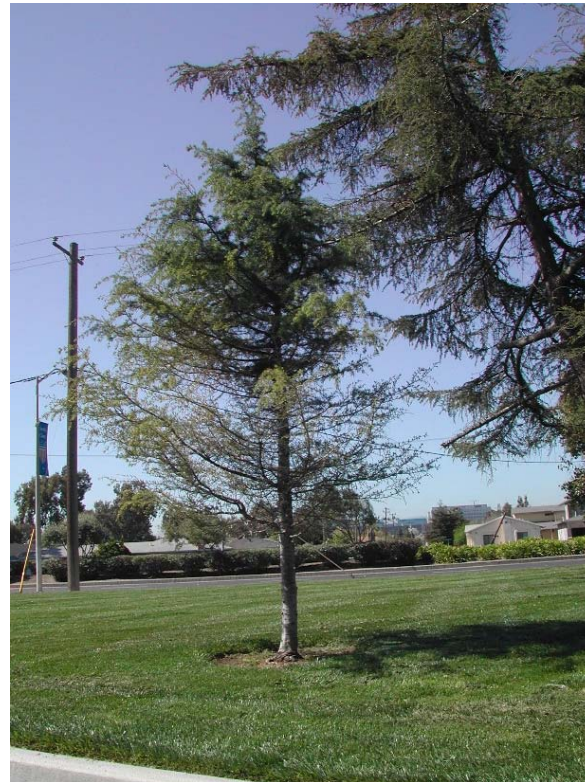


# Fix pre-existing problems



Ensure drainage

Repair  
equipment  
Irrigation audit

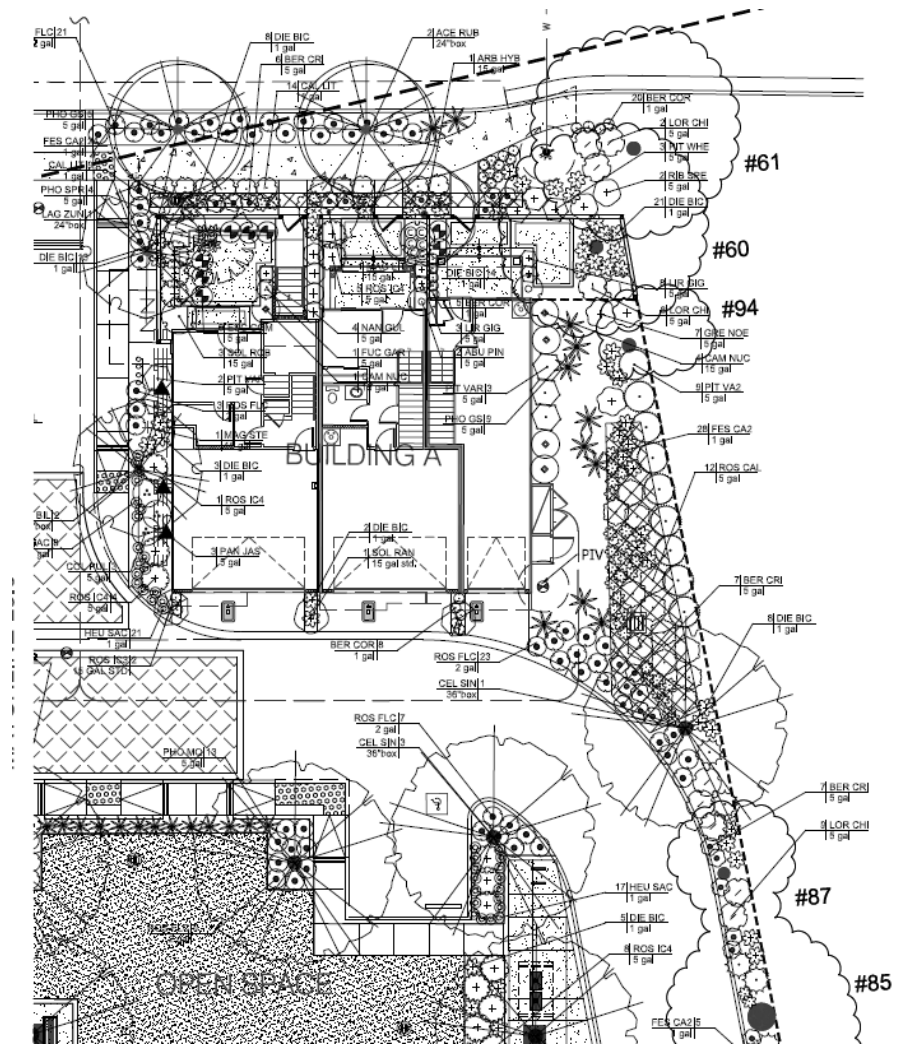


Convert spray  
to avoid wetting  
foliage



# Designing landscapes for RW

- Select plants with appropriate salt tolerance
- Evaluate soil characteristics and modify if needed
- Identify and solve drainage problems







# Irrigation systems

- Meet health and safety regulations
- Use equipment for RW
  - Valves resistant to Cl
  - Low trajectory spray
  - Large orifice drip, filters
- Expect increased repair/replacement
- Less tolerance for poor distribution uniformity

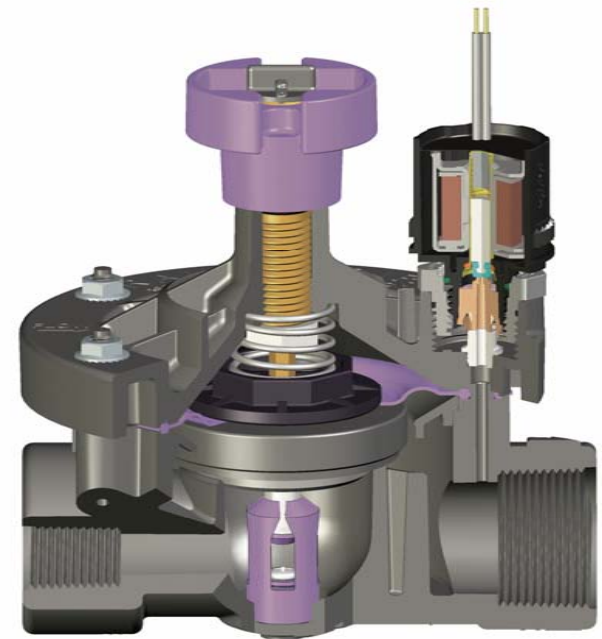


Photo:  
Rainbird

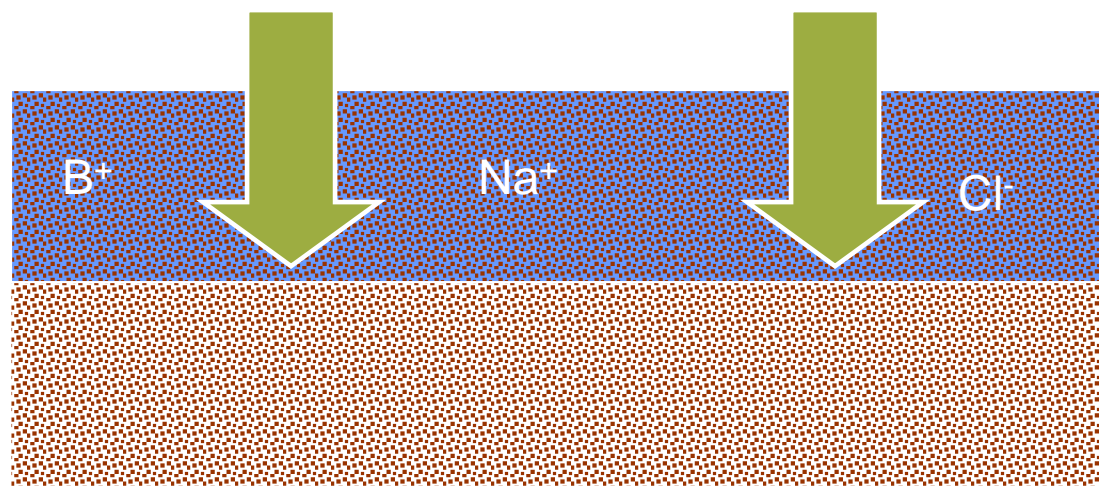




# Managing salt in landscapes

Leach to minimize salt accumulation

Wetting  
zone

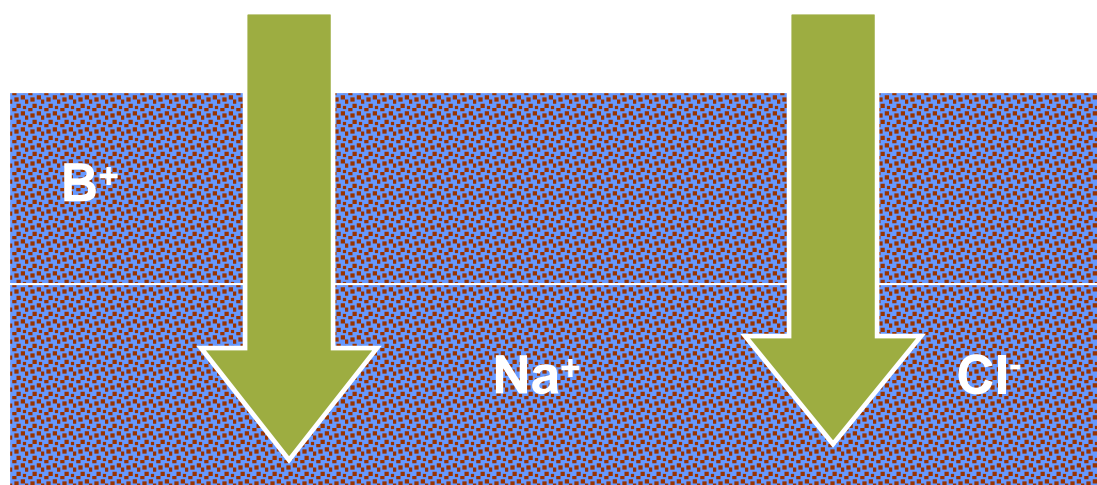


Salt  
accumulation



# Managing salt in landscapes

Leach to minimize salt accumulation

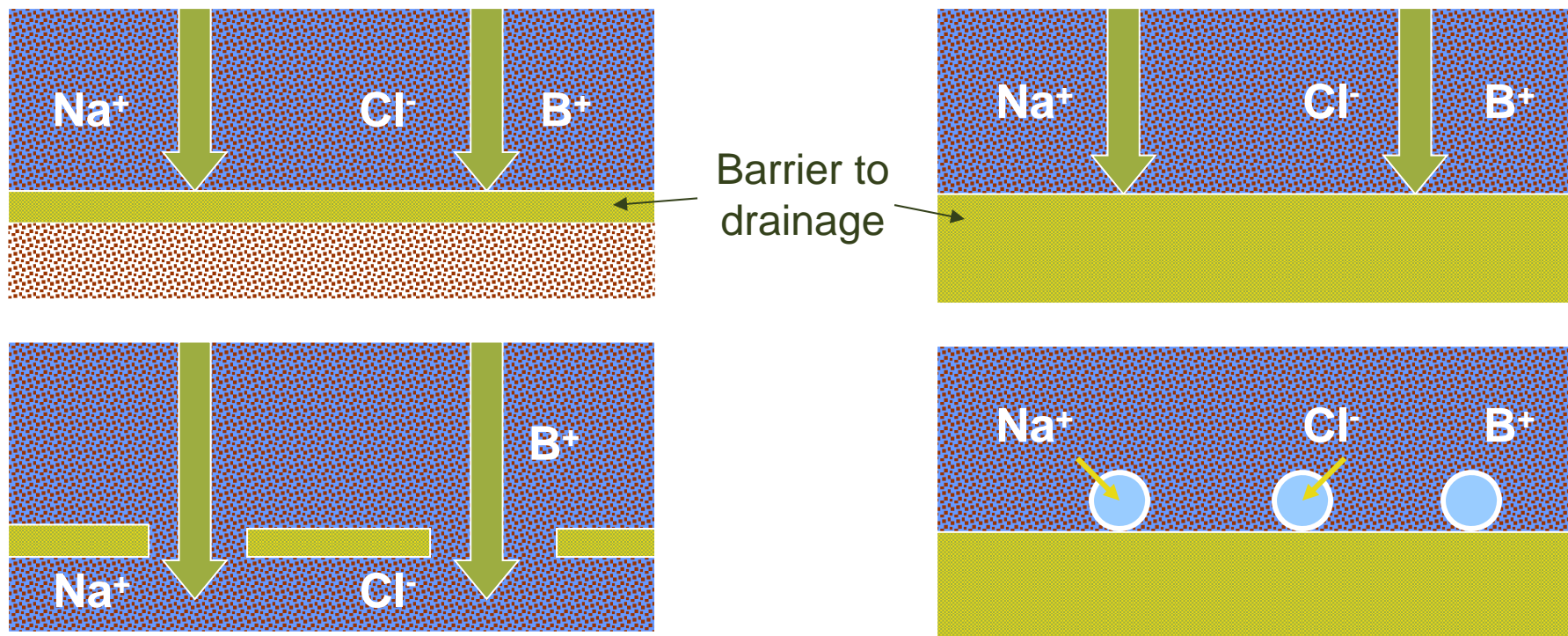


**Apply heavy irrigation  
to move salts  
downward below  
roots**



# Managing salt in landscapes

**Must have  
drainage to leach**







# Managing landscapes with RW

**Maintain soil  
moisture**



**Poor tree**  
few roots  
dry soil



**Good tree**  
many roots  
moist soil





# Managing landscapes with RW

- Decrease/adjust fertilizer
  - slow release
  - low salt index
  - acid-forming
  - foliar application for micronutrient deficiency







# Managing landscapes with RW



## Monitor regularly

- Plant health
- Pest populations
- Soil pH and salts
- Foliage sodium, chloride







## Managing landscapes with RW

- Need a “technical” approach
- Maintain moist soil
- Leach soil to minimize salt
- Avoid wetting foliage
- Manage sodium with gypsum
- Decrease fertilizer application
- Monitor soil and plants
- Plan for increased repair and replacement of irrigation equipment





## Embrace Change

- Before too long we will irrigate with recycled water or no water
  - We must learn how to use this resource
- Not all recycled water has high salts
  - Advocate for adequate recycled water quality
- Most drought tolerant plants have moderate to high salt tolerance
  - Phase out salt sensitive, high water use plants

