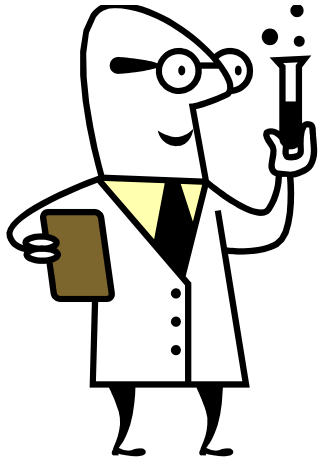
Irrigating Landscapes with Recycled Water

Nelda Matheny

HortScience | Bartlett Consulting

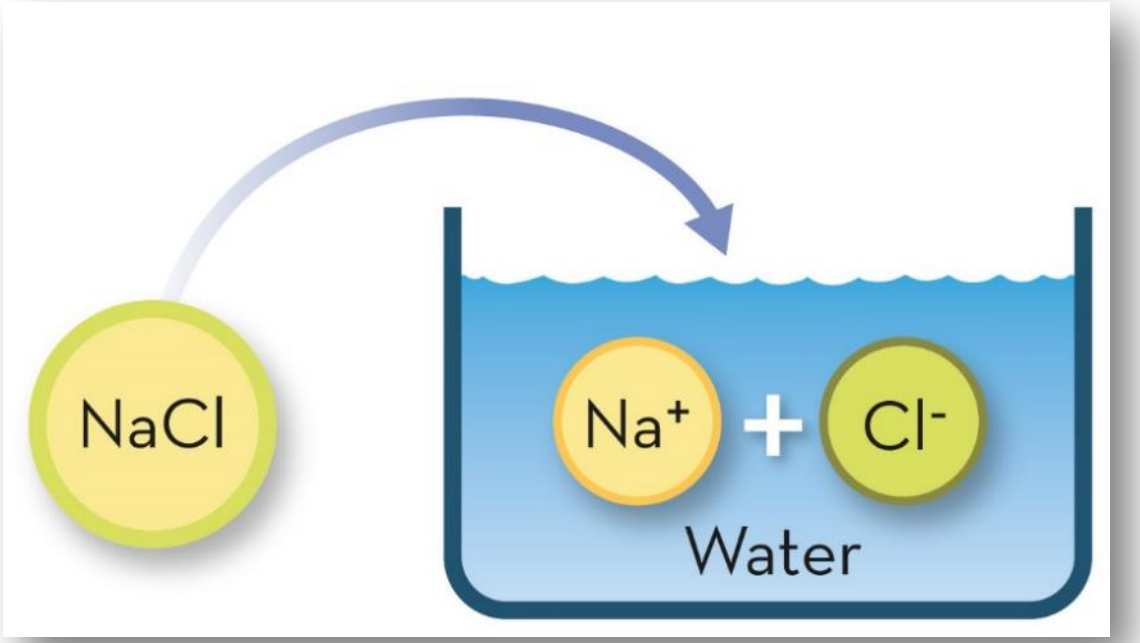
May 2019



A (very) brief science lesson

What are salts?

- Ionic compounds that result from the neutralization reaction of an acid and a base.



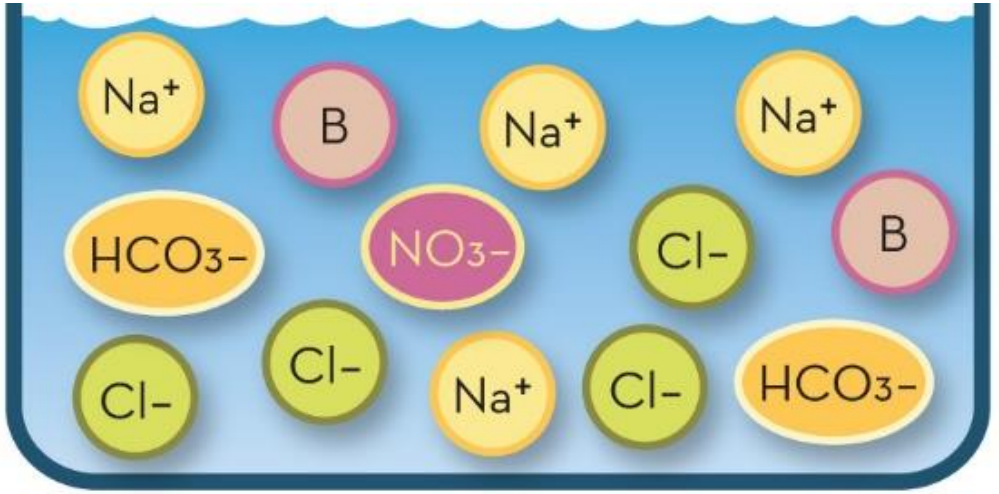
Disassociate in water

How total salts are measured

- Electrical conductivity

  Ec_e , Ec_w

  - dS/m, µS/m
  - mmhos/cm, µmhos/cm



- Total Dissolved Solids

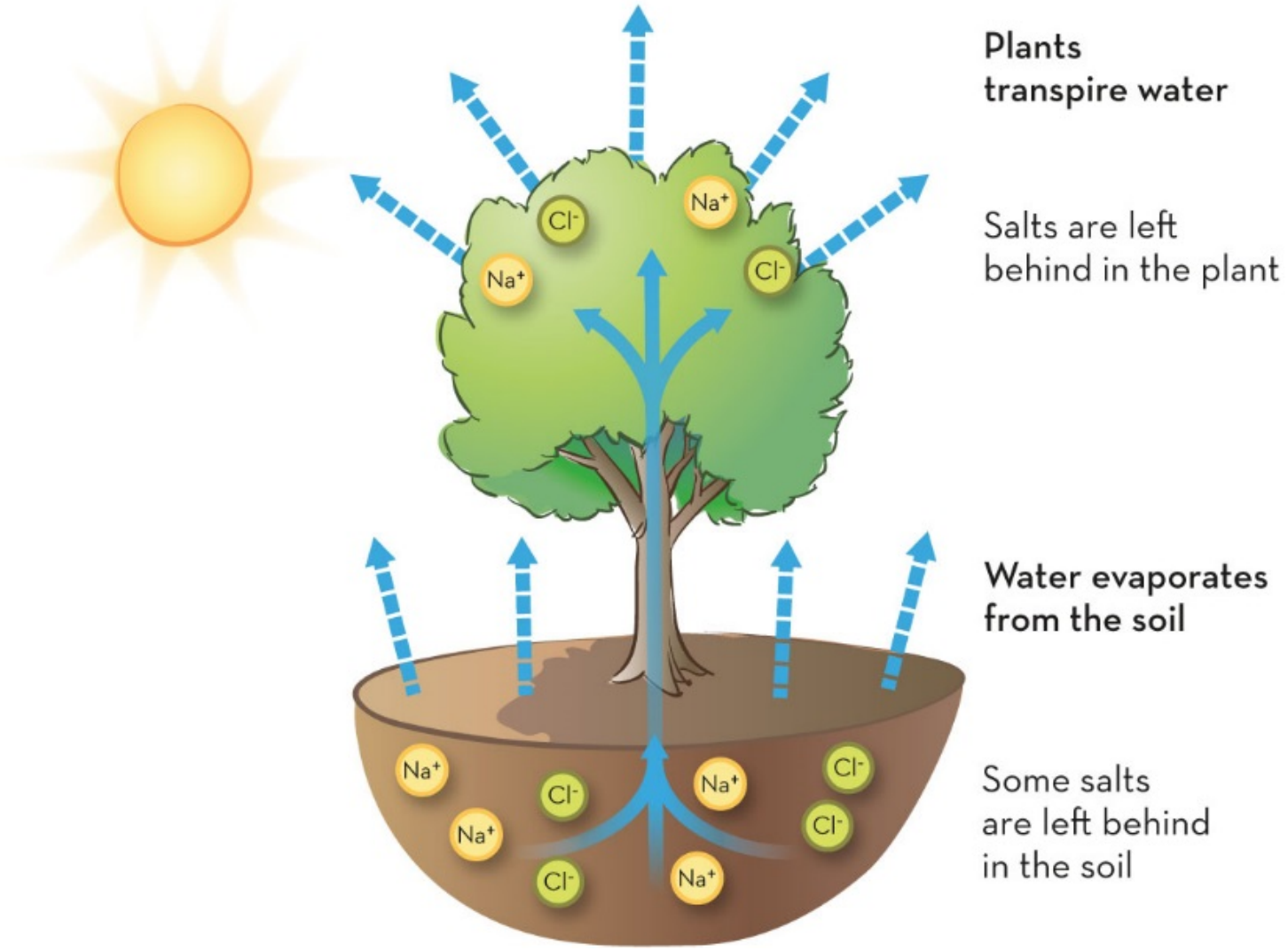
  TDS

  mg/l, ppm

Plants require salts…but not too much!

- Nutrients required for plant growth and function
- Too much salt may damage sensitive plants and degrade soils

Salts can accumulate in plants and soil



Specific ions are very important!

Chloride

Cl^-

Sodium

Na^+

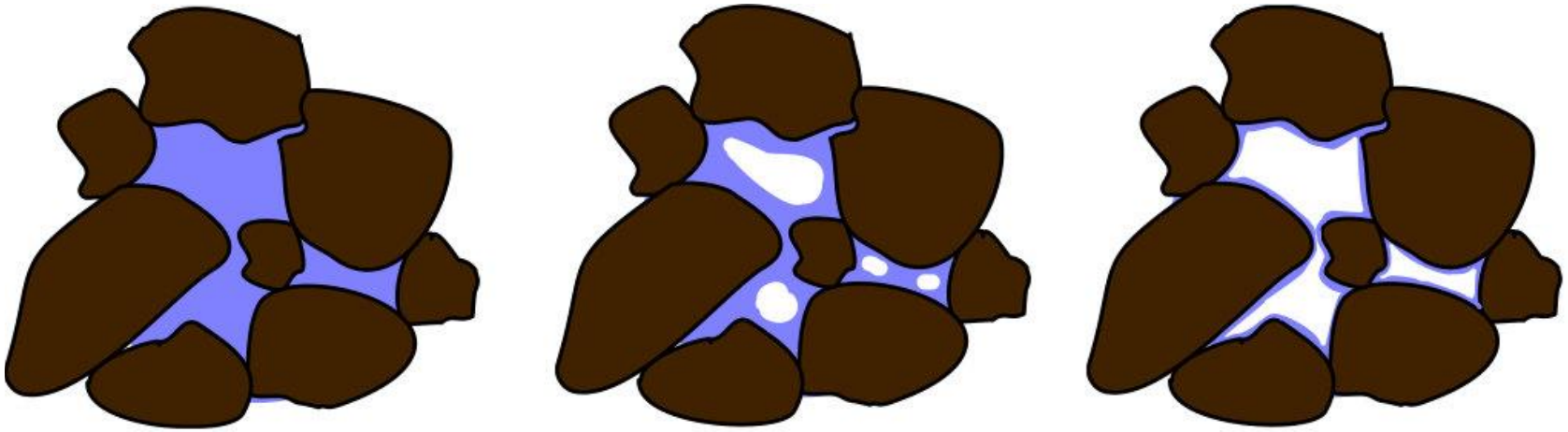
Boron

B^+

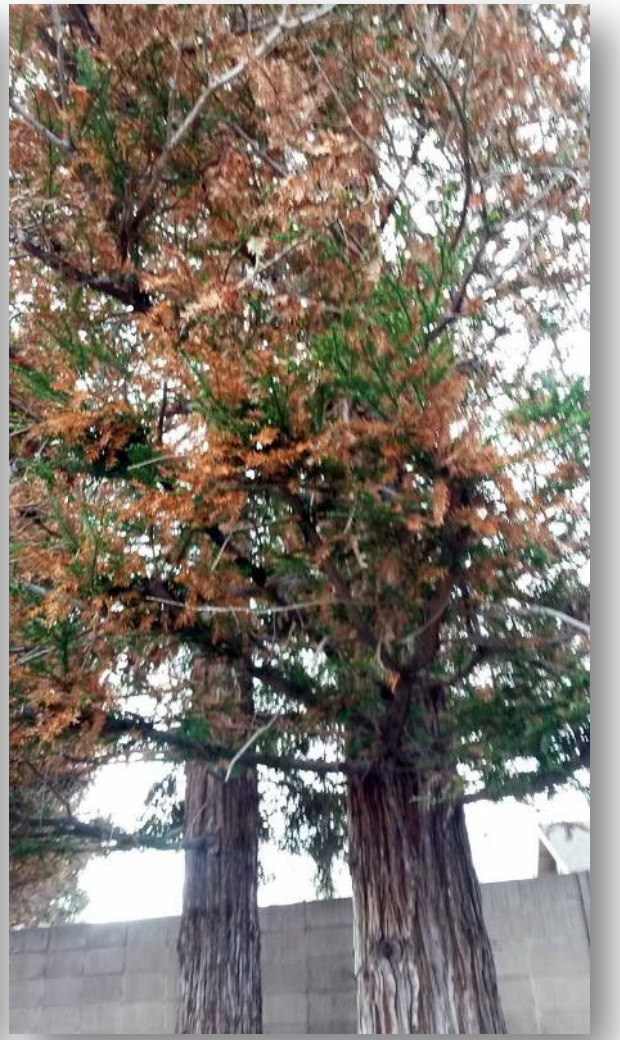
Salt concentration varies with soil moisture

Water in the soil solution

As soil dries, the salts become more concentrated.



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

Recycled 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
TDS mg/l	<640	640-830	830-1,600	>1,600
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

EBMUD Water Quality

Parameter	EBMUD Drinking Water	EBRWP Recycled Water[a]	SRVRWP[b]
EC_w dS/m	0.16	1.93	1.33
TDS mg/l	91	860	691
Boron mg/l	<0.1	0.2	0.6
Chloride mg/l	8	355	170
Sodium mg/l	4-30	234	145

[a]Average Nov., Dec. 2017, Oakland & Emeryville

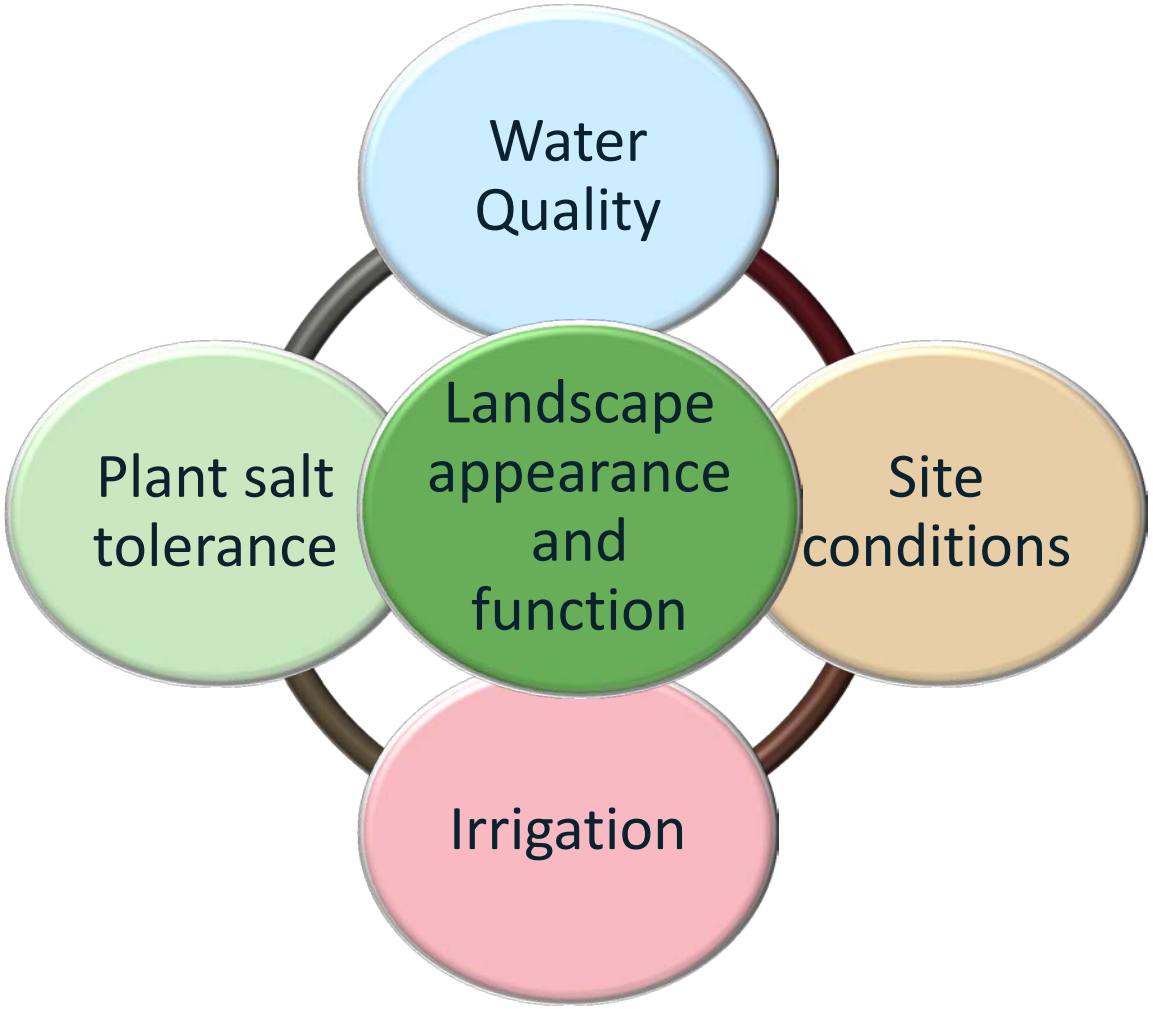
[b]San Ramon Valley Recycled Water Program, joint project of DSRSD and EBMUD (San Ramon, Danville, Blackhawk); average 2017

EBMUD Water Quality

Parameter	EBMUD Drinking Water	EBRWP Recycled Water[a]	SRVRWP[b]
EC_w dS/m	0.16	1.93	1.33
TDS mg/l	91	860	691
Boron mg/l	<0.1	0.2	0.6
Chloride mg/l	8	355	170
Sodium mg/l	4-30	234	145

Good Fair Moderate Poor

Managing landscapes irrigated with RW



Plant Salt Tolerance

- Low
- Moderate
- High

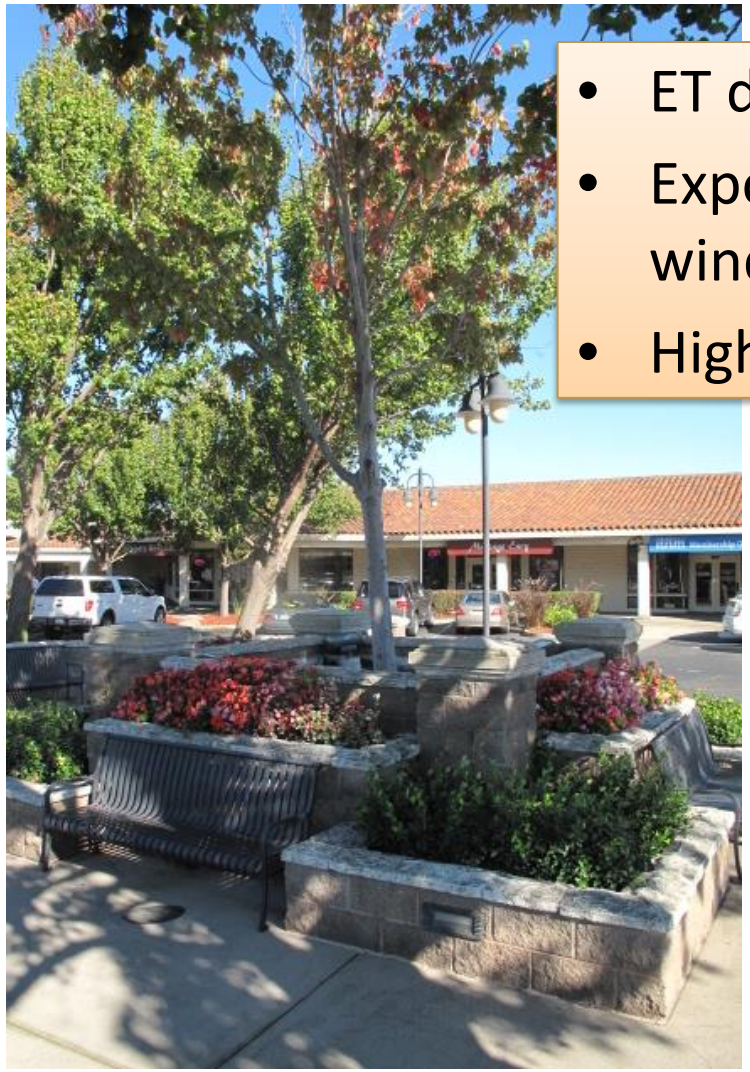
Site Conditions

- **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.

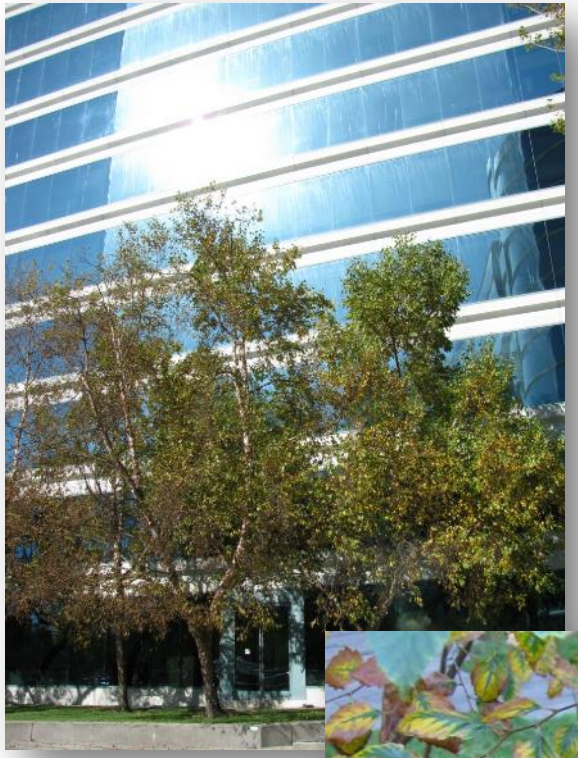
Site Conditions



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

Water + heat + salt stress

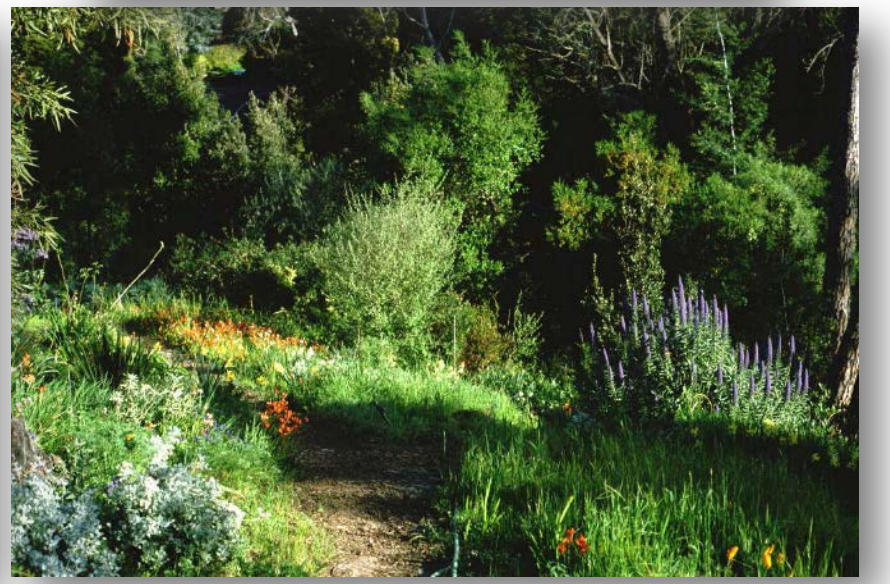
- **Degree of symptoms worse when plant heat and water stressed.**



River birch

Irrigation

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



Designing landscapes for RW

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

Select salt tolerant plants

- Trees
  - Canary Island pine
  - Ornamental pear
  - Coast live oak
  - Brisbane box
- Shrubs
  - Coleonema
  - Ceanothus
  - Rockrose
  - Euonymus
- Ground covers
  - Rosemary
  - Indian hawthorn
  - Lantana
  - Manzanita
- Turf
  - Tall fescue
  - Perennial ryegrass
  - Coarse-leaf zoysia
  - Bermuda

Irrigation Equipment

Meet health and safety regulations - *Title 22, California Code of Regulations (CCR)*

- control cross-connections
- use purple pipe and include signage
- protect public areas from overspray, runoff, and ponding

Irrigation Equipment

Select appropriate equipment

- self-flushing valves resistant to chlorine
- low-trajectory spray nozzles
- large orifice, turbulent flow drip emitters with micro disc filtration

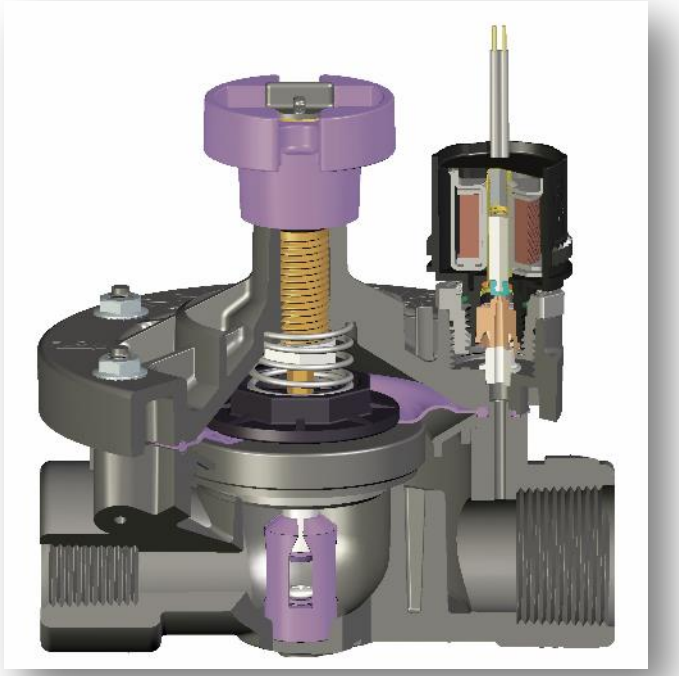


Photo: Rainbird

In-line dripper filter

Photo: Netafim

Introducing RW into existing landscape

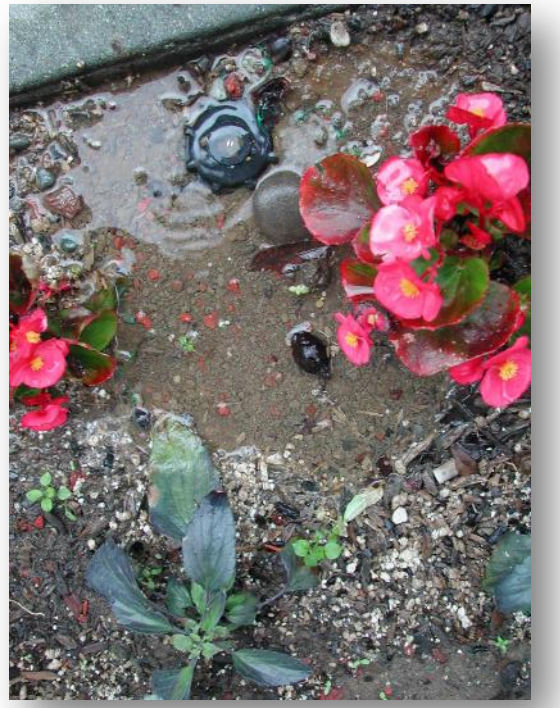
- What is the water quality?
- Conduct site/plant assessment
- Fix existing problems
- Establish soil salinity threshold
- Adjust maintenance practices

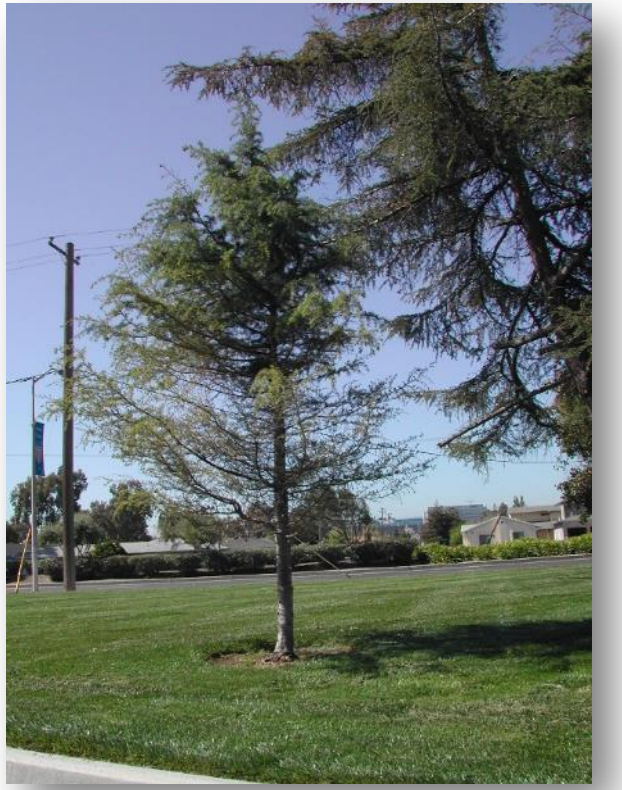
Fix pre-existing problems

Ensure drainage

Repair equipment

Irrigation audit





Convert spray to avoid wetting foliage

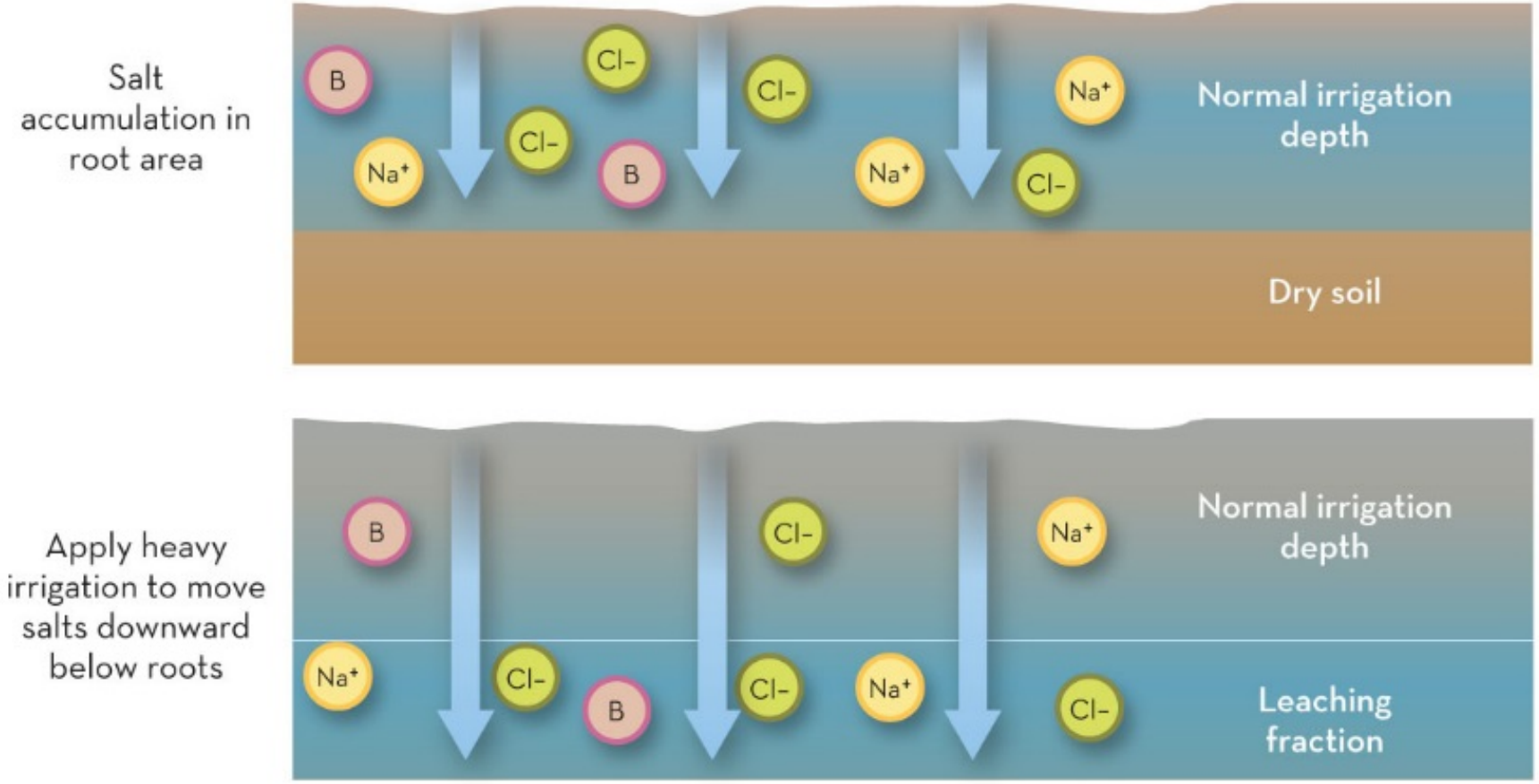
Determine threshold soil salinity

Landscape Salt Tolerance	Estimated Threshold (EC_e)
Low	2 mmhos/cm
Moderate	4 mmhos/cm
High	6 mmhos/cm

Test soil in spring and fall to assess salinity

Managing salt in landscapes

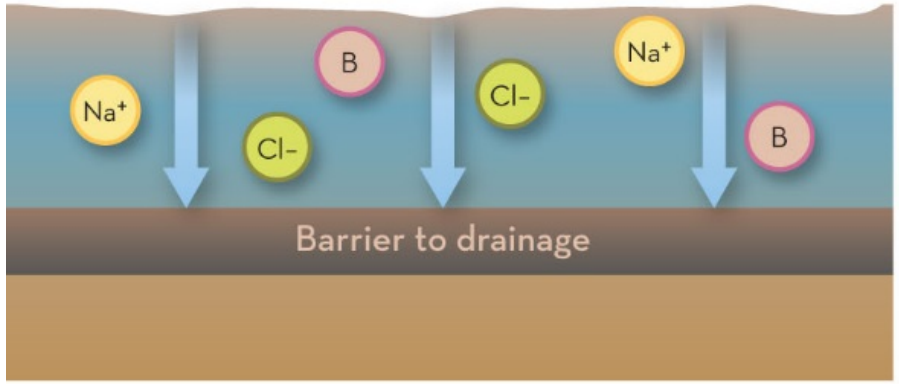
Leach to minimize salt accumulation

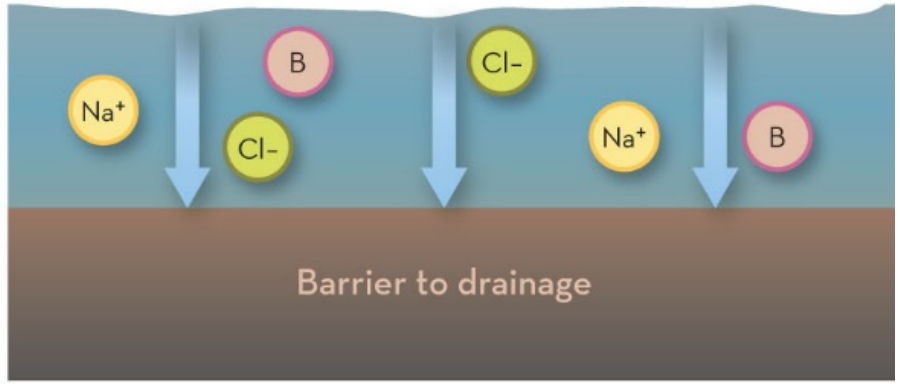


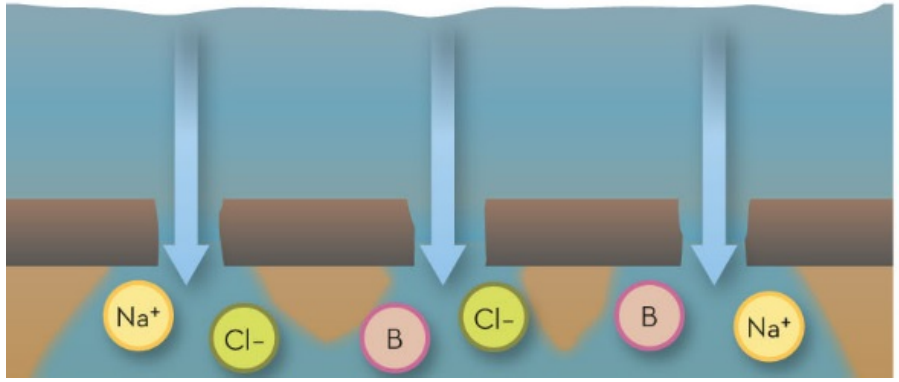
Gypsum may help if SAR>6 or increases more than 2 units

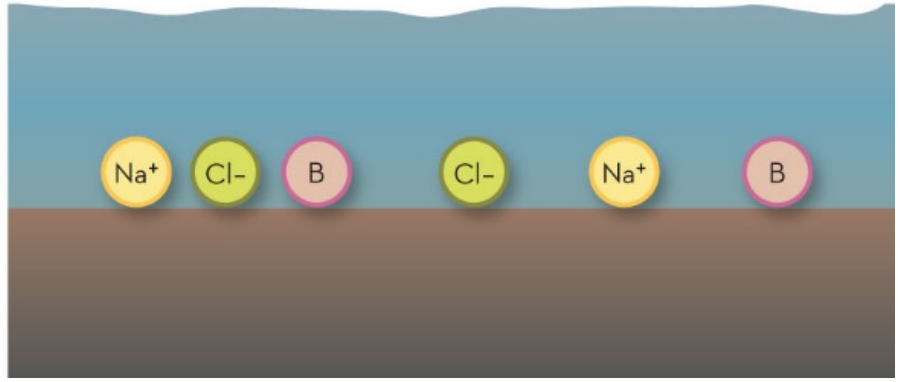
Managing salt in landscapes

No drainage, no leaching









Managing landscapes with RW

Maintain soil moisture

Poor tree

few roots

dry soil

Good tree

many roots

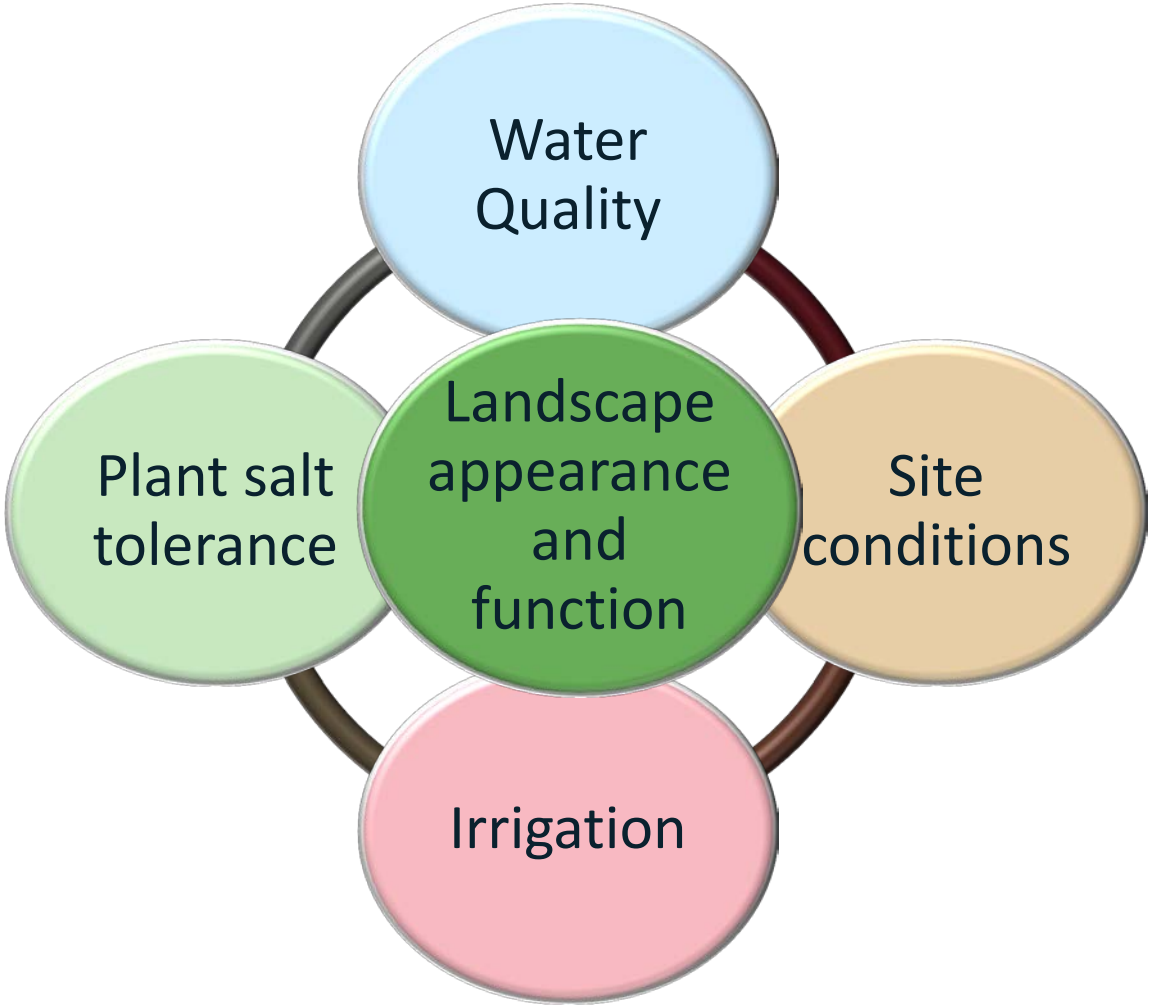
moist soil

Managing landscapes with RW

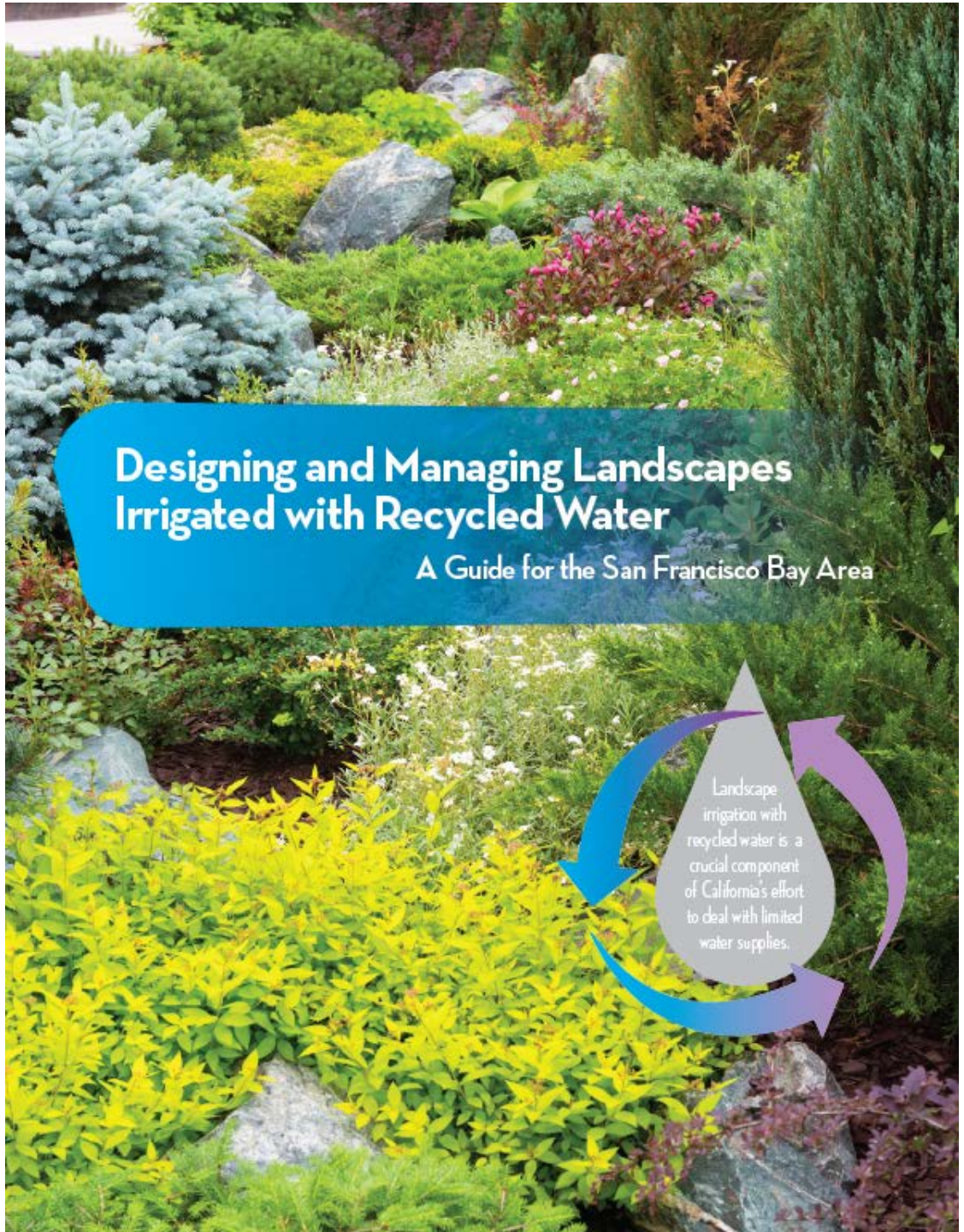
- Decrease/adjust fertilizer
  - slow release
  - low salt index
  - acid-forming
  - foliar application for micronutrient deficiency
- Enhance soil biological activity
  - Conserve and replenish soil organics
  - Mulch soil surface

Turf tends to do well with RW

Recycled water in landscapes



- Design for success
- Retrofit landscapes
- Monitor plants and soils
- Adaptive management strategy



- Introduction
- Water, soil and plant primer
- Evaluating site conditions for use of recycled water
- Modifying existing landscape for irrigation with recycled water
- Designing new landscape that will be irrigated with recycled water
- Designing and modifying irrigation systems to deliver recycled water
- Water management