Building Blocks for Resource-Wise Landscapes:

- Efficient Watering
  - Effective hydro-zones
  - Efficient equipment / layout
  - Appropriate schedules
  - Documentation

- Proper Plants
  - Mostly drought-tolerant / low-maintenance
  - Group “thirsty” and “needy” plants in few zones
  - Appropriate size / spacing

- Good Soil
  - Well-drained, compost-amended
  - Loose sub-grade
  - Adequate depth / planter size
  - Mulch

Stumbling Blocks:

- Lack of information on good practices
- Poor communications and oversight
- Low bids = cut corners
- Landscapes don’t get no respect

Management Makes the Difference Between...

- Efficient Watering
  - Install according to plans
  - Document system “as-built”
  - Schedule based on plants, conditions and equipment
  - Know when to stop (established plants)

- Plants
  - Install the right species / variety
  - Water / fertilize / prune appropriately
  - Replace stragglers and failures

- Soil
  - Protect existing topsoil
  - Proper soil and amendment
  - Adequate depth / planter size
  - Maintain mulch on beds

Steps to Sustainability

- “Best Practices” in specifications, plans and bid documents = level playing field
- Clear communications and documentation
- Oversight / Enforcement
- Educate professionals and customers
- Ways to shift benefits to the development phase
**Building Blocks:**

- Good Soil
  - Well-drained, compost-amended
  - Loose sub-grade
  - Adequate depth / planter size
  - Mulch

**Healthy, Deep Soil Makes Up For A Lot of Other Mistakes and Short-Cuts**

- **Healthy Soil**
  - Absorbs and stores water; reduces irrigation need and plant stress.
  - Supplies and stores nutrients and minerals.
  - Feeds soil life that help plants resist pests & diseases.

- **Healthy Plants**
  - Need little fertilizer or pesticides.
  - Make low-input management practical.
  - Protect soil from erosion and compaction.

- **Sustainable Management**
  - Requires less inputs.
  - Protects soil and soil life.

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**There Ought To Be a Law**

- Protect undisturbed native soil and vegetation where possible.
- Provide 8” depth topsoil with 10% organic matter content (5% for turf).
- Scarify compacted subsoil 4” deep.
- Mulch planting beds 2” thick.

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**“% Organic Matter” vs. % Compost**

- **% Organic Matter** is measured by weight, not volume:
  - Compost is just 40-60% organic matter by weight.
  - Mineral soil weighs 2-3X more per volume.

- **5% Organic Matter Content** =
  - Topsoil mix: 25-30% compost + 70-75% sand/mineral soil
  - Amend: 1.75” (+/-) compost mixed to 8” depth of soil

- **10% Organic Matter Content** =
  - Topsoil mix: 40-45% compost + 55-60% sand/mineral soil
  - Amend: 3” (+/-) compost mixed to 8” depth of soil

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**Effect of Organic Matter Additions on Water-Infiltration**

- Water infiltration (inches/hour) with varied rates of amendment with moisture.

- 16 dry tons/acre = +/− 1/4’
Effect of Organic Matter Content on Plant-Available Soil Moisture Storage

Organic Matter and Soil Biology

Organic Matter: Decomposing plants and animals—absorb water and pollutants, feed plants and create soil structure.

Soil Life: Improve soil structure, store nutrients, decompose pollutants, nourish healthy plant cover.

Plant Canopy: Protects soil from erosion and compaction, intercepts rainfall to evaporate without reaching soil surface.

BMP Lets You Choose the Most Economical and Practical Method

Soil Depth:
- Import soil or compost to build up.
- Rip compacted layers to go down.

Organic Matter:
- Add compost at default rates: (1.75”/turf, 3”/bed).
- Test soil organic % and density, and calculate reduced rates.

Protection:
- Protect undisturbed areas, no amendment or tillage required.
- Stockpile and reuse Soil.

King County Compost and Topsoil Calculator

Calculates:
- Amendment rate (inches) needed based on inexpensive tests of soil and compost product.
- Cubic yards of compost or topsoil needed for each area.

Allows different treatments for each area on a site.

“Soil Management Plan”

- Seattle, King Co., Snohomish Co. and other permitting agencies have version.
- Provides worksheet to calculate amounts of amendment and topsoil needed.
- Useful record.
Soil Protection: Most Economical Option—By Far

Requires:

- Advanced planning
- Education of owners, Civil Engineers, Architects, Landscape Architects, contractors
- Communication: Early and often
- Physical barriers and signage

Preserving Topsoil Through Grading and Stockpiling

- Saves transport costs—export and import.
- Stockpile topsoil separate from subsoil—reuse in order.
- A good plan—and a skilled operator—make it easy!

Specifications: Keep It Really Simple

- Put essential soil specs on plan NOTES sheet, details in specs.
- Put NOTES in front of plan set, to be sure.
- USE REALLY BIG RED LETTERS (NEXT TIME)

Specifications: Use Standards—Don’t Reinvent the Wheel

- Soil mixes using standard sand specifications that can be met by multiple local source.
- Fertilize based on lab tests—cut waste, nutrient runoff, excessive growth prone to disease and damage and damage to soil life.
- Don’t add unnecessary provisions or test requirements that are costly to test, difficult to meet...

Specifications: Provisions to Ensure Soil Quality

- Specify SCA-Certified Compost

- Submit soil mix sample to retain at job site. Project Manager can stop delivery and require testing if delivered mix doesn’t match submittal.

- Project Manager can inspect delivery tickets for any load to confirm product comes from source approved on submittal. Prevent the old Swith-eroo.

Speaking of Sustainability...Buy Compost Made from Local Recycling Programs
Don’t Hesitate To Speak Up and Dig In

Step 1: Compare conditions to Soil Management Plan / drawings.
Step 2: Inspect delivery tickets to make sure topsoil and compost delivered match.
Step 3: Dig many test holes to check depth of amended soil & scarification.
Step 4: Use shovel to check uncompacted depth in multiple locations.

Mulch Can Cover A Lot of Mistakes...Among Other Benefits

- Protects soil from compaction during construction, planting and establishment.
- Reduces water use over 50% in new / sparse plantings.
- Keeps surface porous: Absorbs water and reduces runoff.
- Feeds plants and soil life as it decomposes.
- Easiest tool to renovate soil on established sites.

Mulching Guidelines

Mulch whole beds, or 3' rings around trees in lawns:
- Trees & shrubs: 2-4” wood chips or “medium-fine” bark. Replenish when decomposed – don’t apply too often.
- Annuals, perennials, berries, roses: Composted bark or woody composted “overs”, or mixes of bark and compost.

Bark and Wood Chip Mulch:
- Don’t tie up nitrogen
- Longer-lasting and better weed barrier than compost or aged sawdust.
- Protect soil from compaction
- Avoid fine bark, and over-applications.

Sheet Mulching:
- Cardboard or paper layers suppress weeds until plant canopy can shade them out.
- Adds extra moisture retention and compaction protection.
- Decomposes 1-3 years.
- Secret to Success: Top with an attractive mulch.

Wood Chip Sheet Mulch Protects Soil During Construction and Planting

Pull Back to Plant. Leave In Place As Mulch

Recycle Organic Material: It’s Not Yard “Waste”

Chipped woody debris as mulch:
- Supplies 100% nutrients needed by most ornamental shrubs and trees.
- Cuts water need by 20-80% (depending on canopy density).
- Builds soil organic content—water and nutrient holding capacity, porosity, pest and disease resistance.

Grasscycling:
- Can supply >40% of WSU recommended nitrogen. (Or 100% of HMS recommended amount).
- Decreases thatch over a few years.
- Builds soil organic content—water and nutrient holding capacity, porosity, pest and disease resistance.
Building Blocks:

**Efficient Watering**
- Effective hydro-zones
- Efficient equipment / layout
- Appropriate schedules
- Documentation

**Proper Plants**
- Mostly drought-tolerant / low-maintenance
- Group “thirsty” and “needy” plants in few zones
- Appropriate size / spacing

Efficient Irrigation Starts with Good Documentation
- Plans and photos of installation
- Creates template for inspections, repair punch lists, staff and customer communications...
- Enables management continuity when staff change

And Ends Without It

Typical Documentation At A Controller

I’m Thrilled To See Documentation Like This

Plans Are More Useful For Most People
- Include (at a minimum):
  - Zone locations and numbers.
  - Locations of valve boxes and point of connection.
  - Pipe and wire trenches
  - An electronic copy—sent to everyone involved.

This Is Not An Irrigation Plan!

Irrigation Design: Step 1
Define Hydro-zones:
- Groupings of plants with similar water needs, which can be efficiently irrigated together.
- Allows changing drought tolerant plants to irregular irrigation once they are established.
Consider Technical Irrigation Audits

- Measure equipment efficiency.
- Fine-tune scheduling.
- Calculate site irrigation needs.
- Estimate conservation potential and costs/benefits.

Efficient Hydro-Zones & Scheduling:

1. Based on Plants / Water Needs

<table>
<thead>
<tr>
<th>Grass</th>
<th>Annuals</th>
<th>Perennials, Shrubs, and Trees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where the Roots Are</td>
<td>Where to Water</td>
<td>Spread 2-5 times branch spread.</td>
</tr>
<tr>
<td>Typically 4-6 inches deep, only under grass cover.</td>
<td>Irrigation must be uniform to avoid brown areas.</td>
<td>Most in top 12 inches of soil, with similar spread.</td>
</tr>
<tr>
<td>Have to moisten &gt;50% of soil adjacent to plant crown.</td>
<td>Summer Water Need</td>
<td>Needs vary widely, typical 1/4 inch to 1/2 inch per week.</td>
</tr>
<tr>
<td>Where to Water</td>
<td>Spread 2-5 times branch spread.</td>
<td>Can recover from deficit.</td>
</tr>
<tr>
<td>2/3 to 1 inch / week, to stay green. Can recover from deficit.</td>
<td>Spread 2-5 times branch spread.</td>
<td>Needs vary widely, typical 1/4 inch to 1/2 inch per week.</td>
</tr>
<tr>
<td>2/3 to 1.5 inches / week.</td>
<td>Spread 2-5 times branch spread.</td>
<td>Can recover from deficit.</td>
</tr>
<tr>
<td>Deficit may stunt or kill plants.</td>
<td>Spread 2-5 times branch spread.</td>
<td>Many need no irrigation a few years after planting</td>
</tr>
</tbody>
</table>

How Would You Meet the Needs of These Two Planting Areas if they Were In the Same irrigation Zone?

You Wouldn’t

- 1/4” Per Week
- 3/4” to 1” Per Week X 150% for Uniform Coverage

Efficient Hydro-Zones & Scheduling:

2. Based on Plant Exposure

Reflected heat on south and west sides of this structure increases water need 50% or more.

Shade on the east and north sides reduce need by half.

Dense plantings can increase water need 50% or more

Sparse plantings may require 50% less water

When a large plant canopy must get water from a small or shallow root zone, irrigation has to be increased proportionately.

Which Suggests Another Way To Save Water
Efficient Hydro-Zones & Scheduling:
3. Soil Type and Depth Change the Equation

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Total Water Storage (inches/foot)</th>
<th>Plant-Available Water Storage (inches/foot)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sand</td>
<td>1.2</td>
<td>0.9</td>
</tr>
<tr>
<td>Sandy loam</td>
<td>1.9</td>
<td>1.6</td>
</tr>
<tr>
<td>Loam</td>
<td>3.2</td>
<td>2.0</td>
</tr>
<tr>
<td>Clay loam</td>
<td>3.8</td>
<td>2.0</td>
</tr>
<tr>
<td>Clay</td>
<td>3.9</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Diggling in is the only way to determine soil depth. A core-sampler makes checking soil depth and moisture easier.

Less moisture storage requires smaller and more frequent watering.

Efficient Hydro-Zones & Scheduling:
4. Based on Irrigation Type

- Non-uniform sprinklers require over-watering some areas just to keep others alive.

<table>
<thead>
<tr>
<th>Irrigation Type</th>
<th>Areas &gt;15' wide</th>
<th>Areas &lt;30' wide</th>
<th>Areas &lt;18' wide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotors</td>
<td>Mostly turf</td>
<td>Mostly beds</td>
<td>Mostly turf</td>
</tr>
<tr>
<td>Drip</td>
<td>Mostly turf</td>
<td>Mostly beds</td>
<td>Mostly turf</td>
</tr>
</tbody>
</table>

Rotary Nozzles

<table>
<thead>
<tr>
<th>Areas &lt;30' wide</th>
<th>Mostly turf</th>
<th>Mostly beds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprays</td>
<td>Turf / beds</td>
<td>Mostly turf</td>
</tr>
</tbody>
</table>

Sprinkler Uniformity: 100% (+/-) Spray Overlap

Needed for Efficient Coverage

Impact of irrigation uniformity on water use / costs

<table>
<thead>
<tr>
<th>Water Need (inches/ year)</th>
<th>Irrigation Uniformity</th>
<th>Irrigation Need (inches/ year)</th>
<th>Water Need (hundred cubic feet / 1,000 sq. ft.)</th>
<th>Cost (at $5 / hundred cubic ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.5</td>
<td>100% (土/土)</td>
<td>14.5</td>
<td>36.3</td>
<td>$151</td>
</tr>
<tr>
<td>14.5</td>
<td>100% (土/土)</td>
<td>14.5</td>
<td>20.7</td>
<td>$87</td>
</tr>
</tbody>
</table>

Impact of irrigation uniformity on water use / costs

How Do We Get There?

- Do A Basic Assessment of Problems and Opportunities
  - Run the irrigation system, and record:
    - Zone locations, plant types, exposures, equipment.
    - Identify basic irrigation system problems and maintenance needs.
    - Zones with poor coverage, mixed planting types or exposures.
    - Gather information needed to develop efficient schedules: Soil type and depth, sprinkler rates, uniformity.

- Confirm Controller Basics—Start Building Your Documentation
  - Zone list and program posted? Don’t trust it.
  - Review and record the programs actually set for each zone.
  - Rain / weather sensors connected and turned on?
  - Each zone only set to run on one program? Multiple programs probably unintentional.
Consider Technical Irrigation Audits
- Measure equipment efficiency.
- Fine-tune scheduling.
- Calculate site irrigation needs.
- Estimate conservation potential and costs/benefits.

Planting Beds: Look for...
- Dead/dying plants—often irrigation related. This plant is drowning.
- Unneeded sprinklers on unplanted areas. Turn off zones or nozzles, or cap heads.
- Narrow zones (parking strips, etc.) best without irrigation or use drip.

Do New Irrigation Technologies Really Save Water?
- High-Efficiency Spray Nozzles: (Should Be) The New "Standard" for Residential and Small Commercial Applications
  - Can be retrofitted on sprays to meet plant needs better with 20–30% less water.
  - Uniformity similar to rotors, at lower cost per head.
  - Use less water, so can fix undersized or under-pressured zones.
  - Less misting and overspray.

When It Comes to Uniformity—Drip Irrigation Rules!
- Applies water directly to soil. No evaporative waste "in flight" or from soil.
- Highly uniform (99%) = no overwatering some spots to barely moisten dry spots.
- No foliage blockage = un-watered plants.
- No spray on pavement, buildings....
- Prevents foliage disease spread by splashing soil.
- Reduces summer weeds.
- Grow healthier plants with 50% less water / $$$.

Strategies for Successful Drip Irrigation
- Use only high-quality, standard drip parts.
- Apply water directly to soil. No evaporative waste "in flight" or from soil.
- Highly uniform (99%) = no overwatering some spots to barely moisten dry spots.
- No foliage blockage = un-watered plants.
- No spray on pavement, buildings....
- Prevents foliage disease spread by splashing soil.
- Reduces summer weeds.
- Grow healthier plants with 50% less water / $$$.
Keep It Simple and Straight(ish)  
KISS

- ½” tube to most plants, ¼” line costs more in long run.
- In-line emitters (Netafim, Rainbird Dripline) for most plantings.
- Low profile emitters (no outlet barb to 1/4” line) where needed.
- Bury lines under mulch—not deep in soil.
- Use lots of staples to keep lines in place.

How About Smart Controllers?

Automatically adjust run times based on weather data from on-site sensors or local weather station.

Seasonal adjustment of irrigation schedules has the potential to reduce irrigation 25% or more.

Smart Controller Retrofits

Many controllers can be retrofitted with sensors to create weather-based scheduling:
- Hunter Solar Sync Sensor Module
- Rainbird ESP Modular Upgrade Kit
- Irritrol Climate Logic System
- Hermit Crab retrofits for most major brands

Smart Operators?

- Proper programming is essential to success.
- Some (Hunter, Irritrol) adjust user-set peak summer program by %, based on weather data from on-site sensors or local weather station. Some savings guaranteed (almost).
- Some (Rainbird, Weathermatic) calculate program based on inputs of plant/soil/sprinkler type and exposure for each zone. Lots of work. Many assumptions that could be wrong. Sometimes use goes up!

Smart Managers Can Get Similar Conservation With “Dumb” Controllers

Standard Controllers
- Multiple Programs & Start Times
- Non-Volatile Memory
- Sensor Overrides: Rain, Soil Moisture
- Seasonal Adjust. Some allow monthly preset for entire year.

Smart Controllers
- Multiple Programs & Start Times
- Non-Volatile Memory
- Sensor Overrides: Rain, Soil Moisture, Flow
- Automatic ET Adjust

Conservation Success

Standard Controllers
- Set programs based on plants, exposures, soil type/depth.
- Use Multiple Programs & Start Times
- Use Sensor Overrides
- Use Seasonal Adjust or Automatic ET Adjust
- Document zones, schedules, problems
- Observe & Maintain

Smart Controllers
- Set programs based on plants, exposures, soil type/depth.
- Use Multiple Programs & Start Times
- Use Sensor Overrides
- Use Seasonal Adjust or Automatic ET Adjust
- Document zones, schedules, problems
- Observe & Maintain
Flow Sensors

- Measure flow data and send to controller.
- Compatible controllers learn each zone’s flows, and detect irregular flows caused by leaks or stuck valves.
- Controllers shut down problem zones—or entire system if main line breaks. So if system is not networked, controller must be checked onsite frequently for warning lights.
- Great potential. But can be expensive to install. A good wireless system if the Holy Grail...

Central / Networked Controllers

- Allow remote monitoring and program adjustment. Huge savings potential just from identifying leaks and out of season irrigation.
- Essential for effective use of flow sensors that isolate and shut off breaks—and send alarms.
- New technologies / lower prices every year.
- Still require dedicated, trained professional managers.

Rain Shutoff Devices: Why Not Us?

- Shut off irrigation after rain to save water—and avoid bad PR.
- Can save >20% of annual use on systems that are not regularly maintained and adjusted.
- Misunderstood and underutilized technology—great potential for a fraction of the cost of the high-tech solutions.

Soil Moisture Sensors / Controllers

- New products improving soil moisture-sensing accuracy.
- Several available as add-on modules. Some only work with proprietary controllers.
- Most sites need controller equipped to use multiple sensors and assign each zone to a sensor in appropriate conditions (exposures, soils and irrigation uniformity). Need professional attention.

Today’s Case Studies Will Show: Thoughtful, Committed Managers Make A Difference

- Start with compost-amended soil.
- Plus loosened sub-grade.
- Adequate depth / planter size.

Proper Plants

- Mostly drought-tolerant / low maintenance plants. Minimize irrigated turf.
- Concentrate “thirsty” and “needy” plants in a few highly visible irrigation zones.

Our Challenges

- Lack of information on good practices
- Poor communications and oversight
- Low bids = cut corners
- Landscapes don’t get no re$pect