INTRODUCTION TO IRRIGATION DESIGN
& WATER-EFFICIENT LANDSCAPE DESIGN

In VECTORWORKS LANDMARK

VECTORWORKS® LANDMARK

WHAT'S **INSIDE**

INTRODUCTION AND **OVERVIEW**

Irrigation is not at all a new or modern practice. In fact, we understand from anthropological studies that ancient farmers found ways to make canals, channels, and other mechanical methods of diverting river water to irrigate crops in areas where water did not always fall or seep from natural sources like rain or underground springs. Even the convention of harvesting water in cisterns or other vessels was common practice to help sustain people and their crops when access to water was not a guarantee. It was no surprise to see that civilizations were founded, and grew, in areas where access to water seemed easiest. Eventually, that access to water became an additional resource for transportation and not just for sustenance. This is when water usage became more managed as everyone wanted to use it for different purposes. Fast forwarding to current practices, the access to water for irrigation, be it for agricultural or landscape maintenance, has become even more managed, and rightfully so. Access to potable water, safe for human consumption, is tightly regulated in many places due to higher populations, limited supply, and other environmental challenges. The process to clean this water for drinking has strained the access to use of this water for non-drinking purposes, such as irrigation, manufacturing, and energy.

Sustainability movements, such as Low Impact Development, governmental laws and ordinances, Sustainable Sites Initiative™, LEED, and more, have reminded the world populations, by way of regulations and project-based objectives, how every site can participate positively in better water management. From collecting natural water resources on-site for reuse to the reduction of how much water would be needed to sustain those sites, the expectation of designing and installing for water-efficient sites is becoming more mainstream worldwide, and the irrigation tools within **Vectorworks Landmark** are purpose-built to support the site designer in this effort.

UNDERSTANDING IRRIGATION DESIGN & WATER-EFFICIENT LANDSCAPE DESIGN

TERMINOLOGY

Backflow Device
A safety device used to prevent pollution or contamination of the water supply due to the reverse flow of water from the irrigation system.

Baseline
The amount of water required by the site during the peak watering month if watered at 100 percent of reference evapotranspiration (ETO). The following formula is used to calculate the baseline: **Baseline = ETO X A X CU**

Controller (Control Panel)
An automatic timing device used to remotely control valves that operate an irrigation system. Automatic irrigation controllers schedule irrigation events using either evapotranspiration (weather-based) or soil moisture data.

Design Zone (Irrigation Zone)
A portion of an irrigation system served by a control (zone) valve. Zones usually contain similar sprinkler types and plant material types.

Drip Emitter
A drip irrigation emission device within a drip irrigation zone that delivers water slowly from the system to the soil.

Drip Outlet (Drip Irrigation Zone)
Any non-spray, low-volume irrigation system utilizing emission devices with a flow rate measured in gallons per hour. Low volume irrigation systems are specifically designed to apply small volumes of water slowly at or near the root zone of plants.

Drip Tubing
(aka "micro") Flexible piping (low pressure and low volume); water is applied to soil as drops and/or small streams through emitters.

Estimated Total Water Usage (ETWU) –
Similar to EPA LWR, it is the total water used for the landscape, calculated using this equation:
ETWU=(ETO) (0.62) [((PF x LA)/IE) + SLA]
(Source: California MWELO)

Evapotranspiration Rate (ETO)
The quantity of water evaporated from adjacent soil and other surfaces and transpired by plants during a specified time.

Flow Rate
The rate at which water flows through pipes, valves, and emission devices, measured in gallons per minute or cubic meter per minute.

GPM
Gallons Per Minute

Hydrozone
A portion of a landscaped area having plants with similar water needs. A hydrozone may be irrigated or non-irrigated.

Irrigation
The application of water to sustain plant growth and/or optimize plant production.

UNDERSTANDING IRRIGATION DESIGN & WATER-EFFICIENT LANDSCAPE DESIGN [CONT'D]

Irrigation Design (Plan)
The plan view of an irrigation system with pipe sizing, head, or drip area layout with valve location.

Irrigation Designer
A person who designs irrigation systems, often certified by an accredited academic institution, a professional trade organization, or other program such as the US EPA's WaterSense irrigation designer certification program or Irrigation Association's Certified Irrigation Designer program.

Irrigation List of Materials
A table which identifies equipment for installation.

Irrigation Schedule
A table that establishes the time and amount of irrigation water to apply.

Jumper (Plan Graphic)
A semi-circular shape which spans the visual intersection of two irrigation lines.

Landscaped Area (LA)
Similar to a hydrozone, a planted area of similar watering needs; includes Special Landscape Area (SLA) if identified.

Landscape Coefficient (KL)
Coefficient for the plant type or other water-using landscape feature used to modify the reference evapotranspiration (ETO).

Landscape Water Allotment (Allowance) (LWA)
Calculated using this equation:
LWA=.70 X Baseline (Source: EPA)

Landscape Water Requirement (LWR(LWRH))
Landscape water requirement for a hydrozone (gallons per month).

Lateral Line
The water delivery pipeline that supplies water to the emitters or sprinklers from the valve.

m3/min
Cubic meters per minute.

Main Line
The pressurized pipeline that delivers water from the water source to the valve or outlet.

Maximum Applied Water Allowance (MAWA)
Similar to EPA LWA, the upper limit of annual applied water for the established landscaped area as specified by water-efficiency guidelines. It is based upon an area's reference evapotranspiration, the ET Adjustment Factor, and the size of the landscape area. The Estimated Total Water Use shall not exceed the Maximum Applied Water Allowance, which is calculated using this equation:
MAWA = (ETO) (0.62) [(0.7 x LA) + (0.3 x SLA)]
(SLA portion of formula may be excluded if not identified in LA) (Source: California MWELO)

UNDERSTANDING IRRIGATION DESIGN & **WATER-EFFICIENT LANDSCAPE DESIGN** [CONT'D]

TERMINOLOGY [CONT'D]

Model Water Efficient Landscape Ordinance (MWELO)
Revised 2015. (Source: California MWELO)

Non-Potable Source
Non-domestic water or water not treated for drinking; it can be used as a source of irrigation water.

Nozzle
An outlet through which water passes from the sprinkler equipment or emitter to the air, plant or soil.

Operating Pressure
The pressure at which the parts of an irrigation system are designed by the manufacturer to operate.

Overspray
The irrigation water which is delivered beyond the target area.

Peak Watering Month
The EPA defines this as the maximum monthly change of ETO (evapotranspiration rate) and rainfall.

Pipe Size
Size (Dimension) of a circular pipe, usually but not always the inside diameter (ID).

Point of Connection
Location where irrigation system is connected to a water supply.

Plant (Water Use) Factor
A factor that, when multiplied by ETO, estimates the amount of water needed by plants. The plant factor range for low-water-use plants is 0 to 0.3, the plant factor range for moderate-water-use plants is 0.4 to 0.6, and the plant factor range for high-water-use plants is 0.7 to 1.0.

Precipitation Rate
The rate of application of water measured in inches per hour.

Rain Sensor
Also known as "rain-sensing shutoff device," this is a component which automatically suspends an irrigation event when it rains.

Rotor Outlet (Sprinkler)
A sprinkler that rotates, or also a gear-driven sprinkler.

Soil Moisture Sensor
Also known as "soil moisture sensing device," this is a type of environmental sensor that measures the amount of water in the soil. The device may also suspend or initiate an irrigation event.

Spray Outlet
A sprinkler head that does not rotate.

Spray (Distribution) Pattern
Water distance measured from a sprinkler head or outlet.

UNDERSTANDING IRRIGATION DESIGN & **WATER-EFFICIENT LANDSCAPE DESIGN** [CONT'D]

Static Water Pressure
The pipeline or municipal water supply pressure when water is not flowing.

Valve (Zone Valve)
A device used to control the flow of water in the irrigation system.

Water Budget
The amount of water a site will require based on the proposed landscape needs; often compares the estimated water requirement to a calculated allowance based on site area.

Water Feature
A design element where open water performs an aesthetic or recreational function, such as ponds, lakes, waterfalls, fountains, artificial streams, spas, and swimming pools (where water is artificially supplied). The surface area of water features is included in the high-water-use hydrozone of the landscape area. Features used for on-site wastewater treatment or stormwater management, that are not irrigated, and used solely for water treatment or stormwater retention are not water features and, therefore, are not subject to the water budget calculation.

Water Meter
(aka Irrigation/Sewer/Deduct Meter) A deduct water meter measures the amount of water not going into the sanitary sewer system.

Water Sense
Water efficiency standards and specifications created and maintained by US EPA as a fulfillment of the US Clean Water Act.

WUCOLS
The Water Use Classification of Landscape Species published by the University of California Cooperative Extension, the Department of Water Resources and the Bureau of Reclamation, 2000. (Source: California MWELO)

Zone Valve (Control Valve)
A mechanical device that controls flow to lateral irrigation lines (zones), from main irrigation lines.

UNDERSTANDING IRRIGATION DESIGN & **WATER-EFFICIENT LANDSCAPE DESIGN** [CONT'D]

OVERVIEW OF IRRIGATION DESIGN IN VECTORWORKS SOFTWARE

The inherent flexibility of **Vectorworks Landmark's Irrigation tool** set allows users to approach a given project using their preferred method of irrigation planning. For example, a designer who opts to only create zones for planned watering, because they expect to hand off the layout of the outlets to an irrigation contractor, may choose to use the Design Zone or Hydrozone tools to delineate the areas of specific watering. However, if a designer prefers to lay out the spray heads, drip zones, and lateral and main lines, with all the accompanying equipment, there are tools that make the whole process more automated.

Interoperability among the irrigation tools results in a more integrated site-watering approach. For instance, design zones can be used to document watering for their specific zones without outlets, but if outlets fall within the boundary of these zones, they can be used to analyze for appropriate watering coverage. Likewise, a hydrozone object may document the watering planned for plants of similar watering needs, but when interacting with massing model buildings and hardscape pavements, it can negate those features' footprints from the overall calculated area of those hydrozones. Another example of interoperability among these tools includes lateral and main line awareness. When a main line intersects the position of a lateral line, an adjustable graphic 2D "jumper" is created to emulate the typical convention of showing service lines crossing, but not joining.

Irrigation material scheduling can also be facilitated with the use of both data-rich outlet objects and data-harvesting worksheets (Custom Reports), while automated size, flow, and pressure data calculations also integrate into all service and outlet features.

UNDERSTANDING IRRIGATION DESIGN & **WATER-EFFICIENT LANDSCAPE DESIGN** [CONT'D]

OVERVIEW OF WATER-EFFICIENT LANDSCAPE DESIGN IN VECTORWORKS SOFTWARE

For design professionals who choose to pursue water-efficient landscape design, built-in tools maximize the use of manufacturer-specific irrigation equipment. With the performance data provided by companies like Hunter, Rain Bird, Netafim, Toro, and Irritrol, the irrigation components are pre-configured to use this data as they interconnect to make zones. These objects also report notifications to the user when the equipment chosen is not appropriate to achieve the desired result.

For many, seeking to plan for water-efficient landscape design is a jurisdictional requirement, while others do so to help their clients achieve the objectives of a rating system such as LEED, SITES, or other conservation and landscape performance guidelines. Whether producing irrigation designs from initial zones to construction documents, the tools are fully capable of independent use or working together to achieve a more comprehensive irrigation design for each site. For example, using the Hydrozone tool for water budgeting, users will appreciate the built-in data fields, which report the required information for creating the hydrozone table and water budget. Without the calculations in the built-in worksheets, the hydrozones would still be perfect for conveying areas of similar watering needs to the irrigation contractor. Though, if the designer wishes to carry the irrigation design process further, they can use the worksheet to tabulate the water budget formulas while moving forward with the Spray, Drip, Pipe, and Valve tools to complete the project.

Plant objects and the plant database within Vectorworks software offer additional efficiency in that once your budget is successfully achieved, you can use the smart plant objects' assigned watering needs factors to verify that you are using the right plants for those hydrozones.

APPROACHING **VARIED** IRRIGATION WORKFLOWS

Planning for a site's proposed irrigation can be approached in several ways depending on the designer and the process of going from design to installation. Some design their zones schematically, while others lay out specific equipment, and yet others specify pre-development irrigation zones and wait for the installation to be complete to document the site's irrigation in as-built drawings. There are likely other variations professionals may use, but these three represent the workflows conducted in most irrigation design processes.

DESIGNING IRRIGATION BY ZONES

For those who prefer to create shapes in their plan that delineate zones of similar watering, Vectorworks Landmark's Irrigation tool set contains two tools that can accomplish this based on the expected outcomes. The Design Zone tool is the best of the two to use when the designer intends to build in the data of irrigation outlet type and then harvest the necessary performance data calculated by the tool.

When using the **Design Zone tool**, select the **Outlet Type pull-down menu** to choose from options such as spray, rotor, emitter, drip line, or a combination of these. (FIGURE 1)

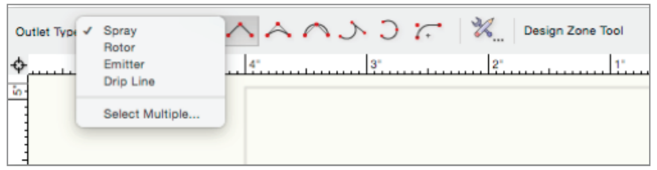


FIGURE 1
Design Zone Tool, Outlet Type drop-down menu

Additionally, designers will want to preconfigure the design zone properties with the zone's number and/or name, the expected point of connection (POC) and any other note that should be provided. (FIGURE 2) It is important to not ignore the available options to **Show Zone ID** and **Show Total/POC Max Flow**. Without these enabled, the flow calculations will not be revealed.

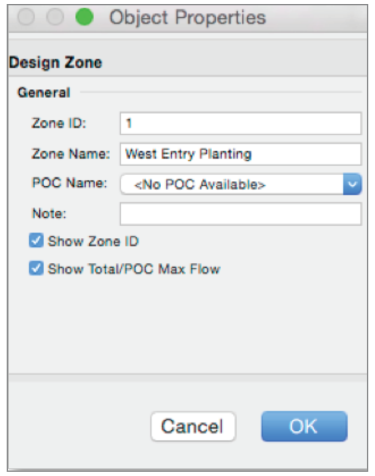


FIGURE 2
Design Zone Tool Properties Palette

The end result of using the irrigation design zones in the schematic irrigation plan layout is a document that can be handed off to an irrigation contractor who can then add the appropriate equipment. This scenario enables designers to defer complete irrigation specifications to the contractor as they take the project to the bidding phase.

However, designers who want to specify the equipment can use these design zones as their "template" for the pre-zoned areas to be irrigated, making the outlet placement even easier.

APPROACHING **VARIED** IRRIGATION WORKFLOWS [CONT'D]

The following figure is a schematic irrigation plan produced by Pacific Coast Land Design before the Irrigation tool set was introduced in **Vectorworks Landmark 2017**. Their use of polygonal objects also assisted them with the area calculations needed for water budgeting purposes.

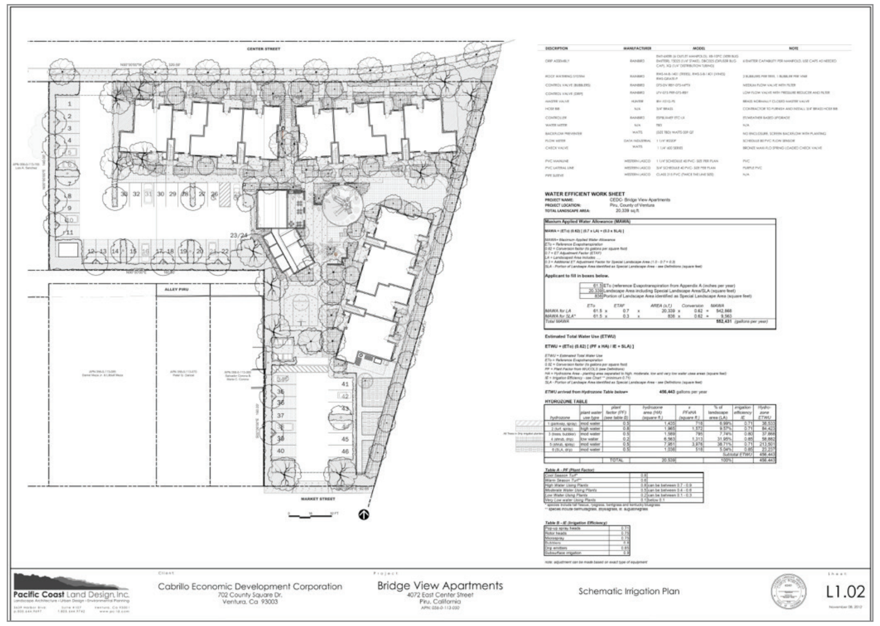


FIGURE 3
Schematic Irrigation Plan by Pacific Coast Land Design

APPROACHING **VARIED IRRIGATION WORKFLOWS** [CONT'D]

PLANNING IRRIGATION WITH HYDROZONES

Over the past decade, planning for a site's irrigation within the last has evolved into considering proposed plants' water requirements even more so than in prior years. Though design and management practices previous to this timeframe encouraged little to no watering, also known as xeriscaping (or zero scaping), current sustainable site practices show that planting with low to moderate water-needing plants is acceptable. This method also encourages the practice of not planning for irrigation, if the plants do not need it, or the planning of temporary irrigation, which would be removed after two to three years, when the plants are considered established. A method of planning for planting beds of specific water-requiring levels is known as hydrozoning, or designing with hydrozones.

Whether a designer chooses to create their hydrozones initially, before planning for the plants, or perhaps they plan for plants and use the hydrozone method to verify that their proposed landscape complies with a water allowance, the process helps the installed landscape become more water efficient and sustainable.

In Vectorworks software, a new tool was created, called the **Hydrozone tool**, to facilitate the hydrozone process. [FIGURE 4] Found within the Irrigation tool set, it is the other of the two "zone" tools, and actually works similarly to the Design Zone tool, but is purpose-built to be used in the water budgeting process.

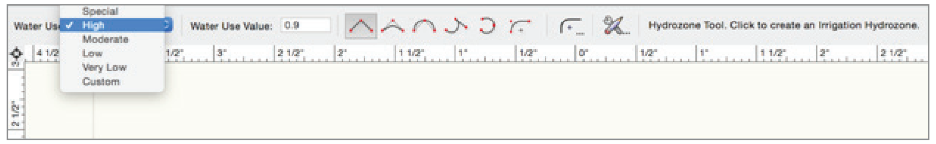


FIGURE 4
Hydrozone Tool

Once the tool is enabled, the designer immediately has a pull-down menu to assign the proposed hydrozone with a water needs factor from a list including Special, High, Moderate, Low. Very Low and Custom.

NON-PLANT HYDROZONES

For designers who include other features that require a supply of water, such as pools, ponds, and fountains, hydrozone objects can be used to document those needs, as well. One method of documenting a non-plant feature's water needs is to include it in the hydrozone being planned, as well as the planted space surrounding it. This method requires the entire hydrozone to be recognized for a higher water use than it may actually consume. In fact, many landscape designers seeking to be as frugal as possible will recommend the other method of creating a separate hydrozone for the space taken up by the non-plant water feature. They will create a different hydrozone for the planting area so that the planting area can be recognized for the lower water use the plants require. The higher-use, non-plant feature is only recognized for its specific water needs, making the entire site's water requirements as efficient as possible.

SUBTRACTING NON-WATER LANDSCAPE FEATURES

Designers may also choose to discount the space taken up by non-plant (non-water-requiring) features. For these situations, the Hydrozone tool has built-in options to subtract areas represented by massing models, hardscape objects, roadways, and parking areas. These subtraction options are found in the **Hydrozone Site Area Settings dialog box**. [FIGURE 5]

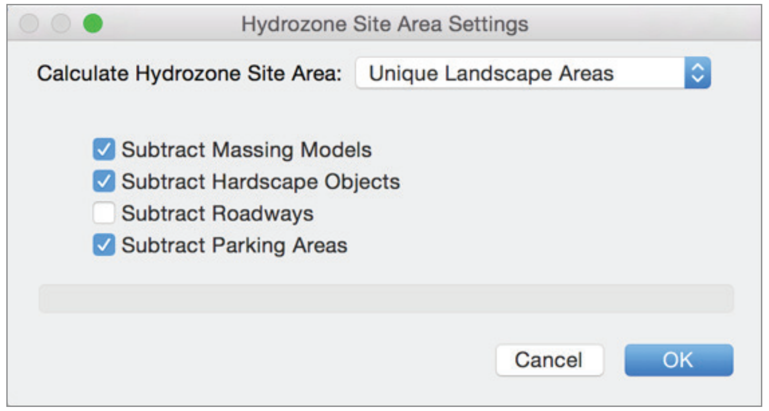


FIGURE 5
Hydrozone Site Area Settings dialog box.

APPROACHING **VARIED IRRIGATION WORKFLOWS** [CONT'D]

WATER BUDGET DATA: HYDROZONE'S ROLE

Since hydrozones are most likely used to perform an analysis of a site's proposed landscape water usage, by means of a water budget, the information needed from these planned hydrozones has been incorporated into the assignable fields within Vectorworks' **Hydrozone Object Properties dialog**.

Water budgets, such as EPA's WaterSense and California's **Model Water Efficiency Landscape Ordinance (MWELO)**, require the following data from proposed hydrozones:

- Name
- Plant Factor/Landscape Coefficient (both text and value)
- Irrigation Method
- Irrigation Efficiency
- Evapotranspiration Adjustment Factor
- Hydrozone Area

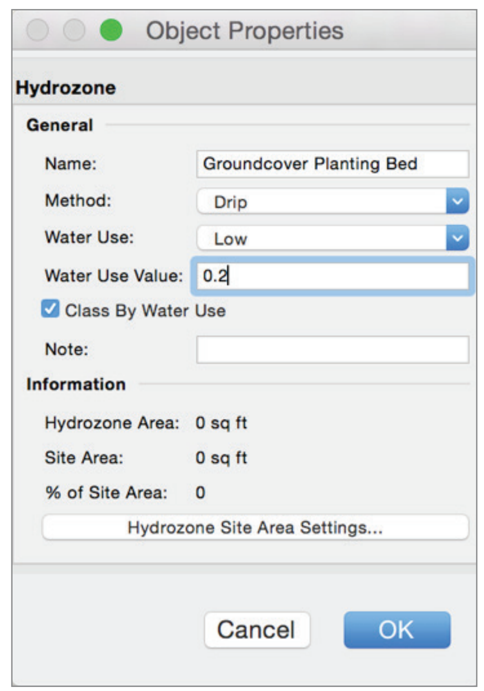


FIGURE 6
Design Zone Tool, Outlet Type drop-down menu

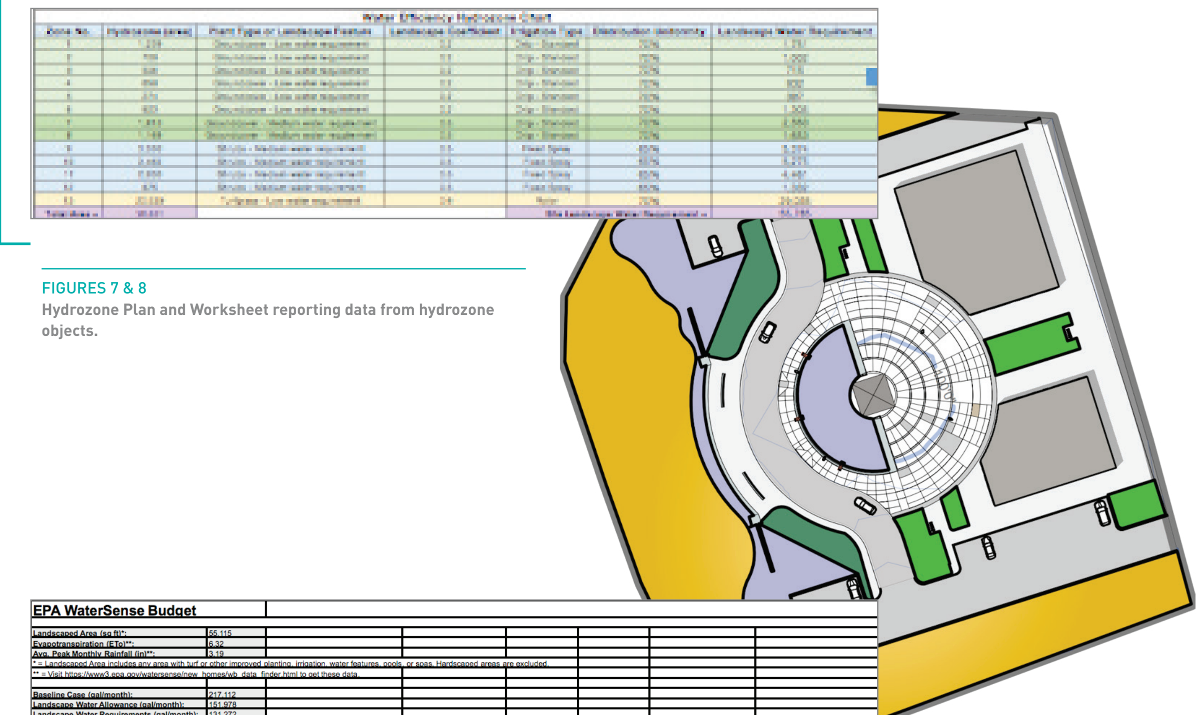
As with many of the tools available in Vectorworks Landmark, the data appended in the fields as seen right **(FIGURE 6)** will be retrieved in the customizable reports (worksheets). An example of this can be seen in the following graphics where a site's hydrozone plan is used to query the proposed areas to be developed and/or planted, while the related worksheet shows the data pulled from those spatial objects, and the necessary calculations are conducted to verify compliance with the site's water allowance.

Since every water budget may vary depending on the location of the project and on which water budget is being considered, the worksheets can support these variations. Whether the designer needs to identify a different evapotranspiration (ETO) for the specific location, or maybe use non-potable water sources to offset the demand for treated water use on a proposed development, the worksheets can be easily amended with these calculation variations to achieve the project-specific analysis.

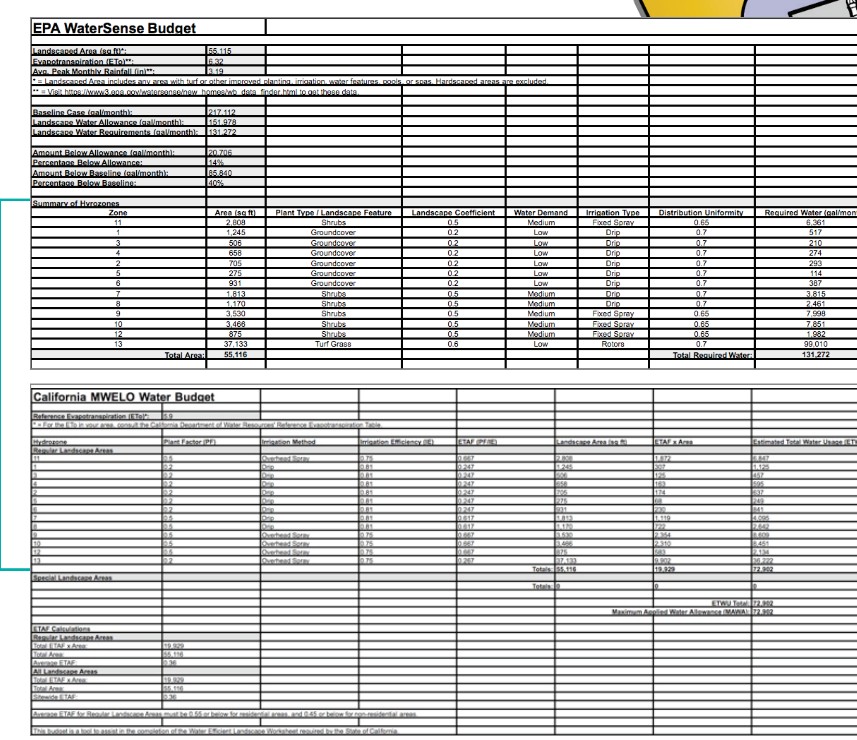
HYDROZONE CASE STUDY:

Stephen Schrader, PLA, ASLA, of Holcombe Norton Partners shares how their firm achieved LEED water efficiency objectives for the [Montgomery Campus Center Auburn University](#).

APPROACHING **VARIED IRRIGATION WORKFLOWS** [CONT'D]



FIGURES 7 & 8
Hydrozone Plan and Worksheet reporting data from hydrozone objects.



FIGURES 9 & 10
Hydrozone Worksheet is reused in reporting water use data for a EPA/LEED/SITES and California's MWELO water budgets.

FILE ORGANIZATION & **SETUP**

PRECONFIGURED CLASSES AND LAYERS

Various industry-focused tools and features within the Vectorworks product line produce preconfigured classes and/or layers. For example, plant objects produce classes such as Plants-Component-Bloom, Canopy, Color Fill, Interior Linework, Outline, and Tags, and hardscape objects populate the file with classes such as Site-Hardscape Comp-Border Joint, Main Joint, Slope Arrow, and Spec. With the Irrigation tool set, the automatic inclusion of these object classes takes place when the equipment is placed, so there is no need to pre-populate the file with these classes before placing the objects. This does not preclude the designing professional from using a template file with the frequently used classes and symbols already included — in fact, this scenario is often encouraged to expedite the design workflow.

PRECONFIGURED CLASSES

See right for **[FIGURE 11]** which provides a visual account of preconfigured classes created when each of these objects is placed. It should be noted that the "Calculated" class visibilities are turned off by default. This effort to prepopulate the file with specific classes allows for easier calculations when using worksheets for material schedules, but more importantly, it assists in the proper calculations of the objects as part of the system of outlets, piping, valves, and other components.

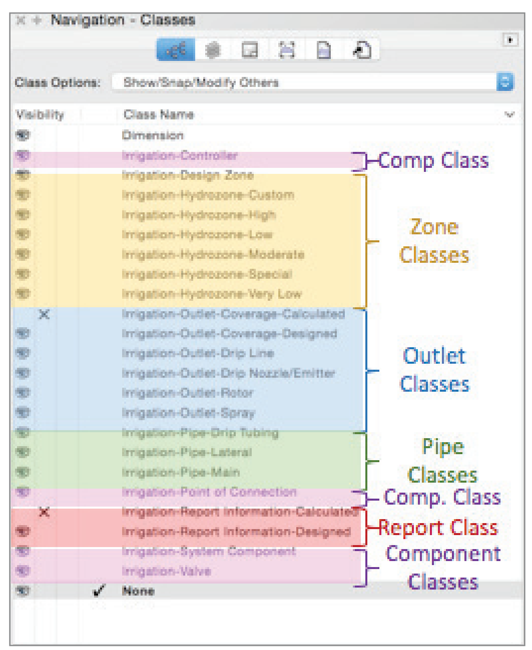


FIGURE 11
Navigation Palette displaying preconfigured classes for the Irrigaion Tools.

DESIGN LAYER USE

Though no design layers are introduced when placing irrigation outlets, piping, and other objects, designers are encouraged to create stacked and labeled design layers so that the irrigation work being proposed agrees with the segregation of components that make sense for each project. For instance, the use of additional design layers may not be essential for each project unless the designer prefers to analyze the system after outlets, piping, and components are placed. Hydrozones are another example of objects not always referenced, so creating design layers that keep these elements visible or invisible when desired may initiate the purpose, management, and labeling of such design layers.

FILE ORGANIZATION & **SETUP** [CONT'D]

IRRIGATION RESOURCE MANAGER & RESOURCE SELECTOR

As with all of Vectorworks software's industry-focused design tools, the irrigation tools each have their own tool-specific Resource Manager, called the **Resource Selector**, which directly identifies available resources that support the design process of those tools. For example, when the designer chooses the Outlet tool from the Irrigation tool set, they immediately see the options for preloaded smart outlet symbols, such as emitters, rotors, and spray objects by manufacturers like Hunter, Irritrol, Rain Bird, and Toro. **[FIGURE 12]**

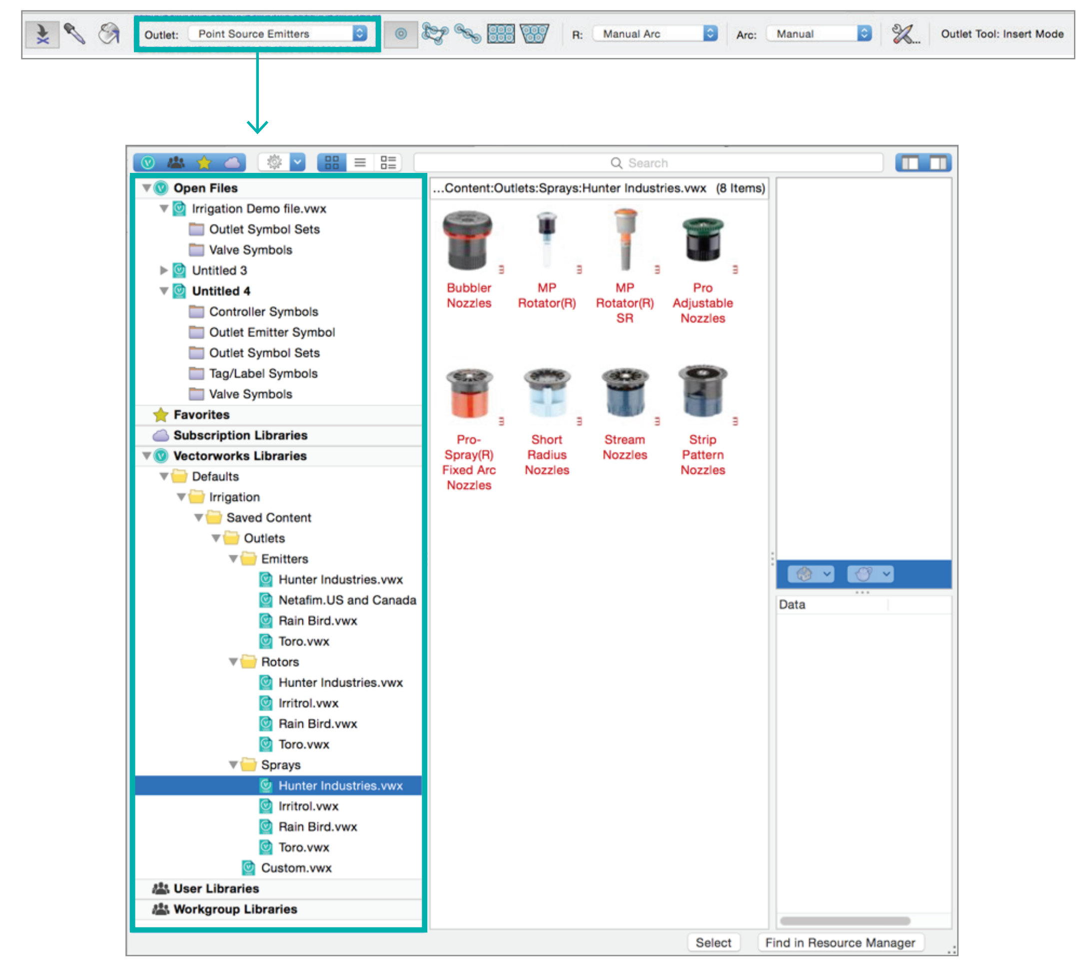


FIGURE 12
The Outlet tool's Resource Selector, typical of all tools within the Irrigation tool set.

FILE ORGANIZATION & **SETUP** [CONT'D]

Users may also find their chosen symbol resource in the general Resource Manager by clicking the button on the lower right of that palette called **Find in Resource Manager** [FIGURE 12], or by simply enabling the Resource Manager. Choosing resources within the general Resource Manager is accomplished by choosing the folders from the application's default or user libraries and then isolating the selection to Symbols/Plug-in Objects within the Resource Type pull-down menu. [FIGURE 13]

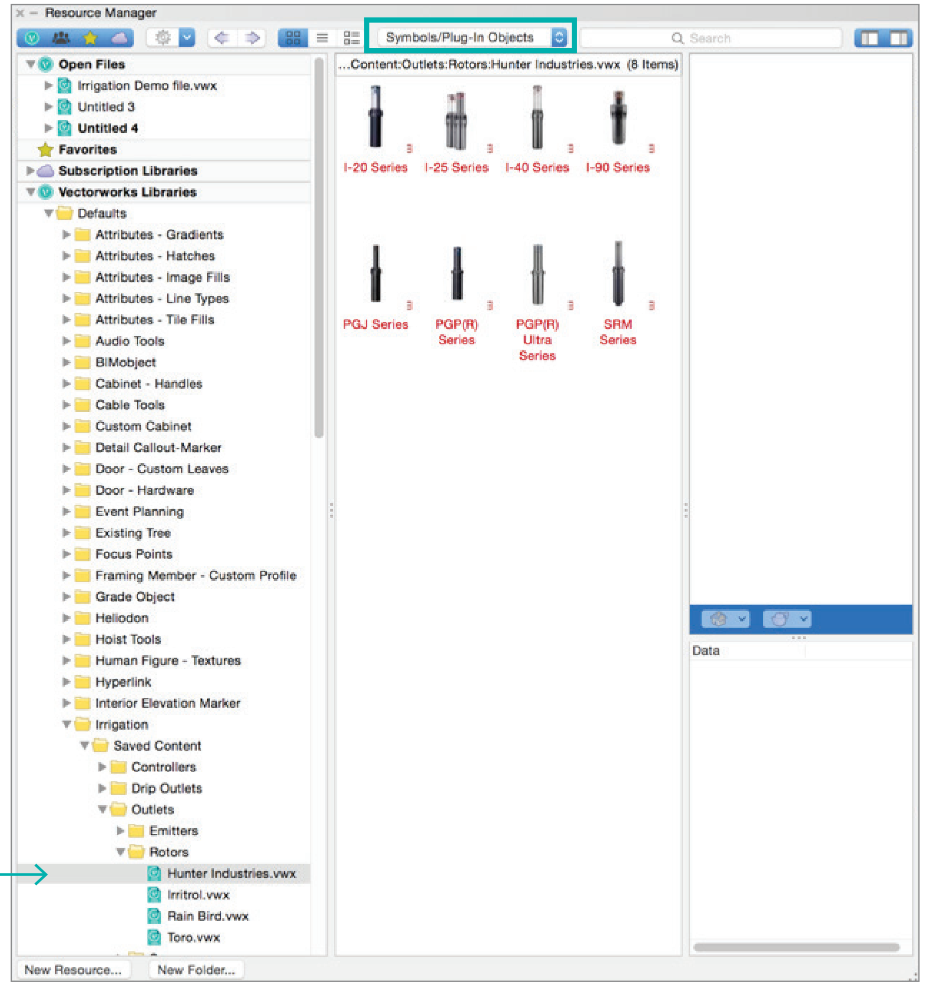


FIGURE 13
Using the general Resource Manager to locate resources like Rotor symbols.

SYSTEM **LAYOUT**

OUTLET LAYOUT

As mentioned earlier, the method of planning for a site's irrigation varies depending on the project's owner, designers, installers, and even its maintenance professionals. Even if a design professional chose to only "zone out" a schematic diagram of where specific types of irrigation should occur, there likely will need to be some form of visual documentation of where the equipment is installed, or in the case of as-built projects, was installed. There is also the recognition that even though a designer may have created a layout plan of where sprinkler heads and drip lines would ideally go, in-field adjustments often take place, meaning the plan is not as accurate as what an as-build plan shows. In any of these cases, the ability to place irrigation equipment outlets is well suited to accomplish this need efficiently.

EQUIPMENT SELECTION AND PLACEMENT OPTIONS

When choosing a specific sprinkler head or outlet for the irrigation layout, select the Outlet tool within the Irrigation tool set. [FIGURE 14]

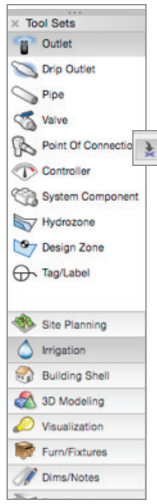


FIGURE 14
Irrigation tool set and Mode Bar.

From there, the tool's modes provide the designer with several options for how the equipment will be inserted, matched, or mass-created. Additionally, the designer can access the irrigation tool Resource Selector to then choose the outlet type (emitter, spray, or rotor) by manufacturer and model. Placement modes enable similar options to the plant object, such as Single Outlet, Poly-Vertex, Poly-Edge Space, Rectangular Array, and Triangular Array.

Designers can also pre-set the expectation to either manually determine the sprinkler's radius or choose from the available radius distances. In addition, the nozzle's arc sweep can be chosen from the equipment's available sweep angle ranges, or it can be designated manually. Choosing the former option in preselecting the radius and arc helps to maintain the manufacturers' specified restrictions in how the equipment's use is proposed, while the latter option provides the designer with more flexibility should the designated equipment be open for change or customization. [FIGURE 15]

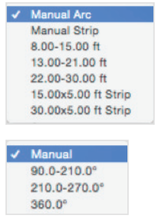


FIGURE 15
Sprinkler radius, distance and nozzle's arc sweep adjustments

SYSTEM **LAYOUT** [CONT'D]

One aspect to note, however, is that though the designer can opt for the manual selection of the chosen radius and arc, the object will limit the radius length and arc sweep to those that are possible, given the manufacturer performance data. For example, if Hunter's MP Rotator is chosen for the selected spray outlet, the designer may have manual selected, but they could not specify a radius larger than 30' or an arc which is less than 90°.

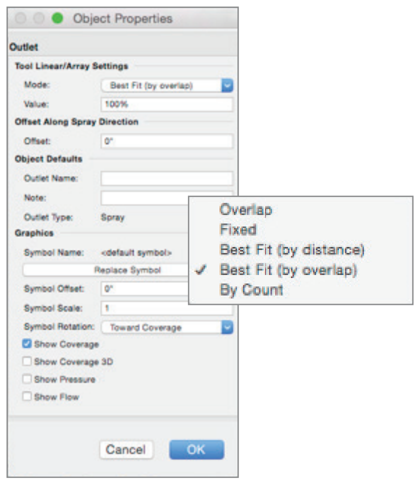


FIGURE 16
Adjust outlet's settings in the Object Properties dialog box.

One last option for presets on the outlet objects is adjusting the outlet's settings within its Object Properties dialog box.

Most likely, designers will choose to adjust linear/array settings such as mode. Options enable Overlapping, Fixed, Best Fit, and By Count placements, and the ability to predetermine the numerical value of a mode. Often, designers recommend the **Best Fit by Overlap** mode since irrigation coverage is not as effective when it is edge to edge. Designers also appreciate the **Best Fit** option to be a bit more elastic for linear and mass arrays of spray heads while still making the value an available option to note the threshold of how much overlap is tolerated. [FIGURE 16]

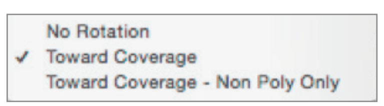


FIGURE 17
You can also adjust the symbol's rotation in the Object Porperties dialog box.

Designers may opt for larger scaled symbols for readability, and this option can be made in the **Object Properties**, as well as replacing the default symbol with another preferred symbol.

The symbol's rotation can also be a matter of layout time saved when using options for the symbol rotation. Choosing **Toward Coverage** lets the designer position its rotation with the surrounding constraints in mind, while **No Rotation** provides a more orthogonal rotation that can be helpful in rectilinear irrigation designs. [FIGURE 17]

SYSTEM **LAYOUT** [CONT'D]

COVERAGE AND PERFORMANCE DATA VISUALIZED

In the outlet's **Object Properties**, there are additional options that relate to showing coverage in 2D and in 3D, as well as showing the equipment's pressure and flow rate. Choosing to show or not show these options is purely the designer's choice and depends on their use in documentation and/or analysis.

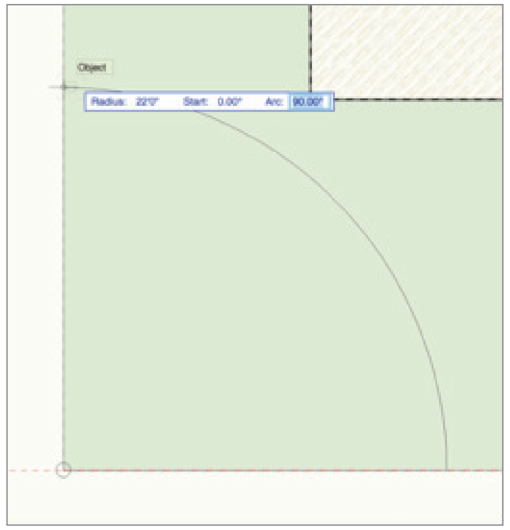


FIGURE 18
Single outlet placement.

SINGLE OUTLET PLACEMENT PROCESS

Once the outlet type is chosen and the preferred preset options are enabled, the designer can begin placing the outlet objects. One may decide to place all corner outlets by the Single Outlet placement mode and fill in between these corner outlets with the linear and/or massing arrays.

In **placing single outlets**, the following sequence is used:

1. First click, the actual head is placed;
2. Second click, the radius distance is chosen (either by clicking on constraining edges or by entering the numerical distance);
3. Third, the next click begins the arc sweep and last click ends the arc sweep. Alternatively, the sweep can also be entered in the cursor display.

ARRAY OUTLET PLACEMENT PROCESS

In choosing to place more than one outlet, the designer can choose either the Poly-Vertex, Poly-Edge Space, Rectangular Array, or Triangular Array placement mode. By choosing the Poly-Vertex mode, the designer still opts for each position of the outlet, and spacing is not controlled by the preset linear/array settings. The other multiple-object placement modes make use of the linear/array settings, such as Overlap and Best Fit.

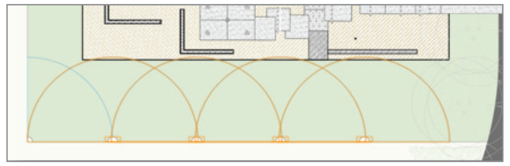


FIGURE 19
Placing outlets in linear array.

In **placing outlets in linear array**, the following sequence is used:

1. First, the actual head is placed;
2. Second, the radius distance is chosen (either by clicking on constraining edges or by entering the numerical distance);
3. Third, the next click begins the arc sweep and last click ends the arc sweep;
4. Fourth, the next click positions the extent of the array and one more click completes the outlet array.

SYSTEM **LAYOUT** [CONT'D]

in **placing outlets in a polygonal array**, the following sequence is used:

1. First, the actual head is placed;
2. Second, the radius distance is chosen (either by clicking on constraining edges or by entering the numerical distance);
3. Third, the next click begins the arc sweep and last click ends the arc sweep;
4. Fourth, the next click positions the next side of the array and each subsequent click adds an additional side to the outlet array, until the final click closes the polygonal boundary of the outlet array.

Designers will still want to do self-positioned mass outlet placing, and for cases like this, the Poly-Vertex placement mode is the best practice method to achieve this, as seen in the image below. **[FIGURE 20]**

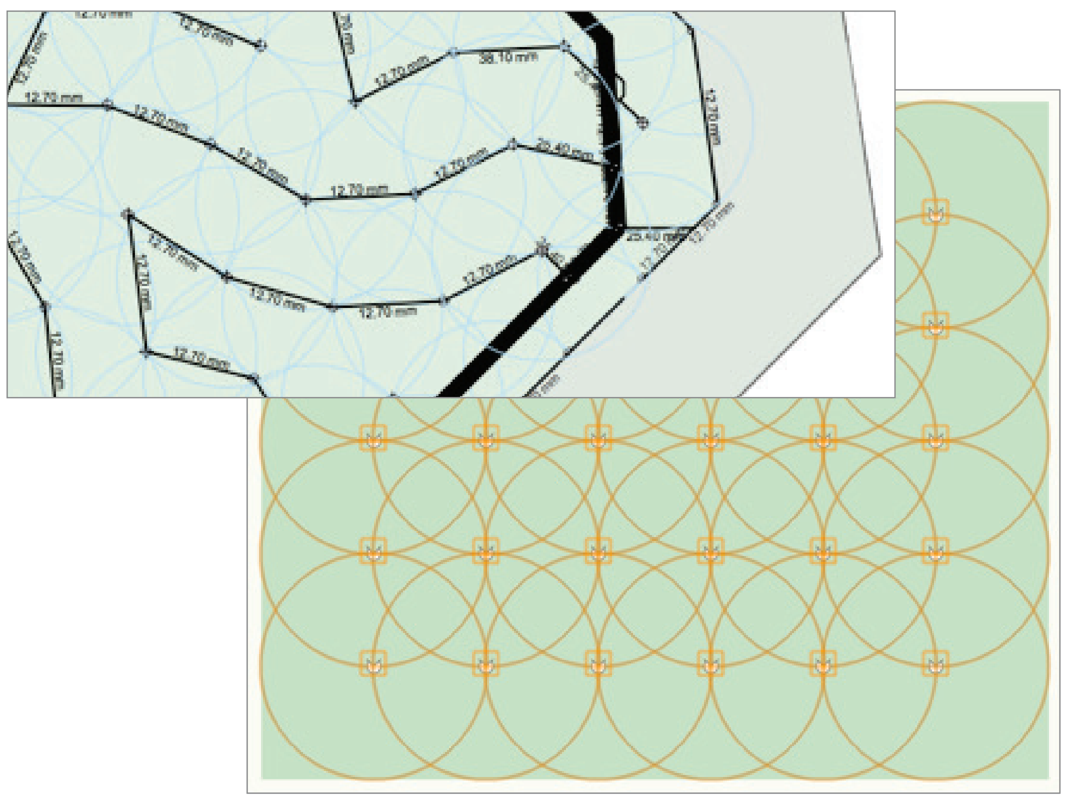


FIGURE 20
Poly vertex placement mode.

SYSTEM **LAYOUT** [CONT'D]

DRIP OUTLETS

Designing zones for drip irrigation within Vectorworks Landmark can generally be done in two ways: drip line or drip area. Drip line is achieved by laying out the drip line piping itself, while the drip area method is accomplished by creating a boundary shape of the area to be watered. Both methods use the polyline creation modes of Corner Vertex (straight line), Bezier Vertex, Cubic Vertex, Tangent Arc, Point on Arc, and Arc Vertex modes. With Drip Line mode, the polyline drawn represents the piping placement in plan view, while the Drip Area mode's polyline becomes the shape's boundary and is filled with parallel lines emulating the water delivery piping, spaced per the distance entered in the row spacing field in its properties dialog or the **Object Information palette (OIP)**. In both cases, the designer can specify the manufacturer and other performance data to be used in the system calculation, and to identify if the valve placed is the correct piece of equipment to support the efficient operation of irrigating the drip area.

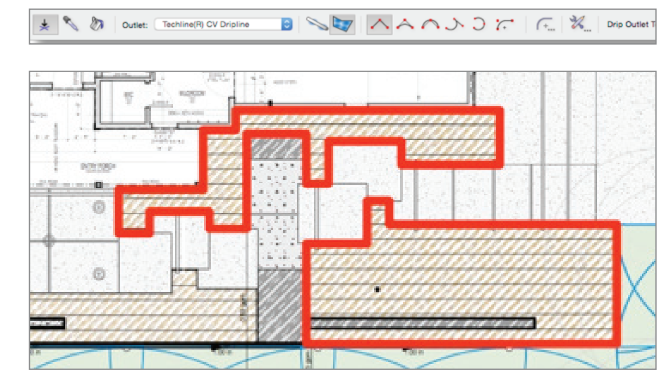


FIGURE 21
Designing drip irrigation in Vectorworks Landmark.

SYSTEM **LAYOUT** [CONT'D]

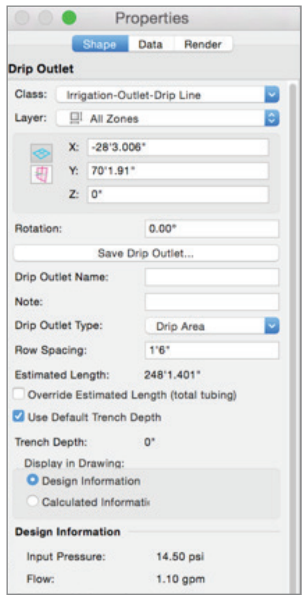


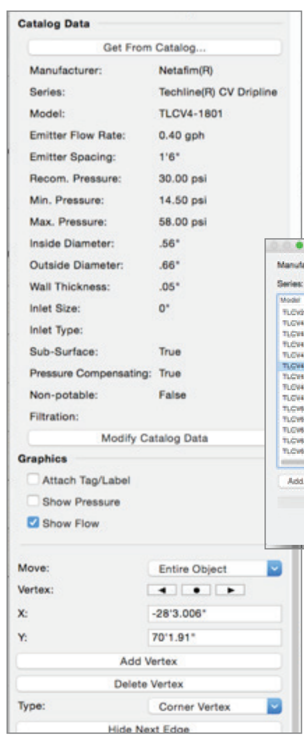
FIGURE 22
Properties dialog box

DRIP OUTLETS PROPERTIES

Within the Properties dialog, irrigation designers have other options for adjusting specific information about the drip area. For instance, if the drip areas need to have their own names, this can be done within the Drip Outlet Name field, in the initial Properties dialog, the more extensive Properties dialog as seen within this section, and the OIP. Designers may find that named drip areas are easier to track for estimating material and costs.

For flexibility regarding how the material is estimated, there is an option to override the estimated length of the drip piping. The designer can build a set amount of overage in the piping into this object if their workflows don't already account for this in the material scheduling worksheet.

Within the Catalog Data portion of the Properties dialog, the designer can populate the performance data with options that are based on how the equipment will operate. The calculations will come in when the designer chooses the **Show Pressure** and **Show Flow** options.



SAVING DRIP OUTLET SETTINGS

Once the designer finds the settings they prefer, they can save the drip object to be used as a Drip Outlet resource within the Resource Manager to automatically configure the next drip zones.

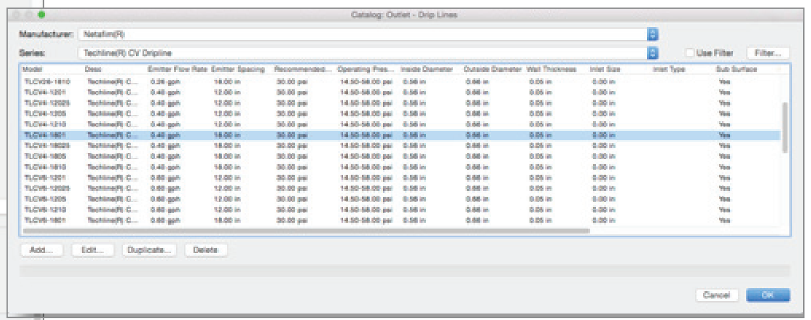


FIGURE 23
Catalog Data portion of the Properties dialog box

SYSTEM **LAYOUT** [CONT'D]

PIPING LAYOUT

Irrigation piping can be placed separately from the outlet placement, providing the designer with even more customization. Since the service lines to irrigation zones are essential to a complete system, the ability to pre-establish pipe settings is in the main Irrigation Settings dialog. [FIGURE 24]

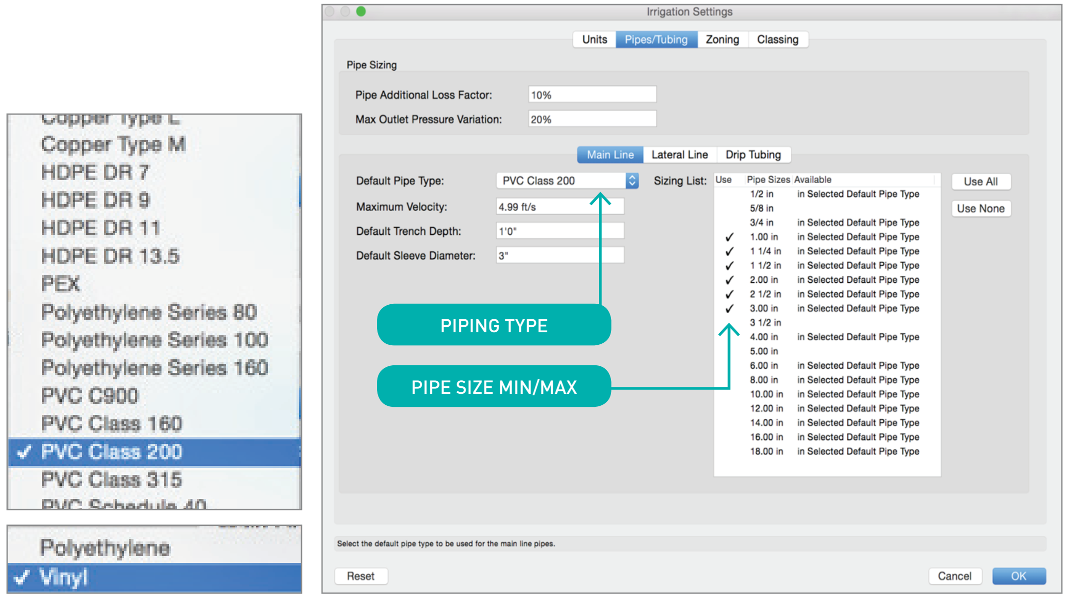


FIGURE 24
Irrigation Settings dialog box

Once in the Irrigation Settings dialog, designers can assign the irrigation pipe-sizing factors like Pipe Additional Loss, Maximum Velocity, Trench Depth, and Sleeve Diameter, as well as default Pipe Type. In fact, the Pipe Type changes from options within Main and Lateral Line, such as copper, HDPE, PEX, polyethylene, and PVC, as well as with Drip Tubing, such as polyethylene and vinyl.

Once the Pipe tool is enabled, the Pipe Tool bar is presented in the tool mode bar. There are three mode options for the Pipe tool: Main Mode for main line piping, Lateral Mode for lateral line piping, and Drip Tubing Mode for flexible drip irrigation areas. When considering the layout of a site's piping, the designer may work their way from small pipe or tubing first, then move up to lateral lines and finish with main lines. With this sequence in mind, the Drip Tube Mode will be covered first.

SYSTEM **LAYOUT** [CONT'D]

DRIP TUBING

In laying out the drip tube lines, designers will note that all of the polyline creation modes are available in the tool mode bar. Whether the lines are constrained to be angular with the Corner Vertex mode, or organic with the Bezier Vertex mode, the options are sufficient to accommodate the designer's preference and/or site's constraints.

The pipe's Object Properties dialog **[FIGURE 25]** enabled by the tool mode bar preference button presents some basic settings to use in establishing the drip line. As with the drip outlets, the drip tubing can also be given a Pipe Name and an additional note. Furthermore, to compensate for pressure loss/gain found within the proposed equipment, starting and ending elevation data can be entered. Keep in mind that designers can certainly design without this information provided, but if the site does incorporate significant elevation change, the objects should include the elevation values.

Other default settings relate to sleeving, trenching, and tube material; designers can provide custom settings for these options. Once drawn, the more detailed object Properties dialog displays more of the pipe's design information, calculated information, and catalog data. **[FIGURE 26]**

Like other irrigation equipment, the graphic settings include nominal diameter, flow, and flow direction, as well as tag/label attachment.

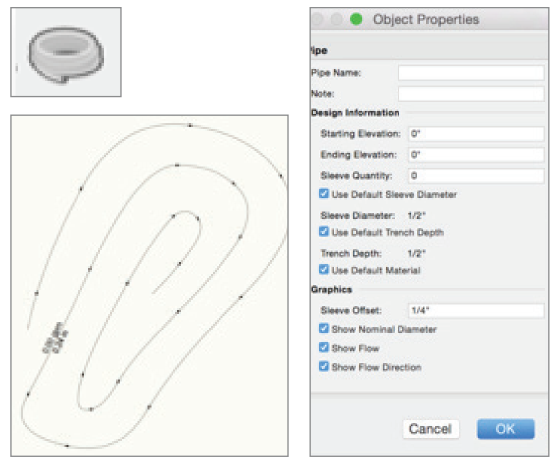


FIGURE 25
The pipe's Object Properties dialog

FIGURE 26
Object properties; design and calculated information and catalog data

SYSTEM **LAYOUT** [CONT'D]

DRIP EMITTER OUTLET PLACEMENT

Whether the designer chooses to place the emitter outlets strategically like the spray and rotor head placement covered in the previous section, or perhaps they choose to place the drip tube first, then attach emitters, both drip tube and emitter objects are suited for either workflow.

If placing tubing then emitters, this will require the designer to choose their drip tubing as mentioned above, then enable the Outlet tool. Once enabled, the Outlet Type Resource Selector is used to select the preferred emitter outlet. **[FIGURE 27]**

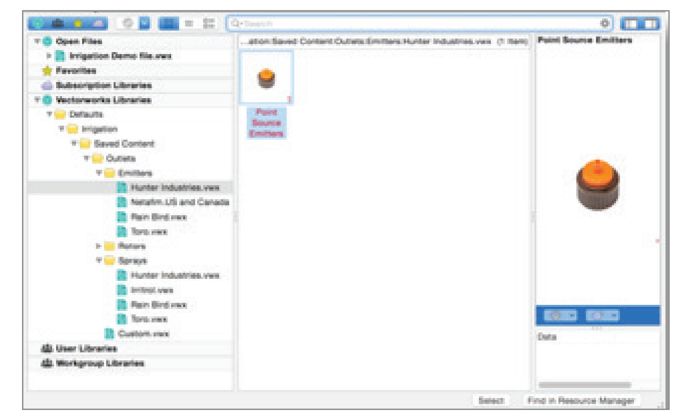
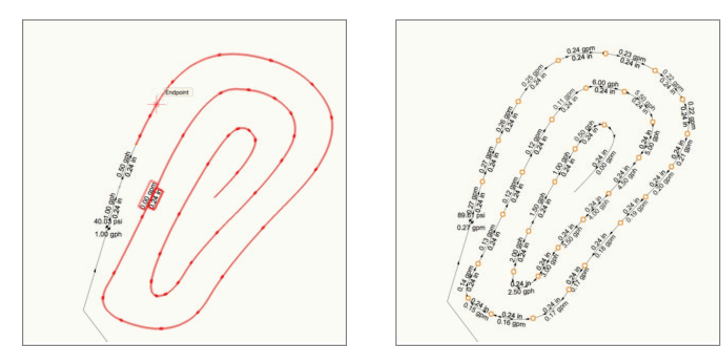


FIGURE 27
Outlet Type Resource Selector

Once the emitter is selected, with the Insert Mode enabled (usually set as the default mode), simply place the emitters along the path of the drip tubing at positions for effective spot watering. As the cursor hovers over the drip line, the line takes on a red halo, indicating it's ready to receive the emitter object. **[FIGURE 28]**

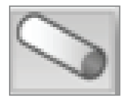
Once placed on the drip tube line, the objects create divisions in the line that prompt the flow and pipe (tube) size data to be displayed between the placed emitter objects. This data updates when the tube is connected to the main line and point of connection. **[FIGURE 29]**



FIGURES 28 & 29
[L TO R] Drip tubing placed on drip line; Flow & pipe data displayed between emitter objects.

SYSTEM **LAYOUT** [CONT'D]

LATERAL LINE PIPING



Often, design professionals lay out their irrigation heads for a site, then, with the understanding of how many heads can be supported by a zone valve, they "connect the dots" of sprinkler heads to determine where all the lateral lines will go to complete each zone. This actually could be done similarly to the drip tubing and emitter workflow where the lateral lines are placed, then the sprinkler heads are placed on the lateral lines. The end result is the same — the lateral lines and outlets are purpose-built to provide connectivity from the zone valve to the individual sprinkler heads, with the flow and pipe sizes annotating the lateral line between each outlet.

Just like with the drip line, the data shown on the lateral lines will update when connected to the main line and point of connection. **[FIGURE 30]**

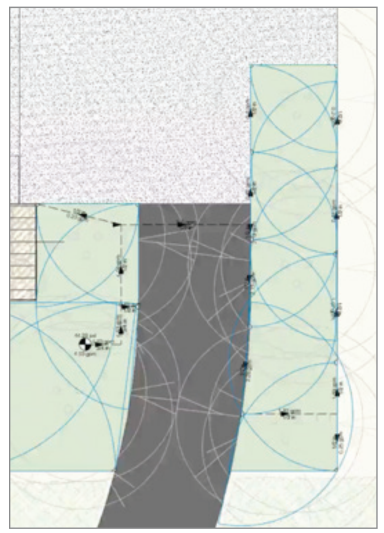
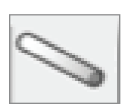


FIGURE 30
Lateral line pipe placement between proposed outlets.

MAIN LINE PIPING



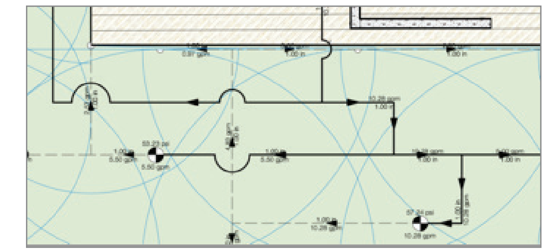
Placing the main line for an irrigation project starts out similarly to the lateral line placement; selecting the Pipe tool and then the pipe material from the pipe object Resource Selector. The Pipe Properties dialog within the tool mode bar is similar to the lateral version. If the pre-set configurations for piping are made in the Irrigation Settings dialog, as was described in the beginning of this piping layout section, then the next step is to choose the polyline creation mode and begin connecting the end of the lateral line for each zone, or the valve, if it has been already placed.

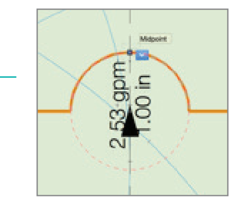
The flow and size notation, again, shows on these main lines, and once the main line makes connections to the informed point of connection, the rest of the lateral lines and zones will update with the proper flow and pressure.

SYSTEM **LAYOUT** [CONT'D]

GRAPHIC 'JUMPERS'

There is no need to insert your own variation of the line "jumper" since the software is designed so that the overlapping drip tubes, as well as lateral and main lines, automatically create an arc to graphically recognize the overlap so that the lines for each are distinctly within the same piping run. Also, the size and position of the jumper can be resized and flipped by using the blue "handle" in the midpoint of the jumper's arc. **[FIGURES 31 & 32]**





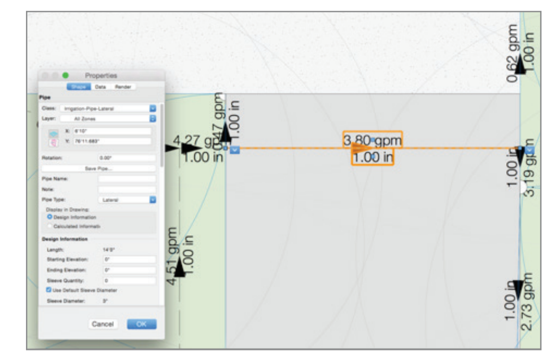
FIGURES 31 & 32
[L TO R] Automatically created arcs; Adjusting size and position of jumper

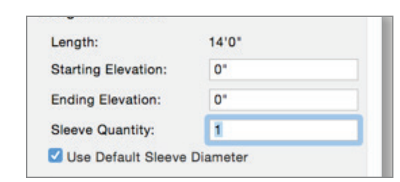
SLEEVING

Assigning the sleeving for irrigation pipes crossing under pavement is similar to the other piping placement in that the size and material is set within the Irrigation Settings as shown in the beginning of the piping layout section. Then, the assignment differs from the other pipe placements in that the sleeve designation is included in the pipe object properties which is shown when it crosses the pavement.

Also, the sleeve diameter is either set to accept the default pipe diameter chosen in the Irrigation Settings, or assigned a custom diameter in the pipe's object properties dialog.

The sleeve is not required to span the whole length of the pipe, in fact, a blue edit handle appears on both sides of the inserted sleeve. This can be positioned in line with the pipe, indicating where the sleeving needs to start and end. **[FIGURES 33-35]**





FIGURES 33-35
[TOP TO BOTTOM] Assigning sleeving for irrigation pipes

SYSTEM **LAYOUT** [CONT'D]

COMPONENT LAYOUT

POINT OF CONNECTION

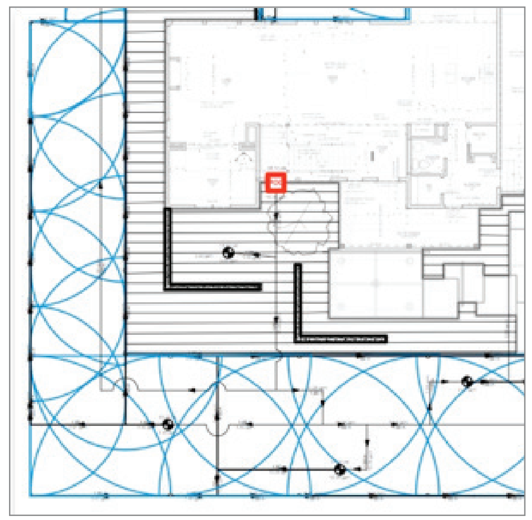
Typically, a project will have one water source, or **point of connection (POC)**. This could be a service line from a public water source, or a source established on-site, such as a cistern, well, or pond with a pump to provide the water's flow and pressure. In Vectorworks Landmark, the designer can specify one or more POCs. If a system is designed without a POC, the designer will receive a warning within the Properties dialog that the equipment is not connected to a source. However, the designer can still proceed with the POC inclusion in their layout, and the data can still provide the information the designer prefers. **[FIGURE S 36 & 37]**

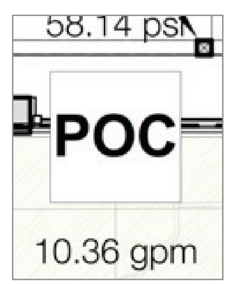
If the designer does provide information for the POC, but the requirements of the designed system are not aligned with the available flow or pressure, the dialog will share a notice of this sizable differential. **[FIGURE 38]**

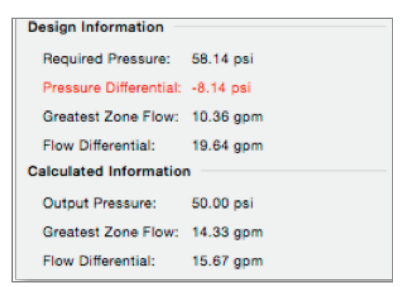
Based on the designed system, the POC will report the required pressure, the greatest zone's flow, which is helpful in identifying the POC's output pressure and its maximum safe flow.

If the project is getting its source from a service line, additional data such as static pressure, line type, size, and velocity is also needed. In either case, the plan information, both pressure and flow, associated with the POC can be displayed.

Like the other irrigation tool objects, the default symbol can be used as is, resized by a numerical scale value, or replaced altogether. By changing the text associated with the symbol, all text becomes resized, so the designer will need to balance the scale of the symbol with the text size for the best result in the irrigation plan document.







FIGURES 36-38
[TOP TO BOTTOM]
POC Inclusion in layout; Dialog showing notice regarding POC

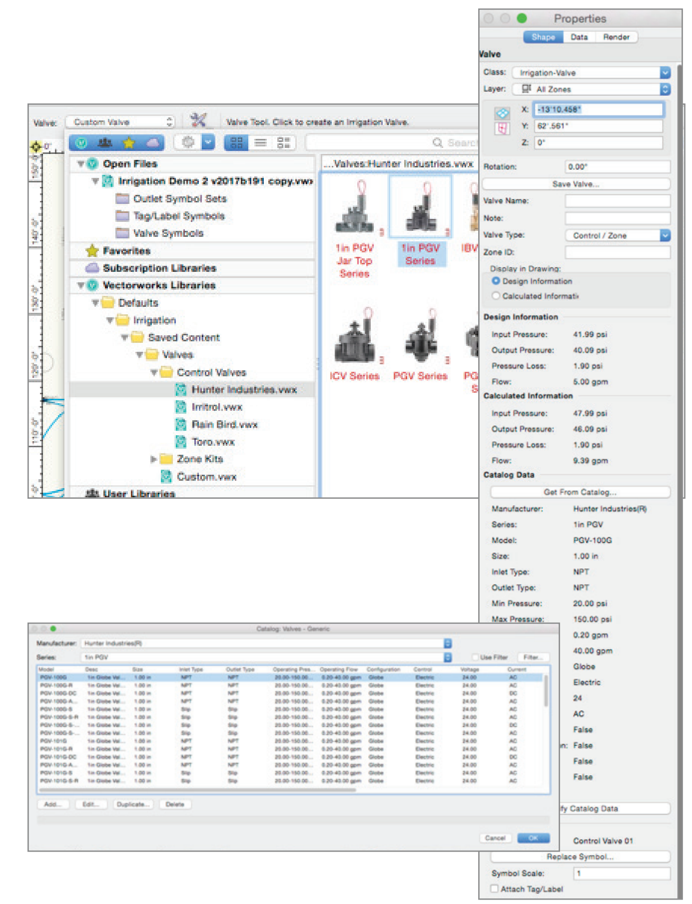
SYSTEM **LAYOUT** [CONT'D]

ZONE VALVES

Irrigation designers often do not consider the zone valve equipment until the sprinkler equipment has been planned. The performance of the equipment, the flow, and available pressure help to identify how many outlets will be included in a zone. From there, the valve that best supports that zone's performance is selected. Often times, the designer and/or contractor has a "go-to" brand and performance-based range of valves they use from project to project. In Vectorworks Landmark, this workflow, and one where unique valves could still be selected, are supported. Bear in mind, consistency in equipment is more important than choosing unique valves that are "perfect" matches for pressure and flow for each zone.

When selecting valves for each zone, the designer can make use of the Valve tool's Resource Selector, much like the other objects being used. **[FIGURE 39]**

Though the initial valve Object Properties dialog **[FIGURE 40]** is still available, choosing the valve through the Resource Manager circumvents the step of using the initial valve object property dialog in valve data appending, since the catalog data preassigned to the library objects already populate the object properties. **[FIGURE 41]** Data that can still be assigned through the object properties dialog is its name, its zone ID, any notes that the designer needs to add, and lastly, any changes to the graphic symbol before committing to the data through the valve's Resource Selector.



FIGURES 39-41
[TOP TO BOTTOM CLOCKWISE]
Valve tool's Resource Selector; Object Properties dialog box; Catalog Values

SYSTEM **LAYOUT** [CONT'D]

ZONE VALVES [CONT'D]

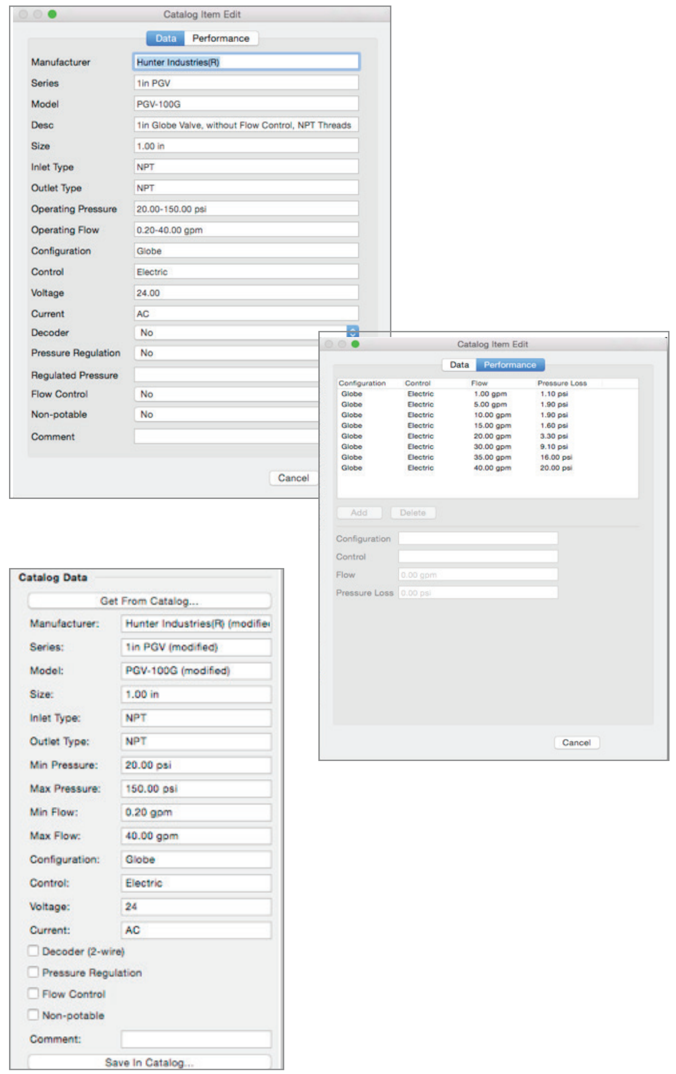
Once the valve has been chosen, the valve's catalog data such as input and output pressures, pressure loss, and flow rates becomes available. The appended catalog data enables the designer, once again, to review the listed performance data.

Conveniently, if the data presented is not satisfactory for the zone, the designer can use the **Get From Catalog** button to access the built-in database of potential zone valve models to revise the performance data shown.

While in the catalog database viewer, the designer can use the **Data and Performance tabs** to change or add to the valve's manufacturer equipment and performance data. Select one of the models then click on the Edit button. **[FIGURES 42 & 43]**

Though not as detailed as editing from the valve's catalog database, designers can also modify the catalog data directly in the OIP. Once the data is changed to reflect the preferred data, the new data and settings can be saved back into the catalog. **[FIGURE 44]**

If a designer chooses to use equipment that is not included in the default library, they can use the custom valve symbol object in the Resource Selector within the Zone Kit folder to populate it with the data needed for the equipment being specified.



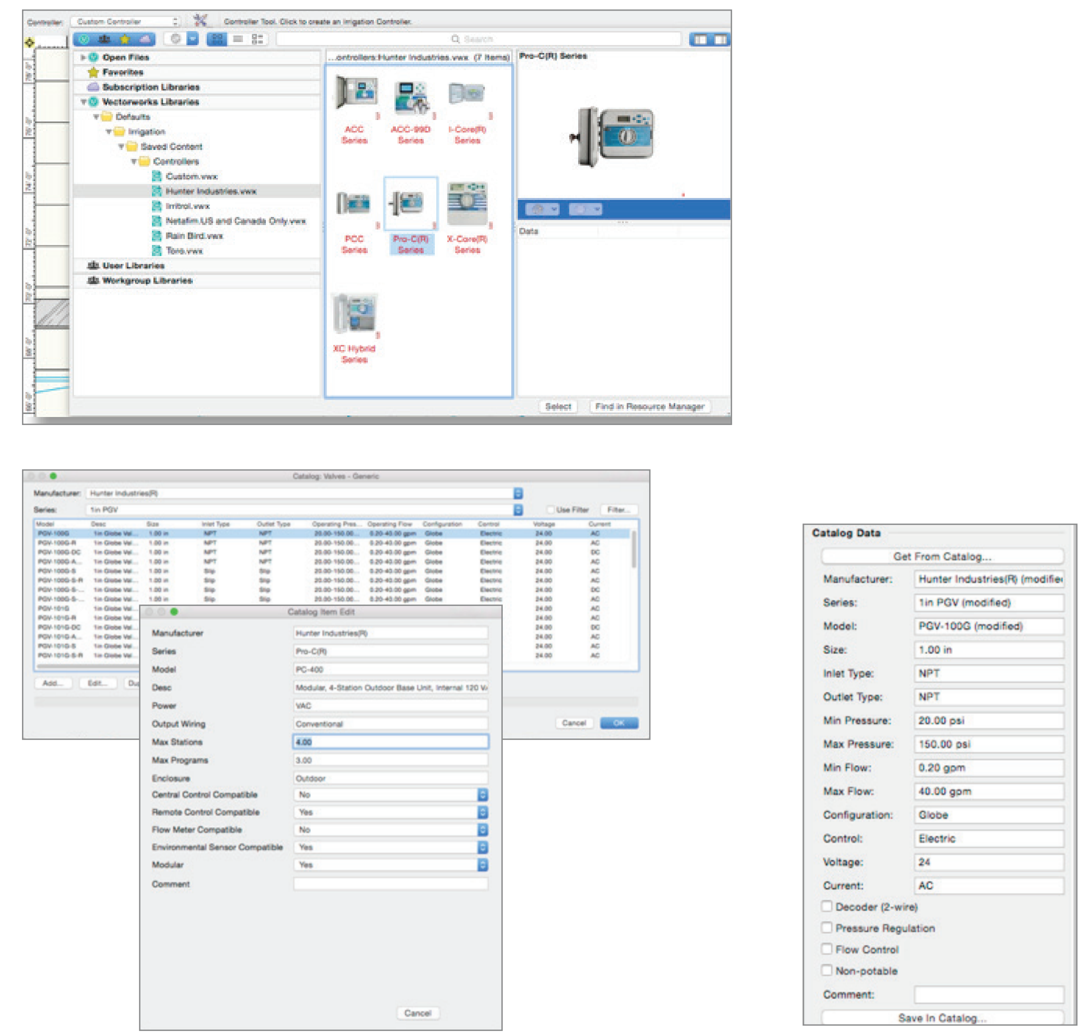
FIGURES 42-44
[TOP TO BOTTOM CLOCKWISE]
Modifying the valve catalog item data and performance information; Modifying the valve catalog data within the OIP.

SYSTEM **LAYOUT** [CONT'D]

CONTROLLERS

Though not relaying data about pressure and flow, like most of the other irrigation equipment, the data available from placed controllers can certainly help the designer and contractor in their efforts to complete the project's irrigation layout and installation.

Choosing the controller is much like working with the other equipment selection workflows. By enabling the Controller tool, the tool's mode bar offers the pull-down Resource Selector letting you pick the manufacturer and model. Once chosen and placed, the properties dialog allows similar edit options, such as from the catalog and from the OIP. **[FIGURES 45-48]**



FIGURES 45-48
Controller tool's pull-down Resource Selector; Properties dialog allowing similar edit options, such as from the catalog and from the OIP.

SYSTEM **LAYOUT** [CONT'D]

OTHER SYSTEM COMPONENTS

By choosing the **System Component tool**, the tool mode bar provides the component-focused Resource Selector. [FIGURE 49]

Within this resource selector, the designer can choose components such as Backflow Preventers, Flow Sensors, Pressure Regulators, Valve Boxes, Auto Fill Devices, Blow-out Devices, Environmental Sensors, Filters, Hose Bibs, Quick Couplers, and Water Meters.

It is important to make sure that the equipment that needs to interact with the service flow and pressure is connected to the main line so that it can share relevant data and determine if the equipment satisfies the system's requirements. If this is not the case, the properties dialog and the OIP will report the incompatibility, giving you the ability to make the changes necessary and see if the changes solve the issue.

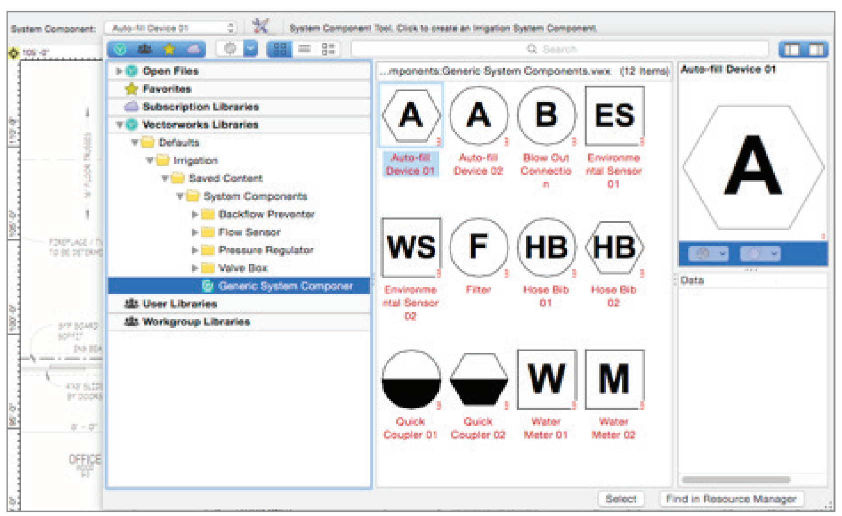


FIGURE 49
System Component Resource Selector

SYSTEM **LAYOUT** [CONT'D]

IRRIGATION DOCUMENTATION

AS-BUILT DRAWINGS

At the beginning of this workflow piece, one of the scenarios mentioned is as-built drawings. As-built drawings [FIGURE 50] are likely to be the most accurate, when it comes to identifying the position and type of equipment included, for obvious reasons.

The person producing the as-built drawings will likely want to document pipe placement before trenches and other openings are filled. Since most other equipment is visible at or above the ground surface the rest could be achieved anytime after installation.

From this point forth, the layout process is going to exactly mimic the workflows described for outlet, piping and component selection and placement. The documentation may also involve the inclusion of relevant field measurements and notes, which can generally be produced in viewport annotations over the top of the irrigation plans.

INSTALLATION DETAILS

Part of the documentation of construction projects, especially those available for contractor bidding, are the installation details. Though some design and build firms provide their own installation services to the client, even these firms may find the need to document how materials are installed, particularly when subcontracted work is involved.

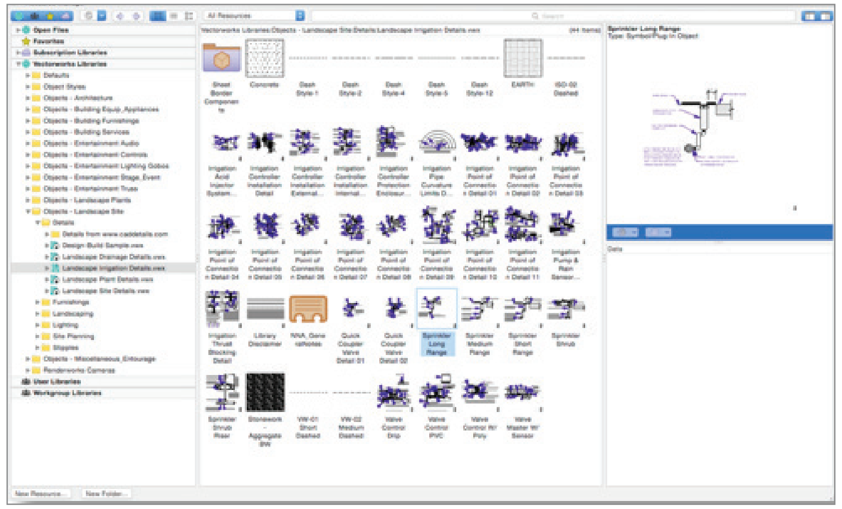


FIGURE 50
As-built drawings

SYSTEM **LAYOUT** [CONT'D]

With irrigation, the manufacturers go to great lengths to provide equipment specifications and installation information, including installation details. [FIGURE 51]

Once acquired, these details can be used in the drawing sheets "as-is" or, if the installation needs to vary for specific site conditions, it can be revised. If the supplier of the details provides static image or PDF files of details, the former option is usually the only option. For those sources where the files were digital in format, be it a VWX, DWG or DXF file, the line and text work can be altered and saved as a Vectorworks resource for future re-use.

The Vectorworks Resource Manager can also be a source for these details, by accessing the Vectorworks Libraries. The **Objects – Landscape and Site** folder contains a **Details** folder, with a **Landscape Irrigation Details.vwx** file with numerous general details ready to be imported and re-used. This same process can be used by the designer who wants to make their own library of details, though they may want to save them in the User Libraries or Favorites locations.

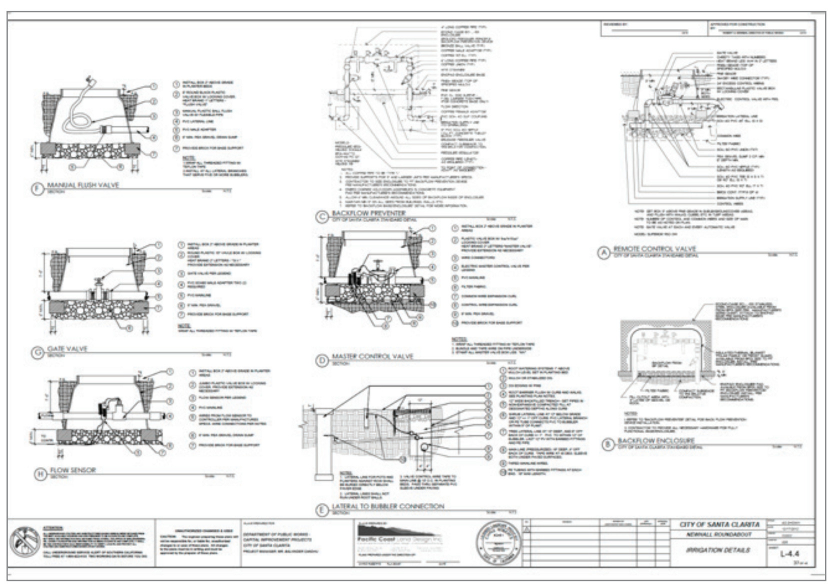


FIGURE 51
Installation details

SYSTEM **LAYOUT** [CONT'D]

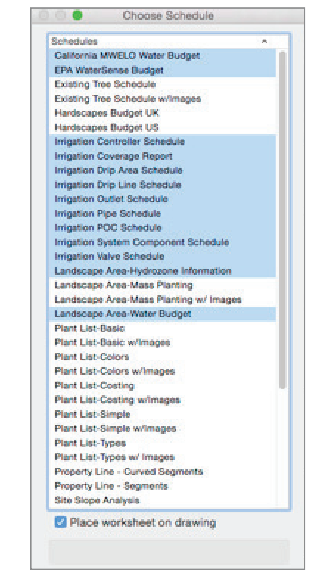
MATERIAL SCHEDULES

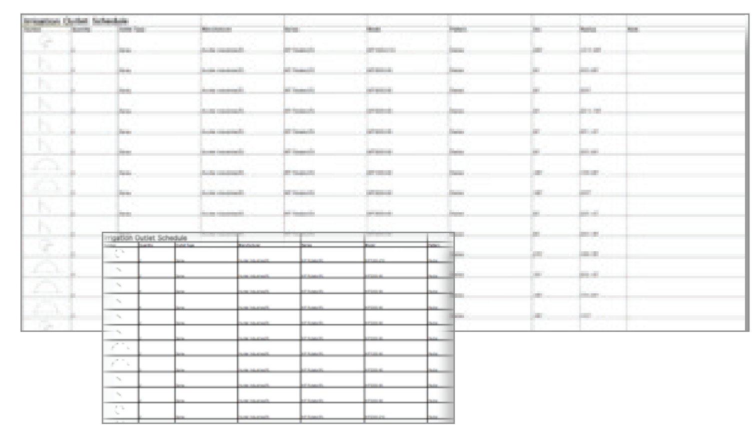
Vectorworks software excels at quantification and scheduling. Worksheets and the subsequent reports derived from them can report objects' quantities, lengths, areas, and volumes.

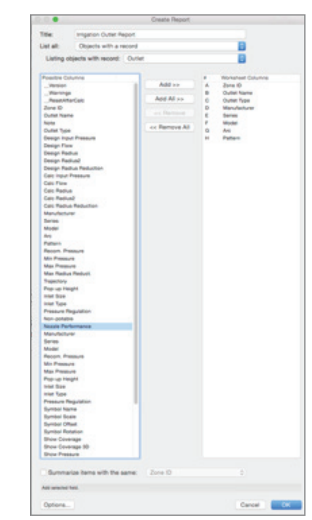
The easiest way to produce a report on irrigation material is to import premade worksheets (reports) through the **Tools** drop-down menu. The **Choose Schedule** option within the menu's **Reports** section provides a list of available material schedules.

It is important to note that the second service pack update of Vectorworks Landmark 2017 also contains both EPA WaterSense and California MWELO Water Budget worksheets, as mentioned in the earlier section on Planning for Irrigation with Hydrozones.

Once a premade worksheet is imported and the type of worksheet is chosen, the next click brings the worksheet into the file, already populated with the material listed. Once changes are made, the irrigation worksheets should be recalculated. [FIGURES 52-56]







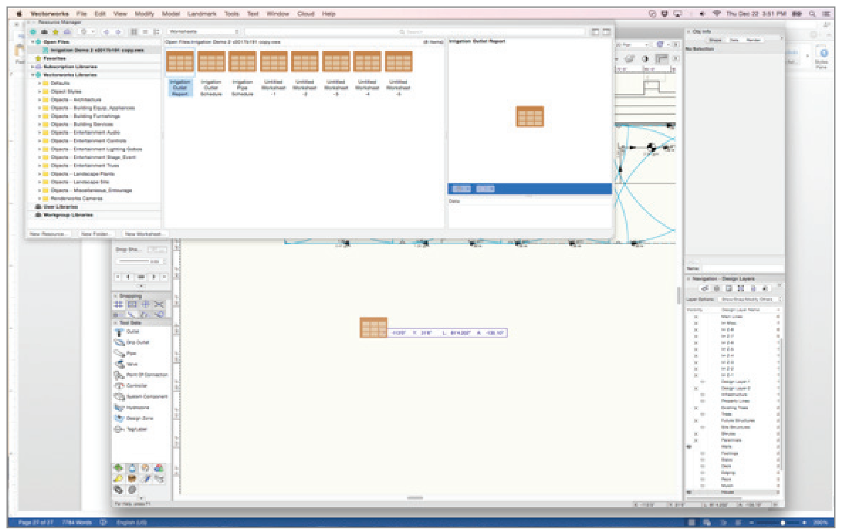
Irrigation Pipe Schedule

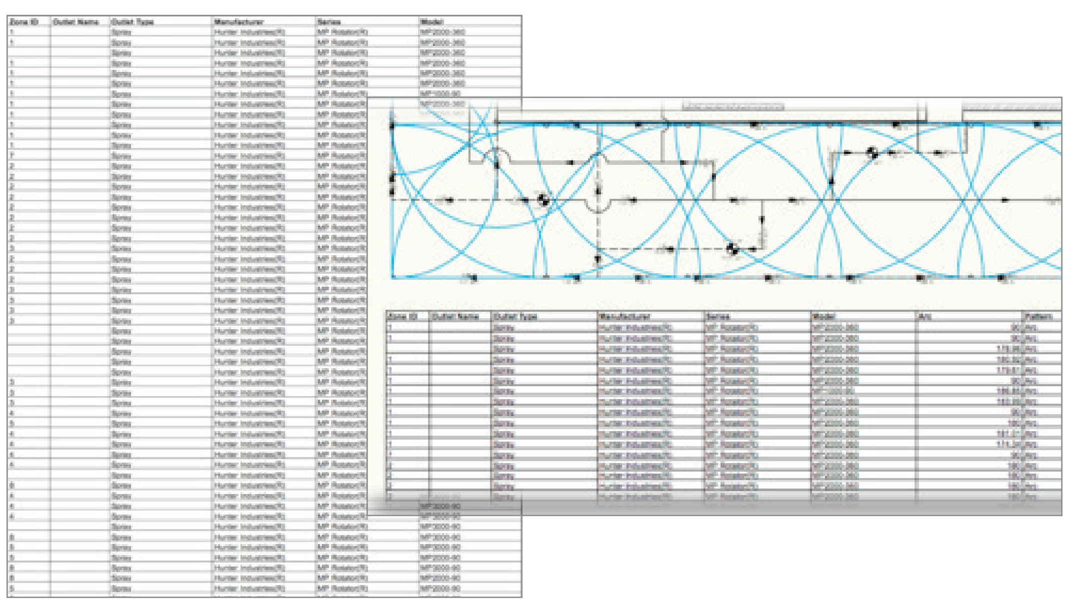
Type	Diameter	Total Length
PVC Class 160	1	1818'0 1/4"
PVC Class 200	1	357'2 1/4"
Vinyl Tubing	1 1/4	20'2 1/4"

FIGURE 52-56
Material schedules

SYSTEM **LAYOUT** [CONT'D]

Creating a custom report can also provide the designer with just the report type and look that they prefer. Once the reported fields are identified, the resulting worksheet can be immediately placed in the drawing, or on the sheet to document the equipment report. From there, further customization, like fonts, borders, and summaries can take place. **[FIGURE 57-59]**





FIGURES 57-59
Material schedules & reports

SYSTEM **LAYOUT** [CONT'D]

ANALYSIS

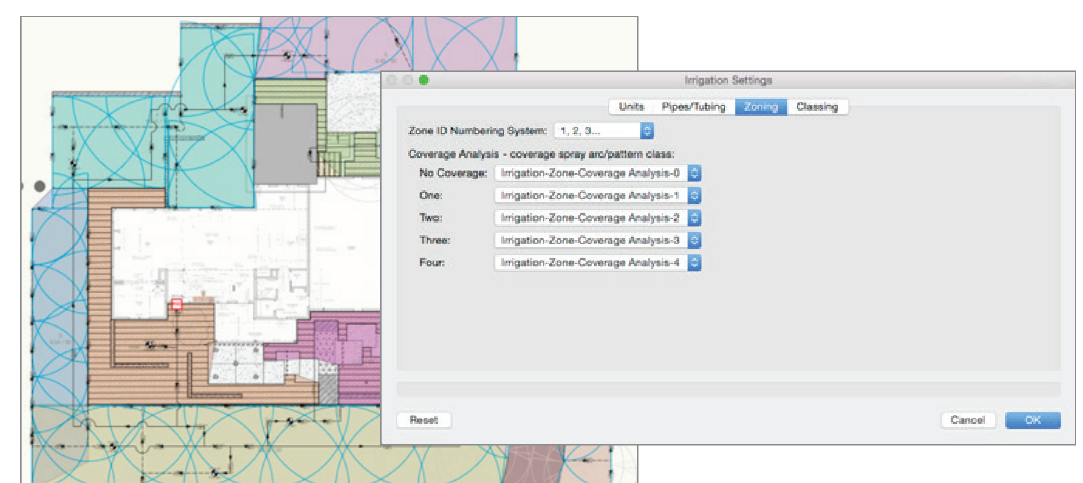
COVERAGE ANALYSIS

Beyond simply designing an irrigation plan with self-gained knowledge of irrigation efficiency, and beyond using the manufacturer's equipment performance data to make sure the most efficient, yet effective, irrigation system is created, designers using Vectorworks Landmark have another, visual option to help design for water efficiency. This is the Coverage Analysis feature of the Design Zone tool.

Once the irrigation layout is created, if the project does not already include design zones, the designer will need to use the Design Zone tool to trace the areas that will best delineate each zone's coverage. Each of those zones should be labeled for their respective zones and for reporting. These design zones will recognize when irrigation outlets of any type are included in their particular zone. This is how it recognizes the level of irrigation coverage.

If the Irrigation Settings were not already preset to recognize multiple levels of coverage in the Zoning tab, this should be done. This will create preconfigured classes which can be assigned color fills for each level of water coverage. The fill colors assigned to these classes are purely based on the designer's preference.

Once these settings are in place, the last step is to select each zone and enable the option to Show Coverage Analysis resulting in the irrigation system showing how much coverage is attained by the perceived overlap of equipment coverage. This tool also recognizes where watering may not reach, alerting the designer so that they can revise the plan to reach the previously un-watered areas and ease up on the equipment placement that may be overwatering other areas. **[FIGURES 60& 61]**



FIGURES 60 & 61
Covergae analysis

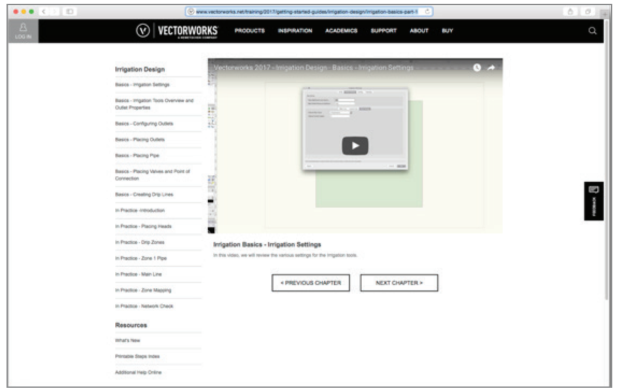
OTHER **RESOURCES**

GETTING STARTED GUIDE – IRRIGATION DESIGN

One of the best resources to learn how to design your next irrigation system is the online Getting Started Guide on irrigation design. Video content is made available from the Vectorworks User Success team, with help from beta tester and Landscape Designer Bryan Goff of Grey Leaf Design.

Each workflow has its own video segment, designed to walk designers through each process using the tools and relevant settings, using the same projects referenced in this document.

Visit http://www.vectorworks.net/training/2017/getting-started-guides
to access all Getting Started Guides, including the irrigation design guide.



GETTING STARTED GUIDE ON VECTORWORKS.NET

OTHER **RESOURCES**

EPA WATER SENSE WATER BUDGET

https://www.epa.gov/watersense

CALIFORNIA MWELO WATER BUDGET

http://www.water.ca.gov/wateruseefficiency/docs/MWELO09-10-09.pdf

Designers are encouraged to seek water efficiency guidelines for their proposed landscapes in their own jurisdiction, as the water budgets referenced in this document are well established guidelines in the United States, but other countries and their local governments and water authorities may have suggested and regulated guidelines that differ from those mentioned in this document.

LEARN MORE

about how Vectorworks can help you design
accurate, detailed irrigation systems.

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