Using Recycled Water to Irrigate Bay Area Landscapes

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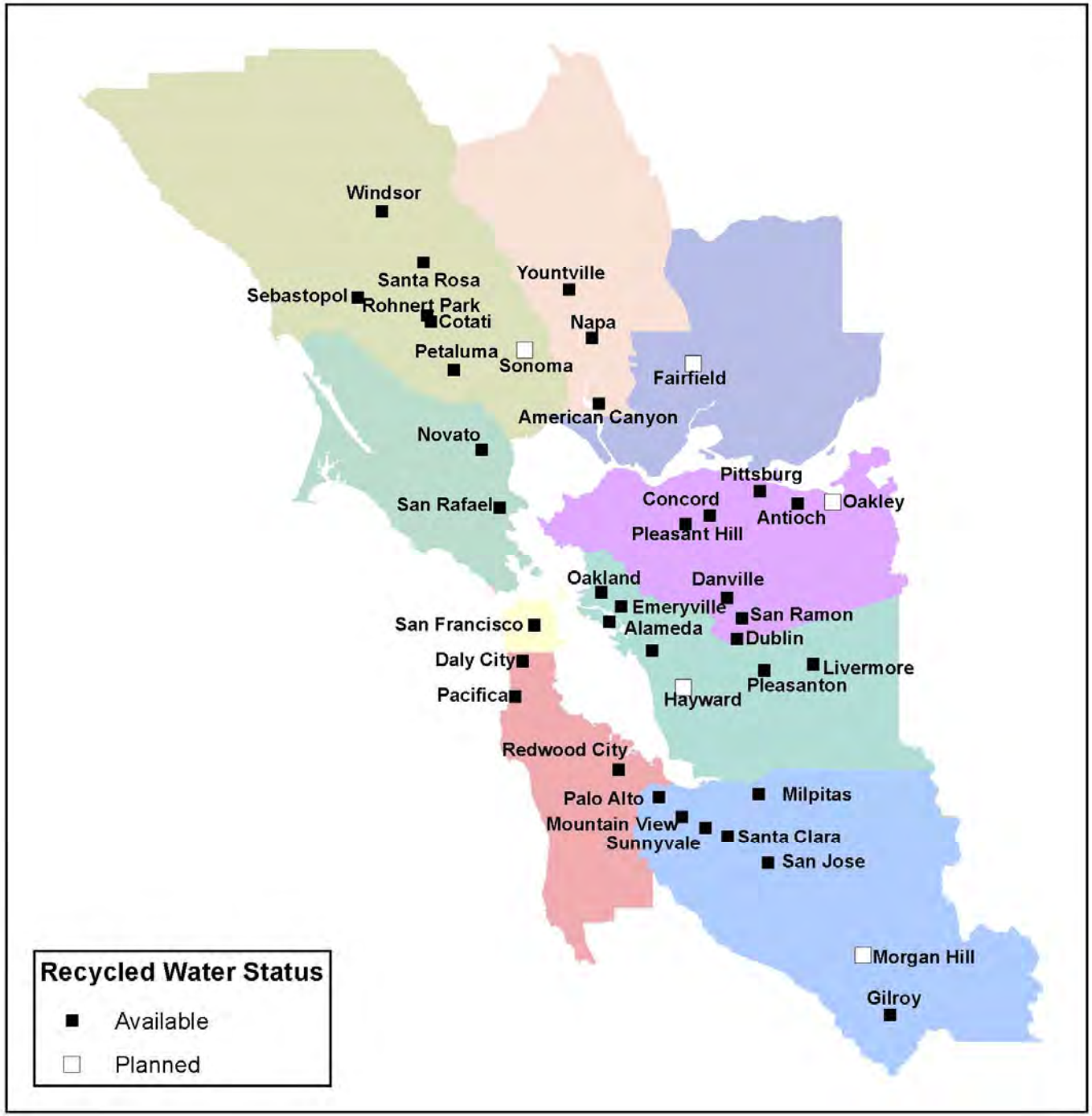
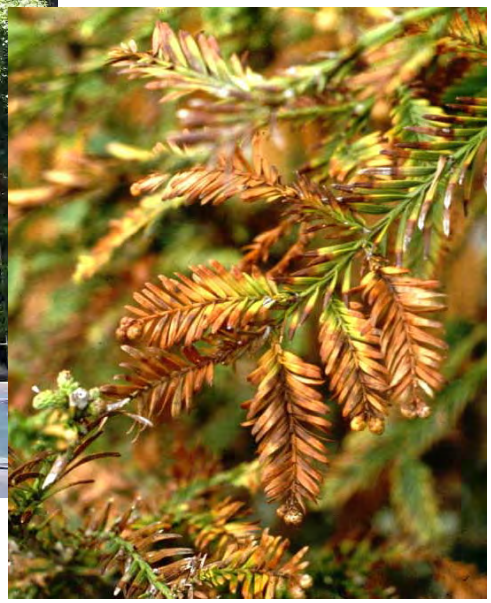
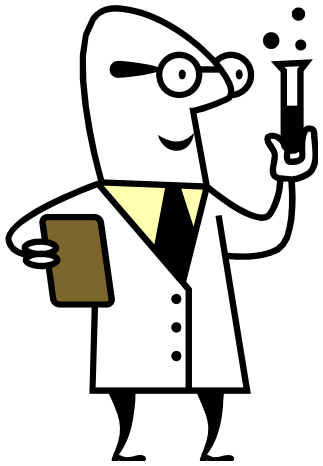
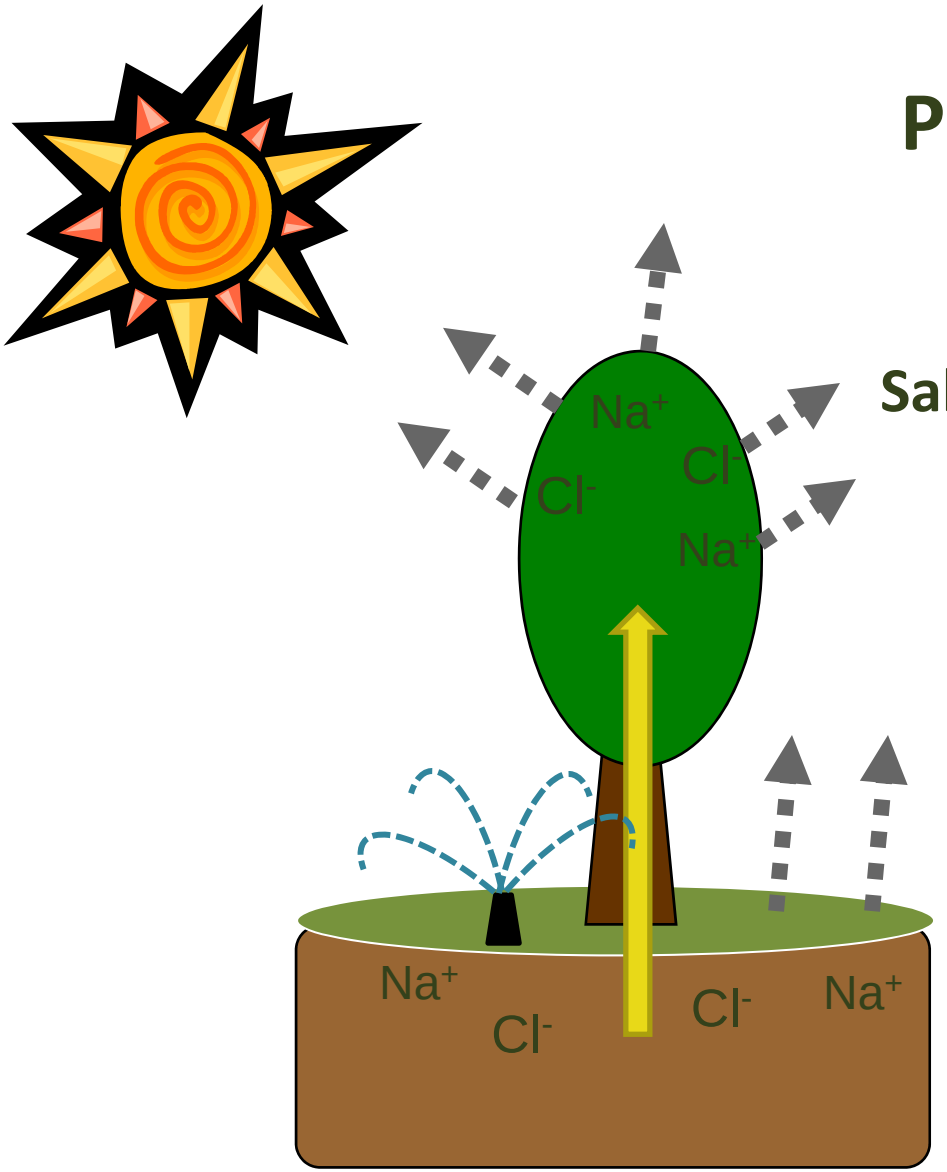


Too much salt may damage sensitive plants and degrade soils





A (very) brief science lesson



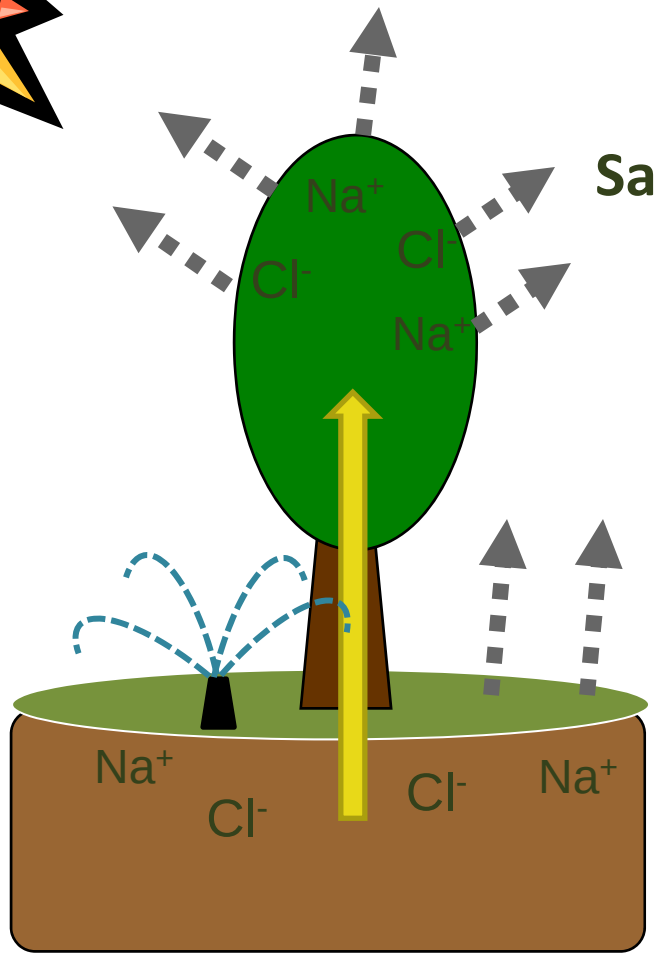
Plants transpire water

Salts are left behind in plant

Water evaporates from soil

Some salts are left behind in soil

Years for salts to accumulate to damaging concentrations



Plants transpire water

Salts are left behind in plant

Water evaporates from soil

Some salts are left behind in soil

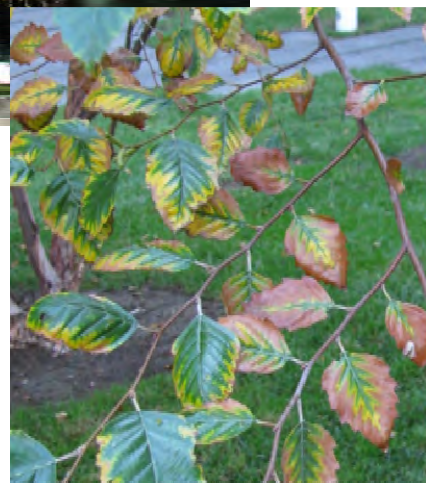
Salt concentration varies with soil moisture

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

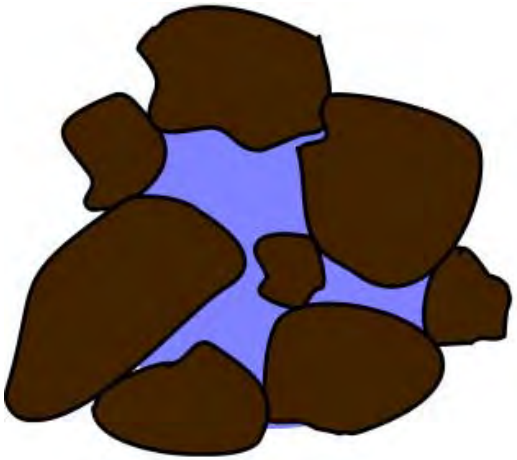
Foliage Analyses

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

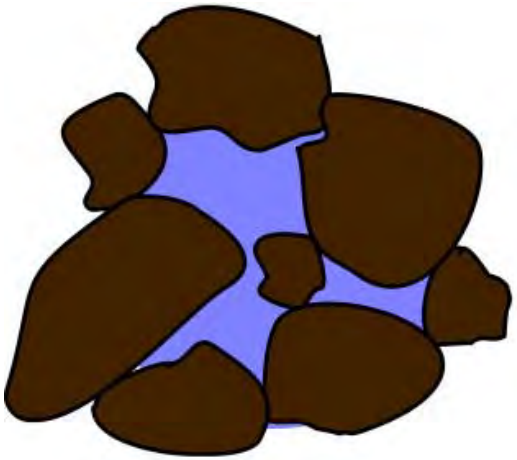
EC_w

www.pce-instruments.com

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

Cl^-

Sodium

Na^+

Boron

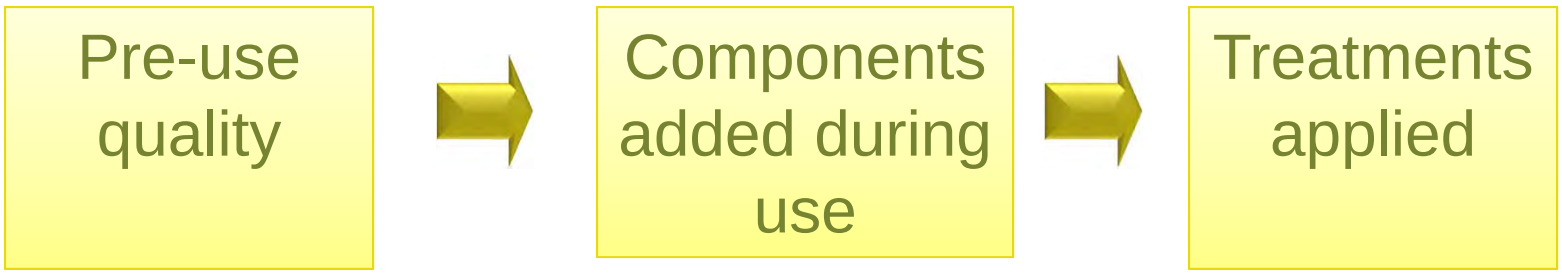
B^+

Bicarbonate affects equipment & pH

HCO_3^- +


Water quality
Plant salt tolerance
Landscape appearance and function
Site conditions
Irrigation

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_w (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_w 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

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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

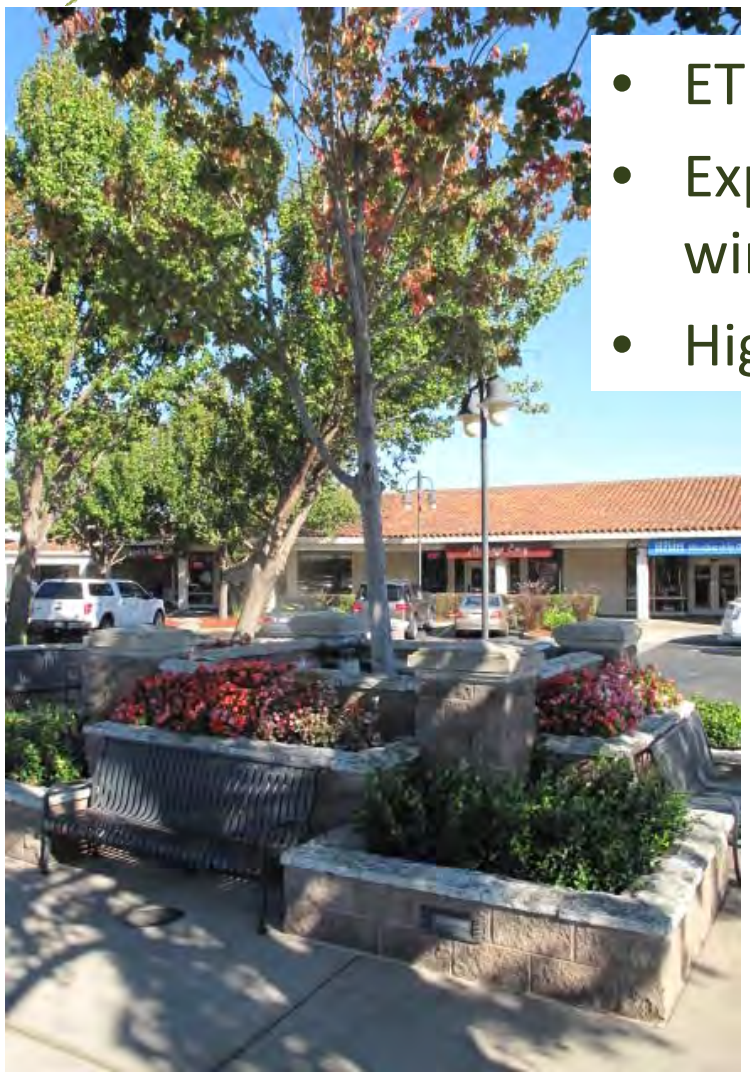
3. Site conditions

- **Soil texture**
  - Problems more likely on clayey than sandy soil.

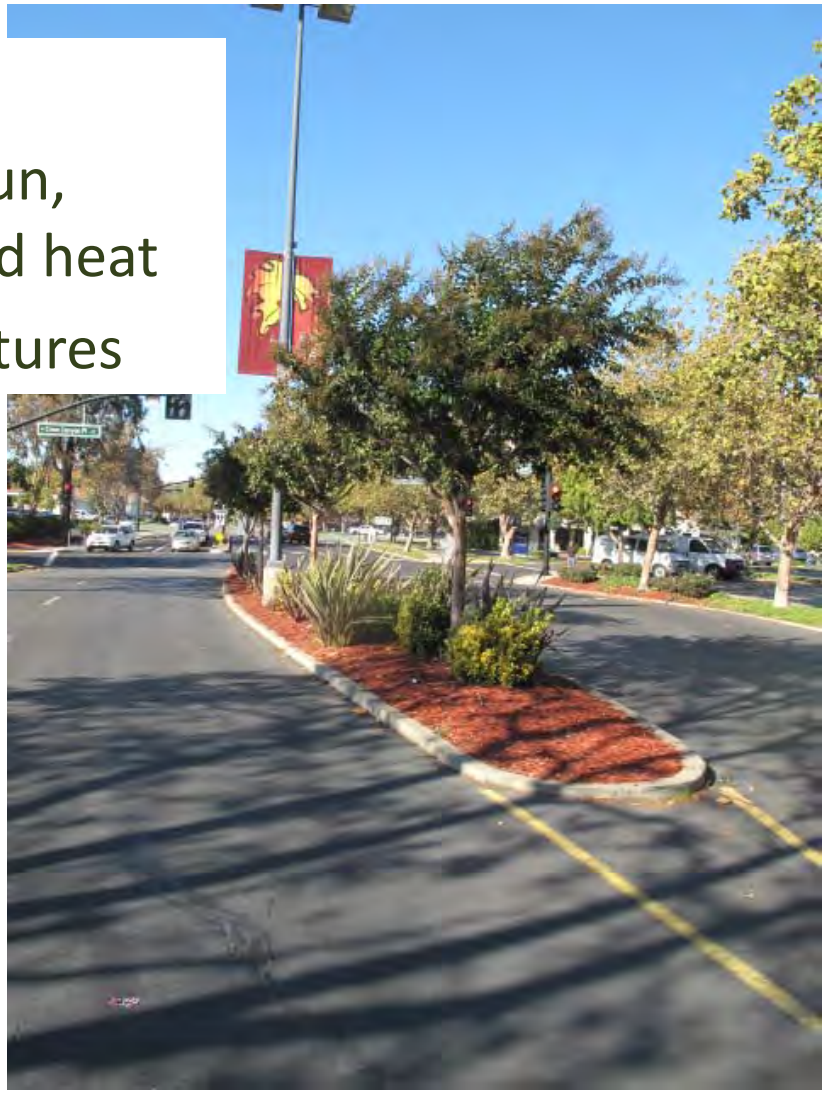
- **Soil salinity, pH**
  - Problems more likely if start with saline, high pH soil.

- **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

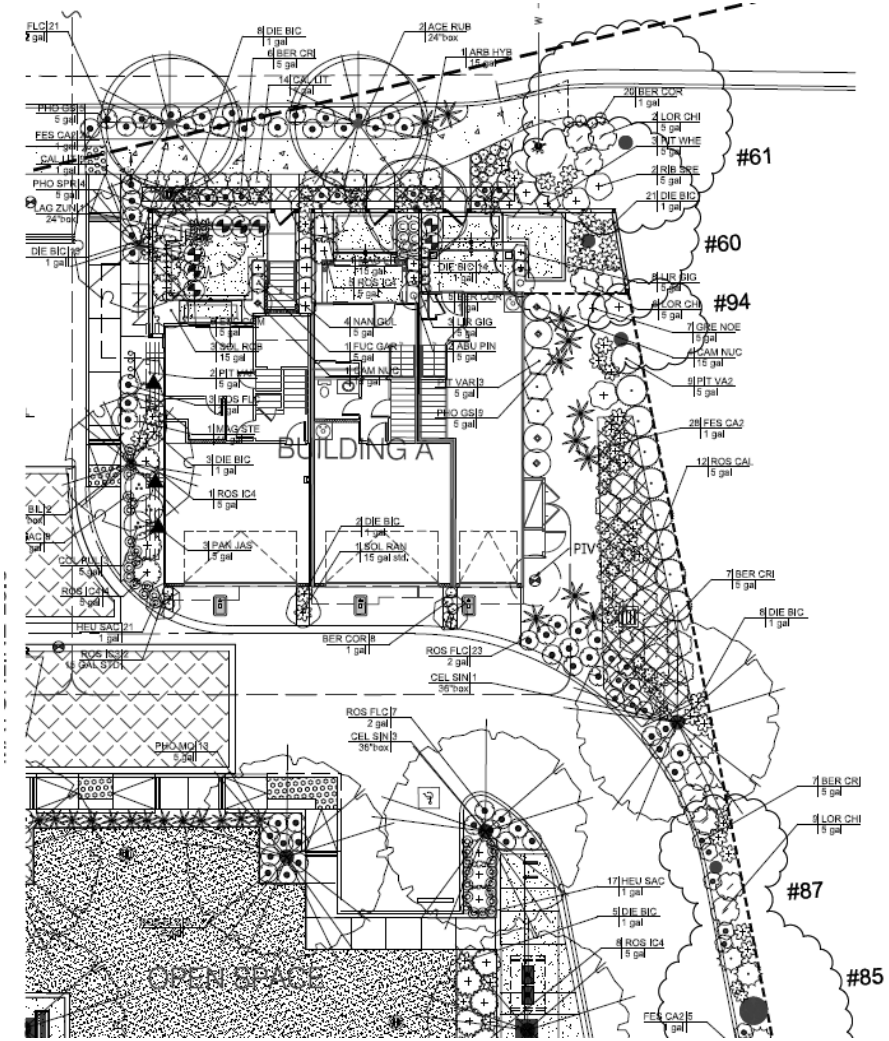
Repair equipment

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

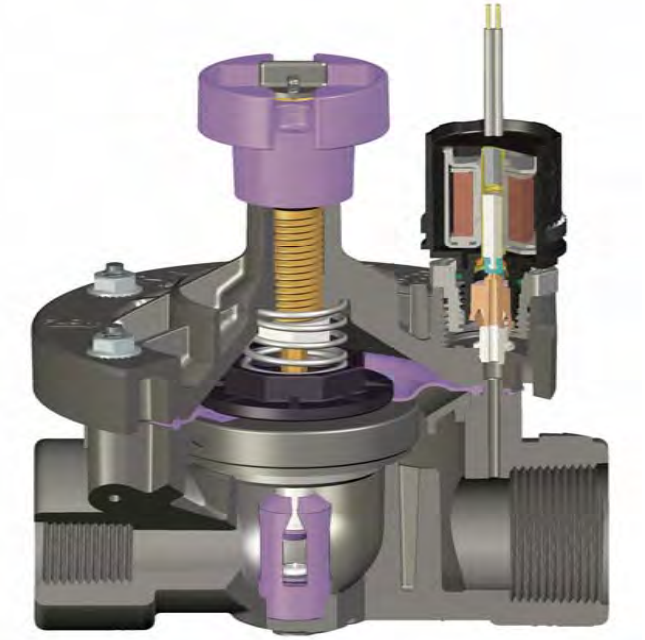
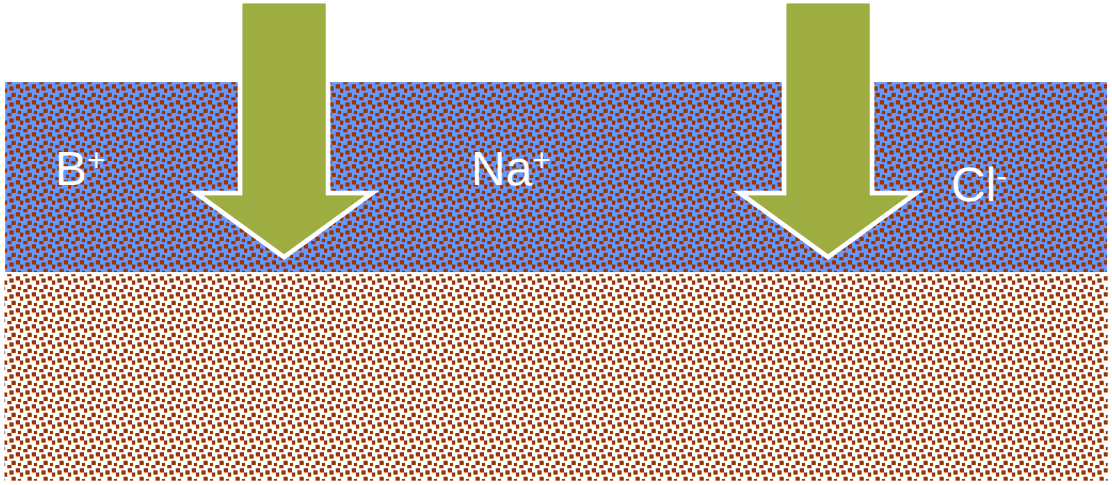


Photo: Rainbird

Managing salt in landscapes

Leach to minimize salt accumulation

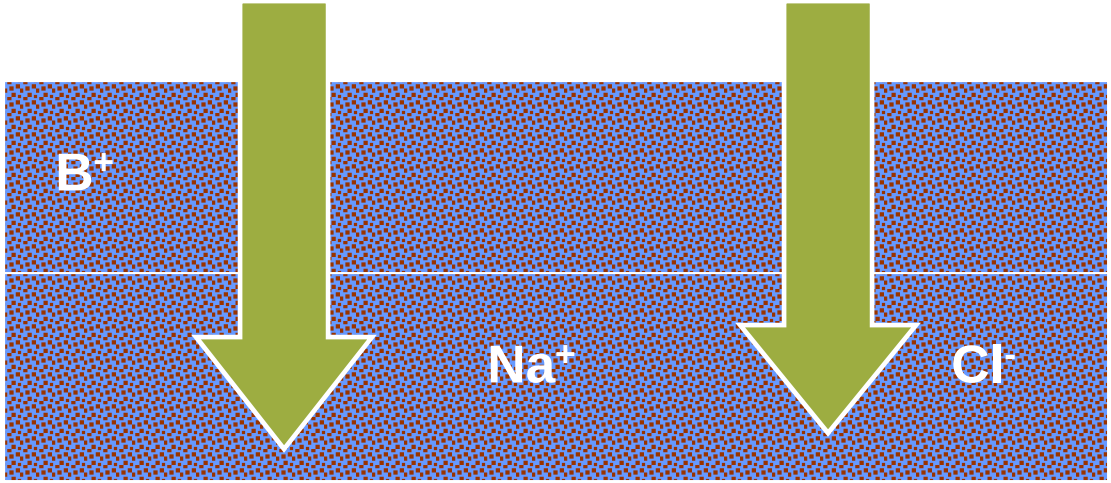
Wetting zone



Salt accumulation

Managing salt in landscapes

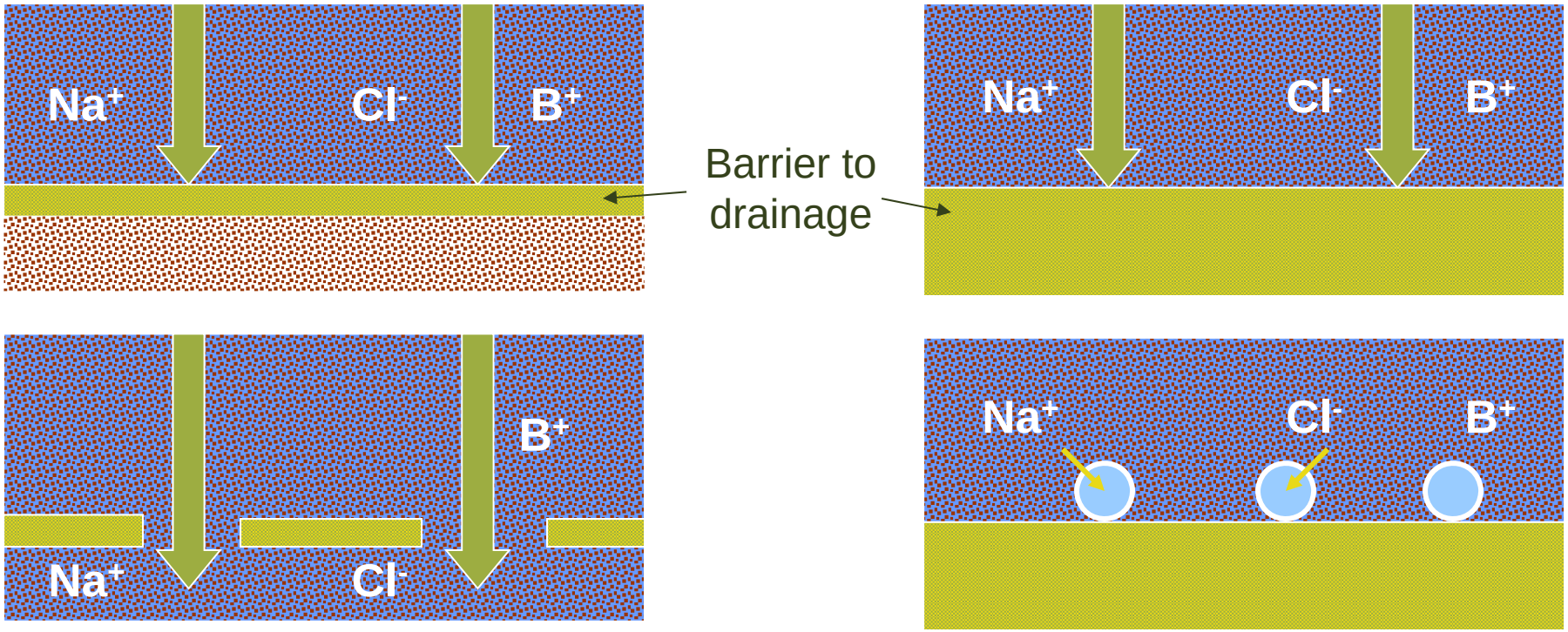
Leach to minimize salt accumulation



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