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Irrigation

A. Introduction

1. These standards apply to all sections for irrigation related to standard automatic, underground, networked irrigation systems for plantings in ornamental landscapes, green roofs, farms, research plots, and athletic fields.
2. The FDS Irrigation is intended to inform scope, but all design and details must be developed on a case-by-case basis. Some details may need modification based on project specific needs before being incorporated into design.
3. The user of this document is responsible for all FDS Irrigation content including adapting items limited to a section to other sections. For example, if a standard is limited to Basis of Design as, “Design all irrigation systems with a controller connected to the campus central control system,” the standard must also be adapted to Installation, Fabrication, and Construction as, “Furnish and install irrigation systems with a controller connected to the campus central control system.”
4. Descriptions herein follow an upstream to downstream sequence unless otherwise noted.
5. Standards
    a. Standards are continuously improved with respect to water conservation, performance efficiency and effectiveness, first and lifecycle maintenance cost balance, industry standards and best practices, testing and introducing new products and technology, compatibility and integration, training, and inventory.
    b. Architects, designers, engineers, and trade partners are encouraged to provide input, substitution requests, or propose variances to help evolve the current standards so that Grounds can review, test, evaluate, and potentially introduce new standards.
    c. Drawings
        i. Refer to drawings listed above in the table of contents and shown in the Drawings section below.
        ii. These drawings are updated regularly but are diagrammatic, may not be exhaustively complete, might require project specific adjustments, and additional project specific specifications and details might need to be developed during design.
6. Team Roles, Communication, Participation & Coordination
    a. Also see Construction Meetings, Milestones, Testing & Inspections.
    b. The ‘project irrigation team‘ a.k.a. the project team, the project, consists of the Project Delivery Group (PDG) and Owner’s Representative, general contractor, the landscape-irrigation trade partner, other trade partners with related work, architect, landscape architect & irrigation designer, civil engineer, mechanical plumbing engineer, electrical engineer, commissioning agent, UW Grounds, UW Engineering Services, UW-IT, UW EH&S, UW Facilities Safety, and others.
    c. All project team members are responsible for all FDS Irrigation content.
    d. With respect to roles, responsibilities, delivery system, contractual requirements, and governance, the expectation is that the project utilize a lateral communication structure for efficient collaboration and layered, interdisciplinary solutions.

e. Utilize scheduling software to offer multiple meeting date and time options, send meeting invitations and deadlines to Outlook calendars, and provide access to Procore, Bluebeam, SharePoint, and other participatory software.
f. The project shall solicit input from Grounds during project formation and programming for evaluation and consideration in the scope of work and value-added opportunities.
g. The project team shall provide designs for site, landscape, and irrigation that meet University of Washington (UW) standards, code, industry standards, best practices, safe access, and maintenance serviceability.

7. Irrigation Content by Team Member
    a. UW Project Delivery Group (PDG) and the Owner's Representative are responsible for overseeing project governance, direction, communication, and coordination. Irrigation content can include advocating for Grounds, ensuring timely information and access to participate and provide input in all irrigation, landscape, and site related content including but not limited to meetings, programming, existing conditions, design, construction inspections, punchlists, as-built plans, eO&M and T2O, lessons learned, and contractor warranty and maintenance periods.
    b. General Contractor (GC). Irrigation content can include coordinating related work between trade partners, communicating design review milestones, submittals, meetings, meeting notes, testing, third party commissioning of controller Ethernet and the irrigation submeter application, testing, and inspection with Seattle Public Utilities (SPU), contractor warranty and maintenance periods, and lessons learned. Lessons learned include but are not limited to underestimating irrigation scope, accepting tree protection guidance from SDCI whereas UW should provide this guidance as it manages the campus urban forest program, MEP related irrigation issues, insufficient conduit sizes for control and spare wiring, conflicts and lack of coordination between work packages, not onboarding the landscape-irrigation trade partner in time for key early irrigation work, sleeves with insufficient diameter, soil cover, and obstructions at end points, not resolving issues in real-time resulting in corrective work later on that is invasive and destructive to finish work adding unnecessary schedule and cost, overall schedule compression impact on landscape-trade partner, and TCO/fire alarm testing conflicts with landscape-irrigation work.
    c. Landscape-Irrigation Trade Partner. In some delivery systems such as progressive design build, the project landscape architect and in some cases their subconsultant irrigation designer take the irrigation design to around 60% construction documents then hands it off to the landscape-irrigation trade partner to finish the irrigation design. Historically on numerous capital projects this approach has not been effective, not added value to the design process, and has added unnecessary cost and delays, given the business model for the majority of landscape-trade partners is to install new irrigation, not design, thus, the landscape-irrigation trade partner typically hires another landscape architect or irrigation designer to finish the design, resulting in the remaining design process being extremely inefficient including errors and omissions that need to be resolved post-GMP during construction or warranty, with change orders, or left unresolved, and given limited Grounds capacity, many issues remain unresolved. The recommendation is to have the primary landscape architect and irrigation designer provide 100% construction documents and in the spirit of progressive design-build have the landscape-irrigation

trade partner review, provide recommendations (or questions), have the primary landscape architect and irrigation design make adjustments, if any, and have the landscape-irrigation trade partner formally adopt the final design. Note that a similar process should also be used for change orders to resolve issues during construction.

d. Architect. Irrigation content can include coordinating related work with consultants, engineers and architects, designing planting areas with dimensions that fit the specified water delivery media without overspray, green roof and vegetated membrane waterproofing, drainage, special growing media and ballast, safe access and fall protection, and maintenance access through non-program spaces for tools, soil, plant materials and green waste, penetrations, seals, and pathways, conduits, and chases for piping, power, Ethernet, and low voltage, preventing space and routing conflicts during design and installation such as irrigation pipe and wiring, domestic water, fire supply, fire hydrants, sanitary sewer, rain leaders and downspouts, storm drainage, foundation drainage, biofiltration cells and rain gardens, paving, light poles, signs, benches, and other field furnishings and site features, possible brownfield scope of work for the Montlake Landfill Project Guide at https://www.ehs.washington.edu/system/files/resources/montlake.pdf, and possible rainwater or gray water cisterns for irrigation. Lessons learned include backloading irrigation design resulting in changes post-GMP.
e. Landscape Architect & Irrigation Designer. Irrigation content can include providing landscape irrigation and planting demolition and protection plans, interim plans, and future state plans, working closely with Grounds, coordinating related work with other consultants and engineers, particularly mechanical-plumbing, electrical, and civil, providing site observation reports, punchlist, green roof irrigation including auto drains to prevent freeze damage in shallow growing media and ballast, special conditions such as high density support blocks for sprinklers, and backstopping prevention of space and routing conflicts during design and installation such as irrigation pipe and wiring, domestic water, fire supply, fire hydrants, sanitary sewer, rain leaders and downspouts, storm drainage, foundation drainage, biofiltration cells and rain gardens, paving, light poles, signs, benches, and other field furnishings and site features, possible brownfield scope of work for the Montlake Landfill Project Guide at https://www.ehs.washington.edu/system/files/resources/montlake.pdf, and possible rainwater or gray water cisterns for irrigation. Lessons learned include backloading irrigation design resulting in changes post-GMP.
f. Civil Engineer. Irrigation content can include coordinating related work with the landscape architect, mechanical plumbing, electrical and site electrical, and backstopping prevention of space and routing conflicts during design and installation such as irrigation pipe and wiring, domestic water, fire supply, fire hydrants, sanitary sewer, rain leaders and downspouts, storm drainage, foundation drainage, biofiltration cells and rain gardens, paving, light poles, signs, benches, and other field furnishings and site features, possible brownfield scope of work for the Montlake Landfill Project Guide at https://www.ehs.washington.edu/system/files/resources/montlake.pdf, and possible rainwater or gray water cisterns for irrigation.
g. Mechanical Engineer. Irrigation content can include modelling and detailing mechanical room irrigation point of connection (POC) assemblies, interior automatic control valves,

routing irrigation piping and water supply from the mechanical room to wall or ceiling penetrations to the site and green roofs, related work for frost free hose bibbs and roof hydrants, direct bury poly iso insulation and protective jacketing for freeze and kinetic protection of shallow pipe, booster pumps, pressure regulating valves for green roof pressure zones, and rainwater or gray water cisterns for irrigation.

h. Electrical Engineer. Irrigation content can include provisioning a 120 VAC dedicated circuit for irrigation controller power in the mechanical room or landscape, Cat6 Ethernet cable from the MDF/IDF to an Ethernet enclosure and to the irrigation controller, and coordinating with UW-IT to provision Ethernet on the Early Outlet Schedule including a subnet, IP address, subnet mask, and gateway on VLAN 2850, power, Ethernet, low voltage control and spare wire pathways and conduits from the mechanical room to wall or ceiling penetrations to the site, green roofs, power for heat trace tape for irrigation pipe in non-climate controlled areas, low voltage conduit water breaks or drains to prevent water intrusion into the controller and mechanical room, backstopping prevention of space and routing conflicts during design and installation such as irrigation pipe and wiring, domestic water, fire supply, fire hydrants, sanitary sewer, rain leaders and downspouts, storm drainage, foundation drainage, biofiltration cells and rain gardens, paving, light poles, signs, benches, and other field furnishings and site features, and pressure switches, pump start relays, programmable logic units, and float or transducer systems for rainwater or gray water cisterns for irrigation.
i. Structural Engineer. Irrigation related work can include green roof fall protection and ensuring viable on-structure weight allowances to support vehicles, equipment, and materials for lifecycle maintenance.
j. Commissioning Agent (CA). Irrigation related work includes coordinating inspecting, testing, and approving the irrigation submeter/deduct meter installation and application and setting up a monthly irrigation consumption meter reading route with SPU.
k. Grounds. Grounds maintains campus site, landscape and irrigation assets and is part of the Outside Maintenance Zone (OMZ) that maintains wet utilities – water distribution, storm, and sanitary, roads, pathways, hardscapes, and building envelope. Please reach out to process partner point of contact Brian Davis, project manager, OMZ, at bkdavis@uw.edu or 206 510-6013, to help coordinate Grounds participation. The Grounds project team consists of the project manager, campus urban forest specialist, supervisor, irrigation lead, and project area gardener lead(s). Grounds generally routes and defers input through the architects and engineers on record via PDG and can backstop findings and recommendations when needed.
l. Engineering Services (ES). Irrigation content can include advocating, collaborating and supporting Grounds for irrigation-landscape related mechanical-plumbing, electrical, civil, structural, and architectural content as described above.
m. UW-IT. Irrigation content can include coordinating with the Commissioning Agent and Electrical Engineer on the Early Outlet Schedule and provisioning Ethernet including setting up VLAN 2850, subnet, IP address, subnet mask, and gateway, pathways and enclosures from the IDF/MDF to the controller, and termination and testing.
n. EH&S & Facilities Safety. Irrigation content can include designs that avoid hazards, provide safe access, and fall protection, regulatory compliance, and training.

B. Basis of Design

General

1. This section applies to the design of underground irrigation systems for landscaped areas, lawns, planting beds, green roofs and vegetated membranes, athletic fields, and related work. Irrigation content in this section applies to all other sections and the perspective of each sections.
2. Also see sections Deliverables & Design Evaluation; Construction Submittals; Related Sections; and Installation, Fabrication and Construction.
3. FDS Irrigation is intended to inform scope, but all design and details must be developed on a case-by-case basis. Some details may need modification based on project specific needs before being incorporated into design.
4. For construction projects that affect site, landscape and irrigation assets, in addition to the project client/customer, Grounds is also a customer. Furthermore, when the project is finished, receiving a turnkey product is essential to sustainable lifecycle maintenance, particularly due to Grounds capacity constraints.
5. Given UW is Seattle's largest water user and the importance of water conservation in supporting the campus urban forest, ornamental landscapes, athletic fields, farms, and academic and research programs, FDS standard networked, automatic, underground irrigation is required for all capital construction with new landscape planting and/or impacts to existing landscaping.
6. Construction impacts to site, landscape, and irrigation shall be anticipated during project development and programming to allocate resources to protect and restore existing assets and provide new irrigation and other related work. Damage from construction must be restored and established to pre-construction conditions or better as determined by experts including Grounds and with respect to maintenance resource capacity. Note that the necessary inputs to achieve this are often underestimated or overlooked. For example, landscapes can take years to establish, especially in areas without standard irrigation, with hand watering only, or no irrigation at all, in addition to other challenging conditions such as unfavorable soil and drainage.
7. Irrigation systems that exceed half of the estimated 30-year lifecycle, obsolete systems, or those that are significantly damaged from and/or require extensive modifications by construction shall be replaced to current standards.
8. Non-standard irrigation with approved variances are not intended for cost control or budget constraints but are possible where needed for flexibility in design, products, execution, process and procedures on a case by base basis and in the spirit of the standards. An example is for smaller scale temporary irrigation systems to restore minor damage, re-establish existing plantings, and establish new plantings comprised of include a new domestic water connection including an AWWA gate valve to an irrigation gate valve, backflow assembly, pressure reducing valve, and a quick coupler valve to an on-grade battery control valve to on-grade piping and sprinklers, or a battery control valve on a building hose bibb to on grade pipe and sprinklers.

Design Criteria

General Design Requirements

1. Irrigation systems shall be supplied by potable water distribution and separated from the domestic water supply with a backflow prevention assembly. Non-standard rainwater, gray water, and hybrid systems including air gap backflow prevention require approved variances.
2. Underground irrigation pipe, wiring, appurtenances, sprinklers, and other irrigation assets shall be routed in installed in planting soil so that it can be excavated without having to dismantle adjacent features. When routed under hardscapes or within buildings, irrigation must be serviceable within sleeves, conduits, and chases. Concrete, hot mix asphalt, grass pave, gravel, synthetic turf, and other hard surfaces are considered hardscapes.
3. Irrigation designs must be developed in partnership with Grounds by a qualified landscape architect and/or irrigation designer and project team included related work.
4. Landscape and irrigation work must be performed by landscape-irrigation trade partners with at least 5 years of experience in moderate to large, public works or commercial landscape-irrigation construction and maintenance. General contractors or other trade partners cannot self-perform landscape-irrigation work.
5. As-built drawings must be maintained on site, updated daily, and made available for project review during construction.
6. Landscape-irrigation and related work shall not occur during saturated soil conditions as this can severely damage and compact the subgrade and topsoil.
7. Landscape-irrigation work shall not occur during or when freezing conditions are anticipated to prevent damage to irrigation, other property, and safety hazards such as ice on hardscapes.
8. Design irrigation systems and plantings for sequential controller operation of each irrigation zone to meet plant water requirements at 130% of 2025 peak evapotranspiration (ET) in the Seattle area to provide a margin for weather extremes and climate change with a water window between 10pm and 7am for up to 7 days per week during the grow-in period in the first full growing season or year 1, with the goal of reducing irrigation to 3 days per week in years 2 and 3, and to 2 days per week when fully established in year 4 onward. (Note that although sequential zone operation is simple, a shift to water budgeting with fixed days and water windows is likely to occur in the future which will likely require the more complex concurrent operation of multiple zones). Frequency of irrigation shall be based on plant water requirements and root zones, microclimate variables, seasonality, soil, and other factors, but in general, deeper, infrequent irrigation is healthier for plants to encourage deep rooting and drought resiliency. Also, fewer days of irrigation per week allows for maintenance, mowing, events, construction, and other disruptions.
9. The irrigation water velocity through copper piping and fittings in mechanical rooms and interior routing shall not exceed 7 feet per second, and the velocity through Schedule 40 PVC and Schedule 80 PVC in the landscape shall not exceed 5 feet per second.
10. Mainline Size. Size mainlines by adding the zone with the highest GPM with a quick coupler valve at 20 GPM and size the mainline for the aggregate GPM to emulate the concurrent operation of these two flow sources. For example, an irrigation system with the largest zone operating at 25 GPM and a quick coupler valve operating concurrently at 20 GPM with an aggregate flow of 45 GPM would require a 2-inch Sch. 40 PVC mainline to have a velocity less than 5 feet per second. This scenario occurs during seasonal maintenance and testing of automatic zone valves or

overseeding lawns with multiple daytime cycles to germinate and establish seed while a quick coupler is in use for hand watering or other uses. Furthermore, this margin can also support water budgeting and concurrent zone operation in the future.

11. Irrigation systems with a 3-inch or larger mainline shall be designed to permit gravity drainage with piping sloped at 1 to 2 percent to low points with manual drain valve assemblies.
12. Static & Operating Pressure
    a. Irrigation system static pressure range shall not vary by more than 10%. Exceeding this threshold can occur due to changes in elevation such as with building green roofs or topography. Mitigate by designing pressure zones including dedicated mainline runs and/or inline pressure reducing valves.
    b. Design irrigation system lateral piping to limit pressure drops to less than 20% of the average sprinkler operating pressure.
    c. Design to a maximum of 80 psi operating pressure for lateral piping with Marlex fittings, and do not exceed 90 psi operating pressure for lateral piping without Marlex fittings. Higher pressure is allowable through the irrigation POC assembly and to green roofs with pressure zones using dedicated pressure reducing valves as needed. Having a high pressure range offers flexibility for long range rotary sprinklers and maintenance using quick coupler valves. High pressure is moderated with pressure regulating automatic control valves and pressure reducing sprinklers to optimize performance and reduce misting.
    d. Design upstream operating pressure to be 15 psi greater than the operating pressure downstream of pressure regulating automatic control valves to optimize performance.
    e. To mitigate systems with excessive vertical elevation in landscape topography, design with inline check valves denoted on the plans and housed within Carson 910 enclosures to prevent low line drainage.
13. Design irrigation systems with topical irrigation using pop-up sprinklers only.
14. Do not design with drip irrigation. Note that Grounds had hundreds of drip zones and miles of subsurface drip tubing and still maintains legacy systems but with the exception of UW Farm use and temporary tree protection irrigation by third party arborists, no longer uses drip irrigation due to frequent leaks and disruptions of service from damage by cultivation, weeding, vandalism, and animals, and relatively higher lifecycle maintenance costs and shorter lifecycles compared to topical irrigation due to frequent repairs, annual manual flushing (in addition to auto flush valves), and cleaning filters. However, in rare circumstances, non-standard drip irrigation with an approved variance can be included in design.
15. Design and install irrigation systems to be winter rated for year-round use and so that they do not need to be drained and winterized. The specified soil cover over pipe satisfies this requirement. Non-standard shallow pipe cover depths with an approved variance must be reviewed and approved in advance by the Owner and Grounds, are only allowed when absolutely unavoidable, and require high quality polyiso direct bury rated insulation to emulate the R-value for 12-inches of soil cover for laterals, 18-inches of soil cover for mainline, and adjusted for concrete and crushed rock base course where 1” of soil R-value equals 0.2” of concrete or compacted crushed rock. This approach allows for year-round use to provide some supplemental irrigation during winter months during non-freezing conditions for natural and built rain shadows, for example, plantings under architectural cantilevers, root zones under spans, weather leeward sides of tall buildings or trees, and sensitive understory plantings with

dense canopy. Note that around 2008, following years of observation of minimal freeze damage of systems that were not winterized prior to hard freezing, follow on testing of ambient temperatures in valve boxes which remained above freezing due to ground heat, and due to insufficient capacity of Grounds to winterize all irrigation systems, Grounds modified operations to shut off controllers and water supplies of irrigation systems without winterizing. To date, annual freeze damage has been limited to a dozen or so cracked sprinklers with check valves that hold water that were excessively elevated and exposed above finish grade. Next, some UW plumbing shops still winterize irrigation systems in their maintenance zones such as the UW Medical Center. Also note that it is acceptable for contractors to winterize new irrigation systems during their warranty provided they provide supplemental winter irrigation as needed for rain shadow plantings. The winterizing process typically pre-drains mainlines and appurtenances via gravity through quick coupler valves and drain valves then compressed air is introduced via quick coupler valves at 40 to 50 psi to discharge remaining water from the mainlines and then laterals and sprinklers by cycling each zone.

16. As part of early design, field verify and update as-built information to represent accurate existing conditions, and test and document performance of existing irrigation to remain or be modified prior to construction including zone numbers, zone flow in GPM, operational status, and conditions including any damage.
17. Modifications
    a. Mainline. When designing extensions or modifications of an existing irrigation mainline pipe, at transitions between existing and new mainline piping and control wiring, provide gate valve assemblies for flow control, quick coupler valves to safely vent stored compressed air energy, and wiring splices with zone number tags on each side of each splice in valve boxes.
    b. Laterals. When designing extensions or modifications of an existing irrigation lateral pipe, to isolate existing from testing of new irrigation, at transitions between existing and new lateral piping, provide simple Sch. 40 PVC isolation ball valves for testing. When testing is completed, open ball valves and direct bury with no enclosures.
18. For transitions between new & existing irrigation, design to provide balanced coverage and matched precipitation at transitions between connected or separate new and existing irrigation systems, zones, and plantings.
19. Design irrigation to minimize risk of theft and vandalism including locks and locking mechanisms for valve boxes, vaults, control and spare wire conduit assemblies and splice boxes, controllers, enclosures, and disconnect switches, and provide rigid conduits with secure connections at above grade exterior locations.
20. Designs shall include direction to properly decommission all irrigation that will be supplanted by new irrigation and no longer in use including the abatement and removal and capping of piping, appurtenances, controllers, conduit, wiring, and sealing penetrations in mechanical rooms and landscapes. Where removal is not possible, for example, piping in a tree protection area, cap ends and abandon in place.

Irrigation Controllers

1. Interior wall mount irrigation controllers
    a. Also see Interior Mechanical Room Irrigation Controller – Wall Mount and Interior Mechanical Room UW-IT Ethernet to Irrigation Controller details.

b. Also see FDS Electrical standards and UW-IT Design Guide.
c. Also see Products, Materials, and Equipment section, and Installation, Fabrication, and Construction section.
d. Provide cross references between related work.
e. Design and specify to mount the irrigation controller adjacent to the irrigation POC assembly.
f. Design and specify to install the top of a wall mount controller enclosure to be 67.25-inches above finished floor.
g. Design, specify, and coordinate for no controller access conflicts or obstructions on the wall a minimum of 18 inches adjacent to the left side of the controller to allow the hinged door to fully open, 12 inches to the right side of the controller, with the same open clearances below the controller to the floor with the exception of supplemental controller related enclosures and conduits that do not project beyond the depth of the controller, and no floor access conflicts or obstructions a minimum of 4 feet in front of and to 1 foot to each side of the controller such as pipes, drains, conduits, or changes in floor elevation such as housekeeping pads.
h. Design and specify to make all low voltage connections between the controller, master valve, flow sensor, and automatic control valves via EMT terminated with single gang metal boxes with protective bushings at wiring outlets.
i. Design and specify alphanumeric adhesive labels 2-inches from control and spare wire terminations to denote zone numbers, names/descriptions for common wires, and names/descriptions for spare wire harnesses that correspond to the irrigation as-built plan and 11” x 17” color coded zone map/table.
j. Design, specify, and coordinate sufficient control and spare wire conduit sizes based upon the total wire quantity to use a maximum of 50% of conduit volume and to provide sufficient pull boxes per electrical code. For quantity, identify quantities of all wiring per the project irrigation plan including all common wires (white), dedicated master valve common (white), dedicated master valve hot (yellow), automatic control valve hot wires for each zone (red), looping spares per quantities noted herein (orange), non-looping spares per quantities noted herein (black), and a dedicated common (white) and hot (red) for the master valve.
k. Design, specify, and coordinate control and spare wire primary and spare conduits to be 2-inch in diameter minimum.
l. Design, specify, and coordinate Ethernet Cat6 cable from MDF/IDF via cable tray or EMT to an enclosure adjacent to the controller, typically a UW-IT Milbank box, a secure, NEMA 3R-rated metal enclosure, part number 12126-LC1 or similar, 12”x12”x6” with hinged cover, with a padlock ready three-point latching mechanism for a specific key, part number 2233, with a patch cord via EMT to a factory knock out on the controller. Coordinate with the project and UW-IT to utilize one of the ports in the Milbank box. If a multiport Milbank enclosure is not available, provide a dedicated junction box enclosure, NEMA-3, 16-gauge steel, 6”x6”x4” with a solid screw plate, with a biscuit jack inside and patch cord to the controller via EMT conduit.

2. Non-Standard Exterior Controllers with an Approved Variance

a. See Non-Standard Exterior Irrigation Controller with Approved Variance – Wall Mount and Non-Standard Exterior Irrigation Controller with Approved Variance – Pedestal drawings.
b. Non-standard exterior irrigation controllers with approved variances are only acceptable when conditions require, and not because of budget constraints. Examples include an athletic field or open space with no suitable adjacent building for mounting, a building with limited access, or where an exterior controller offers clear end user and lifecycle maintenance advantages.
c. Also see FDS Electrical standards and UW-IT Design Guide.
d. Also see Products, Materials, and Equipment section, and Installation, Fabrication, and Construction section.
e. Provide cross references between related work.
f. Design and specify to mount the irrigation controller adjacent to the irrigation POC assembly when both are exterior installations.
g. Design and specify to mount controller with top of wall mount cabinet 67.25-inches above finish grade.
h. Update interior controller products, materials, and equipment for exterior weather rated conditions.
i. Design, specify, and coordinate penetrations, seals, conduits and sweeps from the building into the controller, exterior rated rigid conduit with secure connections where above grade, and Ethernet connected to the campus central control system. Note that it is acceptable for exterior controllers to terminate Ethernet inside locking controller enclosures or supplemental locking NEMA-3 enclosures. Also see additional information in Interior Irrigation Controllers including Ethernet and control and spare wire conduit sizes.
j. Design and specify controllers and related work to be theft and vandal resistant.
k. Design and specify to make all low voltage connections between the controller, master valve, flow sensor, and automatic control valves, preferably underground and if above grade in rigid conduit with secure connections.
l. Design and specify alphanumeric adhesive labels 2-inches from control and spare wire terminations to denote zone numbers, names/descriptions for common wires, and names/descriptions for spare wire harnesses that correspond to the irrigation as-built plan and 11” x 17” color coded zone map/table.

Irrigation POC Assemblies

1. Interior POC Assemblies
    a. Most information for his item is included in FDS Mechanical standards – Potable and Nonpotable Water section. See the Water Header Configuration for Lab and Non-Lab Buildings drawing.
    b. Also see Interior Mechanical Room Irrigation Point of Connection Assembly detail and specification narrative for additional information.
    c. Also see Products, Materials, and Equipment section, and Installation, Fabrication, and Construction section.
    d. Design and specify irrigation POC assembles as part of building systems modelling, provide a project specific enlarged plumbing detail, provide a shop drawing, and

coordinate with related work including electrical for irrigation controller power, low voltage control and spare wiring, Ethernet, and pathways, cable trays, and conduits.

e. The deduct meter shall be a maximum of 4 feet above the finished floor, all other appurtenances a maximum of 5 feet above finished floor, and ball valves shall be a maximum of 6 feet above the finished floor. Note that a compact, hardwired, front-facing remote meter register model can be mounted away from the flow tube at the acceptable elevation if a workaround for a higher meter mounting is needed.
f. Mechanical room irrigation POC assemblies shall consist of Type L copper pipe and fittings, a tie-in upstream of the building pressure regulating valve, a full port ball valve or butterfly valve, a wye strainer (unless there is already an upstream building wye strainer), a backflow prevention assembly, a pressure reducing valve (PRV) assembly with upstream and downstream oil filled 0-150 psi pressure gauges, a normally open master valve, a flow sensor, a drain with a ball valve plumbed to a floor drain, a water hammer arrestor, a deduct meter, a full port ball valve or butterfly valve, and Type L copper pipe and fittings transitioning to Type K copper pipe and fittings a minimum of 2-feet from the foundation, wall, or ceiling penetrations and seals, to a serviceable direct bury condition in soil in the landscape and green roof.
g. Do not install a PRV bypass as this does not provide value and can be inadvertently left open putting the irrigation system at risk of damage from excessive pressure.
h. PRV designer note – PRVs with a maximum 75 psi setting are common for irrigation installations but may not offer sufficient pressure range, especially after losing up to 10 psi through POC assembly appurtenances. Although an irrigation pressure reducing valve is typically set not to exceed 80 psi given the risk of lag from automatic control valves with pressure reducing units, UW FDS Irrigation specifies a 10 – 125 psi range model to offer flexibility. For example, pressure reducing automatic control valves and sprinklers with pressure reducers allow for optimal nozzle performance at or below 30 psi, at 45 psi such as with MP Rotator nozzles, 60-psi for gear driven rotary stream nozzles, and maximum mainline pressure for quick coupler valve output. Or, for elevation changes where higher pressure is needed, for example, in a scenario with a minus 1 level mechanical room irrigation POC assembly and a 6th floor green roof with irrigation, at 6.3 floors (0.3 for raised planters on the 6th floor) * 0.43 psi loss per foot * 13-feet per story, this results in a 35 psi loss. So, if the primary mechanical room PRV is set at 108 psi (pressure at UW ranges from 75 to 120 psi depending on elevation, pressure zone, and if PRV control station settings), losing 5 psi through the remaining downstream POC assembly appurtenances and losing 35 psi for the increase in vertical elevation, the pressure on the 6th floor green roof will be 68 psi, which is sufficient to operate MP Rotators at 45 psi with a 15 psi upstream to downstream differential for optimal performance. Next, pressure at lower elevation green roofs and on-grade plantings would be controlled with pressure zones using inline pressure reducing valves on the warm side for each elevation pressure zone. Or, similarly, for variable landscape topography, based on maximum pressure at the highest topographical elevation, dedicated mainline runs or pressure zones might be needed at lower elevations where decreases in vertical elevation result in increases in pressure.
i. Design and specify Type K copper piping through the penetration and seal to the landscape or green roof, terminated in serviceable planting soil with a brass female

adapter, to an irrigation gate valve assembly(s), to PVC piping, fittings, an initial quick coupler valve(s), and other appurtenances, adjacent to a low voltage control and spare wire assembly. For planting areas in opposite directions from the penetration, provide two mainline branches, each with a gate valve assembly.

2. Non-Standard Exterior Irrigation POC Assemblies with Approved Variances
    a. Non-standard irrigation POC assemblies with an approved variance are only acceptable when conditions require, and not because of budget constraints. Examples include an athletic field or open space with no suitable adjacent building with interior plumbing infrastructure.
    b. Also see Non-Standard Exterior Irrigation Point of Connection Assembly with Approved Variance, Part 1 of 2 drawing, and Non-Standard Exterior Irrigation Point of Connection Assembly with Approved Variance, Part 2 of 2 drawing.
    c. Also see FDS Mechanical standards – Plumbing section, Electrical standards, and Civil standards.
    d. Design and specify a non-standard irrigation POC assembly with an approved variance as part of building and site modelling, with project specific details in the civil plans, the irrigation plans, and electrical and site electrical plans, and develop shop drawings based on actual field conditions for review and approval by the project, Owner and Grounds.
    e. Provide cross references between related work.
    f. Design and specify non-standard exterior irrigation POC assemblies with approved variances to be supplied by a domestic water source from an interior mechanical room or a dedicated exterior connection to a domestic water distribution system per the Civil sheets and not a building domestic service pipe or fire service pipe with a fully restrained mechanical connection or hot tap, followed by an AWWA C509 gate valve immediately adjacent to the connection, pipe and fittings, typically ductile iron, all fully restrained, per UW FDS Civil, Irrigation, and Seattle Public Utilities standards, to an irrigation POC with an FIPT service size connection.
    g. Design and specify an exterior irrigation POC assembly shall consist of bronze and brass pipe, nipples, and fittings to an irrigation gate valve assembly, into concrete vaults with a bronze full port ball valve, a wye strainer, a backflow prevention assembly, a pressure regulating valve with upstream and downstream oil filled 0-150 psi pressure gauges, a normally open master valve, a flow sensor, a drain with a hose connection and ball valve, a water hammer arrestor, a deduct meter, and a bronze full port ball valve, enclosed in a concrete vaults, or with a secondary variance, also in valve boxes and extensions, and with a tertiary variance, exclusively in valve boxes and extensions. Note that the number of enclosures will be contingent upon the size of the irrigation service and sizes and lay lengths of POC assembly appurtenances most commonly ranging from 1 to 2.5-inches.
    h. The irrigation system downstream of an exterior POC assembly shall consist of underground piping to gate valve assemblies, quick coupler valve assemblies, and automatic control valve assemblies, to sprinkler zones and sprinkler assemblies and other irrigation assets in the landscape.

System Layout

Overall irrigation systems shall consist of a point of connection POC assembly with piping and appurtenances and an irrigation controller in a mechanical room with conduits for power, control

wiring, and Ethernet for connection to the campus central control system, through penetrations and seals, to landscapes and on-structure green roofs, with underground piping to gate valves, quick coupler valves, automatic control valves to sprinkler zones, and other irrigation assets.
Design piping, control wiring, sleeves, and other irrigation to avoid installation and lifecycle maintenance and serviceability conflicts with other work and features.
Coordinate piping, control wiring, and other irrigation with new and existing trees. Do not route piping in tree protection zones. Provide a minimum of 8-feet of clearance between mainline and control wiring and a minimum of 5-feet between lateral lines and new trees. For small planters surrounded by hardscapes that are used as mainline and control wiring distribution nodes with incoming and outgoing sleeves to accommodate changes in direction, limit planting to groundcovers, small grasses, and small shrubs but not trees because the tree weight at maturity will break the pipe and wiring and the root mass will make it impossible to repair the piping and wiring without removing the trees. For narrow street planters where new trees are required, provide as much clearance as possible and use sleeves to protect pipe and control wiring in the anticipated mature root zones. For irrigation that needs to enter existing and anticipated tree protection areas, layout piping radially between known and anticipated root growth to avoid trenching and piping perpendicular to roots. Last, specify that trenching in tree protection areas shall be done by air spading, or by hand if permitted by the project and UW arborist. See FDS Tree Protection for additional requirements.

Piping

1. See Exterior Pipe Cover Depth drawing.
2. Design, specify, and show straight piping and directional changes that use common 45 and 90-degree fittings where possible although less common 11 and 22.5-degree fittings are acceptable.
3. Do not show curved or bent piping. If curved pipe is unavoidable under hardscapes, call out HDPE SDR-11 pipe within HDPE SDR-11 sleeves not to exceed manufacturer's recommendations for maximum deflection and provide transitions outside of sleeve ends to minimize stress at transitions with PVC pipe and fittings.

Sleeves

1. See Exterior Pipe Cover Depth drawing.
2. Design, specify, and show straight continuous sleeves with no directional changes.
3. Design, specify, and show sleeve layouts to accommodate pipe and fittings outside of sleeves to use common 45 and 90-degree fittings entering and exiting the sleeves where possible.
4. Design and specify sleeves sized at twice the aggregate diameter of the contents.
5. Do not design curved sleeves. If curved sleeves are unavoidable under hardscapes, call out HDPE SDR-11 pipe sleeves not to exceed manufacturer's recommendations for maximum deflection.

ASTM and ANSI

1. WSDOT, Road and Bridge Standards
2. ASTM B43 - Standard Specification for Brass and Copper Pipe and fittings
3. ASTM D1785 - Standard Specification for Schedule 40 PVC Pipe
4. ASTM D2241 - Standard Specification for PVC Plastic pipe

5. ASTM D2466 - Standard Specification for Schedule 40 PVC fittings
6. ASTM D2466-78 - Schedule 80 PVC fittings
7. ASTM D2564 - Standard Specification for PVC Solvent Cements
8. ASTM D2855 - Standard Recommended Practice for making Solvent Cemented Joints with PVC Pipe and Fittings
9. ASTM D3139 - Swing joint pipe and fittings
10. ASTM F-656 - Standard Specifications for PVC Primers
11. Foundation for Cross Connection Control and Hydraulic Research - University of Southern California

Gate Valve Assemblies

1. Also see Exterior Gate Valve Assembly detail.
2. Design gate valve assembly(s) in areas with serviceable planting soil without obstructions.
3. Design to include gate valves, at the start of mainline branches, every 200 feet or so for flow control and isolation, at the upstream side of sleeves greater than 40-feet, at work phase control points, at staging points for future expansion, and mainline terminations.

Quick Coupler Valve Assemblies

1. Also see Exterior Quick Coupler Valve Assembly drawing.
2. Quick coupler valves are used for pressure testing and as water sources for hand watering plantings and other maintenance.
3. Design, specify, and show a quick coupler valve(s) immediately downstream of the lead off gate valve(s) after the building penetration(s).
4. Design, specify, and show quick coupler valves every 100 feet or as needed to minimize water hoses crossing walkways, roads, and building entrances/exits, and particularly those designated as ADA/accessible.
5. Design, specify, and show quick coupler valves upstream of gate valves and at all mainline terminations to allow for the safe discharge of stored compressed air energy when filling empty or partially empty mainlines.

Frost Free Hose Bibbs

1. See the Plumbing section in the FDS Mechanical standards.
2. Design and specify frost free building exterior and roof hose bibbs for redundant hand watering and other maintenance.
3. Note that all buildings require working frost free hose bibbs at each elevation and each roof. For landmark buildings, the UW Design Review Board will collaborate with landmark agencies to ensure aesthetically acceptable options.

Zone Layout

1. Design and show irrigation zone numbering in a sequential flow on the plans. For example, starting at the point of connection, then clockwise or counterclockwise, separating on-grade zones with on-structure zones, with highest floor green roof as the last zone.

2. Design and show irrigation systems with automatic control valves top dedicated zones based on plant water requirements, microclimate variables, and soil structure, texture, and drainage, and plant types.
3. Microclimate variables include sun, shade, and wind exposure, plant canopy and density, reflective and radiant heat, rain shadows, slopes, on-structure plantings, and raised planters.
4. Plant types include turf, planting beds, temporary tree bubblers.
5. Design irrigation zones so that precipitation rates do not exceed infiltration rates.
6. For slopes, design zones on slopes with respect to contour lines and to not exceed 10 feet of vertical elevation to not exceed sprinkler check valve limits to prevent low line drainage. Design, specify, and show supplemental in-line check valves to prevent low line drainage.

Automatic Control Valve Assemblies

1. See Exterior Irrigation Automatic Control Valve Assembly drawing and Interior Irrigation Automatic Control Valve Assembly to Green Roofs or to Non-Standard Underground On-Grade Landscape Zones with an Approved Variance drawings.
2. Design, specify, and show one automatic control valve for each zone.
3. Design, specify, and show automatic control valves within the zone they control.
4. Design, specify, and show a single automatic control valve per enclosure.
5. Design, specify, and show automatic control valves within or adjacent to the zones they control, lawn zones in lawns, and planting zone and planting beds, and tree bubbler zones as zoned but most commonly in planting beds.
6. Design, specify, and size valves for pressure loss of 3-7 psi through the valve, to compensate for elevation in minus level mechanical rooms to on-grade and on-structure elevations including green roofs, and for flow ranges to support the proper function of pressure reducing automatic control valves.
7. Design, specify, and show all sprinkler zones with a minimum flow of 5 GPM or greater.
8. Specify Christy's valve tags with permanent, alphanumeric labels to denote zone numbers in each valve box and common wire and spare wire run names/descriptions at wire assembly box terminations. Zip tie to valve or valve box in an easy to see location that does not inhibit serviceability.
9. Design and specify that exterior automatic control valves are preferred for underground on-grade landscaping.
10. Design, specify, and coordinate interior automatic control valves for green roofs or vegetated membranes without sufficient soil cover or for a non-standard automatic control valve assembly with an approved variance for sites with limited planting areas as opposed to competing with automatic control valve boxes in the landscape.
11. Coordinate with Mechanical-Plumbing to design, specify, and show automatic control valves in mechanical rooms with in a vertical, upward flow position, with upstream and downstream bronze full port ball valves.

Valve Box Assemblies

1. See related drawings.
2. Also see Products, Materials, and Equipment.

3. Design, specify, and show valve boxes and extensions for each appurtenance and for low voltage wire conduits or splices. For non-standard exterior POC assemblies with an approved variance, it might be possible to house multiple appurtenances in larger enclosures.
4. Design, specify, and show valve boxes, valves, and quick coupler valves in lawns or planting beds at least 36-inches away from hardscape edges.
5. Design, specify, and show valve boxes parallel or perpendicular to adjacent rectilinear features and with the same clearances between features and valve boxes.
6. Design, specify, and show valve boxes and extensions of sufficient size to fit properly installed contents. Do not clam shell valve boxes. If doubling valve boxes in a nesting configuration instead of using extensions, show a minimum 1/3 overlap between boxes to prevent soil intrusion.
7. Design, specify, and show bricks at each corner of the load bearing valve box.
8. Design, specify, and show 1 to 2-inches of clearance between pipe, valve box cut outs, and bricks.
9. Design, specify, and show 3-inches of clearance between the top of the automatic control valve and bottom of the valve box lid and the bottom of the automatic control valve and finish elevation of pea gravel in a valve box.
10. Design, specify, and show filter fabric permanently affixed to the exterior of the valve box and wrapped to seal openings to prevent soil intrusion. Keep filter fabric and method of affixing at least 3-inches below the top of the valve box so that it is not visible, especially with reveals on slopes.

Swing Assemblies

1. See Exterior Irrigation Pop-Up Sprinkler Assembly drawing.
2. See other sections for ¾-inch and 1-inch swing assemblies.
3. Design, specify, and show swing assemblies with a 3-way range of movement at inlet and outlet connections for all sprinklers.
4. Design, specify, and show ½-inch sprinkler pre-assembled swing assemblies with a separate ½-inch Marlex street elbow on the inlet and a separate ½-inch Marlex street elbow on the outlet to provide double elbow connections.
5. Design, specify, and show ½-inch sprinkler custom swing assemblies with a ½-inch Marlex street elbow, a ½-inch barb x ½ inch MIPT elbow, a section of ½-flexible polyethylene piping not to exceed 24 inches, ½-inch barb x ½-inch MIPT elbow, and a ½-inch Marlex street elbow to the sprinkler connection.

Sprinklers & Nozzles

1. See Exterior Irrigation Pop-Up Sprinkler Assembly drawing and Exterior Irrigation Pop-Up Sprinkler Clearances drawing.
2. Design, specify, and show irrigation systems to prevent sprinklers from misting, overspray onto hardscapes and outside of planted areas, and blockage from plant materials, light poles, benches, seat walls, utility enclosures, and other obstructions.
3. Design, specify, and show parking wheel stops and curbs with sufficient setbacks to prevent blockage and damage to sprinklers and plant materials by vehicles.
4. Design, specify, and show sprinklers of the same manufacturer, model, and pressure ratings on the same zone.

5. Design, specify, and show modifications to existing zones including matching existing sprinklers and nozzles or retrofitting all sprinklers and nozzles.
6. Design, specify, and show sprinkler spacing with overlapping head-to-head coverage unless otherwise indicated by the manufacturer, for example, Rain Bird SQ Series nozzles have coverage-to-coverage spacing. For areas with consistent high wind, space sprinklers at 45 percent of diameter.
7. Design, specify, and show to not mix spray nozzles with MP Rotator nozzles on the same zone due to disparate precipitation rates with spray nozzles having around a 400% higher precipitation rates than MP Rotator nozzles.
8. Design, specify, and show to not mix Standard MP Rotator 1000, 2000, 3000, and 3500 nozzles with MP800SR and MP815 nozzles on the same zone due to disparate precipitation rates with MP800SR and MP815 nozzles having around a 200% higher precipitation rates than Standard MP Rotator nozzles.
9. Design, specify, and show mixing MP Corner, MP Corner Strip, and MP Side Strip nozzles with Standard MP Rotator nozzles or MP Rotator 800SR and MP 815 nozzles.
10. Design, specify, and show nozzles with matching precipitation rates on the same zones where possible.
11. Design, specify, and show short and medium range zones with MP Rotator nozzles where possible. Advantages include matched precipitation rates, superior distribution uniformity, ability to broadcast through vegetation with multi-trajectory streams, and low precipitation rates for slopes and compacted soil with slow infiltration rates, and lower output volumes translating to smaller automatic control valves, smaller lateral pipe and fittings, and reduced cost.
12. Design, specify, and show sprinkles and nozzles on systems with non-matched precipitation rates with rectangular layouts such as a soccer field with dedicated zones for each arc type and head-to-head spacing, and for curved layouts such as a softball field, group disparate arcs within a reasonable range of precipitation rates and head-to-head spacing.
13. Design, specify, and show sprinklers on slopes perpendicular to the average surrounding slope. Space sprinklers at 1% for every 1% increase in slope beyond 10%.[1] Percent of slope equals vertical rise in feet per 100 feet.[2] Reduce sprinkler spacing to the actual sprinkler radius at the crown of the slope and increase the spacing at the toe of the slope as to prevent overthrow beyond the bottom boundary of the slope.[3] Sprinkler design layout for slopes should be proportionate to the actual lineal feet of the hypotenuse (leg C), which would be misrepresented if scaled in plan view (leg A) resulting in stretched spacing. For clarification, call out actual spacing on the drawings. (Footnotes 1-3 reference Buckner Irrigation Systems Design Manual, First Edition 1988, pages 2-6.)

Hand Watering

1. Specify to regularly hand water and protect plants and root balls while staged awaiting planting. Also protect staged plant materials by staging in the shade but where sun and heat exposure is unavoidable protect with shade cloth and misters.
2. Specify for pre-planting to rehydrate dry and hydrophobic root balls, particularly for trees, by soaking root balls in water with 1-ounce of natural yucca surfactant per gallon of water to stimulate capillary action between dissimilar soils. If trees are too large to soak, carefully use a 3/8-inch nail to make 2-inch penetrations at 30-degrees off plumb and inward on the upper top quarter of the root ball at 12, 2, 4, 6, 8, and 10 o'clock positions for a 1.5 to 2-foot or larger root

ball, half the penetrations for small root balls, and use a funnel that fits the penetrations to slowly pour in the surfactant mixture.
3. Specify to hand water plants immediately following installation before and in conjunction with automatic irrigation to stimulate capillary action, ensure deep hydration of often disparate plant root ball soils and import soils which make lateral water transfer challenging, and to settle and remove air pockets from backfilled soils.

Conventional Low Voltage Control Wiring Systems

1. See Exterior Mainline, Control & Spare Wire Penetrations & Gate Assembly, Non-Standard Control & Spare Wire Penetration Assembly w/ an Approved Variance, and Green Roof or Vegetated Membrane Mainline, Control & Spare Wire Penetrations, & Gate Valve Assembly drawings.
2. Design, specify, and show irrigation systems with conventional control wiring.
3. Design, specify, and show conventional spare wiring with a minimum of 2 dedicated looping orange spare control wires and 1 white common wire for each mainline branch with up to 8 zones, 3 dedicated spare wires and 1 common wire for mainline branches with 9 to 16 zones, 4 dedicated spare wires and 1 common wire for mainline branches with 17 and more zones. For systems with known future expansion, stage the anticipated quantity of black non-looping spare wires and a common wire in a valve box.
4. Design, specify, and show the termination of all spare and common wiring in an enclosure at the furthest extent of each mainline branch.

2-Wire Low Voltage Control Wiring Systems

1. 2-wire systems are non-standard and require an approved variance. 2-wire installations are used when flexibility and/or future expansion is needed.
2. Design, specify, and show 2-wire control products including but not limited to 2-wire controller circuit boards, a single 2-wire decoder for each zone, 2-wire direct bury low voltage cable, and 3570GN Scotchlok Seal epoxy filled splices.

Trace Wire

1. Design, specify, and show dedicated, separate trace wires for the mainline and for each zone's lateral piping.
2. Design, specify, and show direct bury splices at tees.
3. Design, specify, and show to not overlap trace wire as this nulls an electromagnetic locate signal.

Contractor Maintenance Period

1. See Installation, Fabrication, and Construction.

Contractor Warranty Period

1. See Installation, Fabrication, and Construction.

C. Deliverables & Design Evaluation

The following information is required to evaluate the design:

1. GENERAL
    a. Also see Installation, Fabrication & Construction, Construction Meetings, Milestones, Testing & Inspections.
    b. Design irrigation on schedule with other related multidisciplinary work to maximize coordination and synergies. Do not backload irrigation design deliverables. If delayed, provide the same review duration without penalty for post-GMP changes.
    c. Provide design review opportunities to Grounds for each design phase listed below.
    d. Provide sufficient review meetings for each design phase listed below. Provide additional meetings or dedicated breakout meetings if needed.
    e. Provide email notification with (10) UW business days for review and comment for each design phase. Provide a formal process to review and comment such as a Bluebeam review Session.
    f. Provide a structured, over-the-shoulder, in-person, and/or a remote team review meeting within the first few days of the (10) UW business day review period to introduce deliverables, solicit input, and post comments in real-time for each design phase.
    g. Provide formal responses and a resolution process for each design review phase comment.
    h. 90% design review phase comments shall be resolved in the next design review phase or a dedicated backcheck design review phase.
    i. Design review phases can be modified with an approved variance, mutual agreement, and a written modification plan.
    j. The project shall provide and maintain a spreadsheet to track comment resolution progress and action item tasks in each design review phase.
    k. The project shall translate alternative design formats such as the CDR process to design review phases outlined herein.
    l. Schedule separate inspections of kinetic construction work.

2. 50% PROGRAMMING PHASE
    a. Show the project work area and confirm it includes ALL anticipated disruptions including but not limited to site access, trailer areas, staging, and utility connections.
    b. Identify area and scope of work omissions and impacts on design and operations-Confirm FDS Irrigation standards apply to irrigation and related design work.
    c. Declare proposed non-standard products and practices that require variances, submit variance requests, provide a complete description of why the standards cannot or should not be followed. See the UW Variance Request & Decision Process at https://facilities.uw.edu/files/media/uwf-ds-variance-process.pdf.
    d. Review and comment on variances and impacts on design and operations.
    e. Declare LEED and other building and site rating system pursuits.

3. 90% PROGRAMMING PHASE
    a. Backcheck previous phase revisions.
    b. Resolve work area and scope of work omissions and impacts on design and operations.

c. Resolve variances and impacts on design and operations or disapprove variances.
d. Identify relevant LEED and other building and site rating system requirements.

4. 50% AS-BUILT DRAWINGS, EXISTING CONDITIONS & DESIGN STRATEGY PHASE

   a. Note that existing conditions can require overlaying decades and multiple layers of non-integrated drawings and modifications.
   b. Identify Docfinity record drawings and as-built links.
   c. Conduct a team site walk to document existing conditions and markup plans including modifications, actual zone numbers, and the operational condition and damage for each zone.
   d. Propose rough design strategy options including demo of existing and replacing with new and/or integrating existing with new.
   e. Provide narrative to achieve relevant LEED and other rating system compliance.

5. 90% AS-BUILT DRAWINGS, EXISTING CONDITIONS & DESIGN STRATEGY PHASE

   a. Backcheck previous phase revisions.
   b. Provide a multi-phase design strategy narrative, actual multi-phase markups with notes and call outs, and relevant checklists for LEED or other building rating system compliance.

6. 50% DEMOLITION, LOGISTICS, TEMPORARY IRRIGATION & INTERIM CONDITIONS PHASE

   a. Backcheck previous phase revisions.
   b. Show and specify interior and exterior irrigation capping, removal, and proper decommissioning of existing piping, control wiring, and other irrigation.
   c. Show and specify capping and abandoning in place of existing irrigation when removal is not possible such as irrigation within the root protection area of a tree.
   d. Show and specify modifications and layout of temporary irrigation including but not limited to a POC assembly, control, low voltage wiring, mainline piping, lateral piping, sprinkler assemblies, and possible drip irrigation installed, maintained, and managed by a third-party arborist.
   e. Provide mainline and lateral piping layouts and protection with respect to construction phasing to prevent damage and disruptions of temporary irrigation service. For example, although temporary irrigation is often installed on-grade inside tree protection fencing or adjacent to the site protection fence, pipe routing to interior areas can be vulnerable to construction activity and might need to be sleeved and buried, especially in access and travel routes.

7. 90% DEMOLITION, LOGISTICS, TEMPORARY IRRIGATION & INTERIM CONDITIONS PHASE

   a. Backcheck previous phase revisions.

8. 90% SCHEMATIC DESIGN – FUTURE STATE IRRIGATION

   a. Backcheck previous phase revisions.
   b. Show the irrigation POC assembly and controller location.
   c. Show the Irrigation Legend and preliminary contents.
   d. Show Irrigation Notes and preliminary contents.

e. Show irrigation zones as polygons denoted with sprinkler type and square feet.

9. 50% DESIGN DEVELOPMENT – FUTURE STATE IRRIGATION
    a. Backcheck previous phase revisions.
    b. Show the mainline layout, gate valves, quick coupler valves, and automatic control valves.
    c. Identify related work, responsible parties, and cross references.

10. 90% DESIGN DEVELOPMENT – FUTURE STATE IRRIGATION
    a. Backcheck previous phase revisions.
    b. Show lateral pipe and sprinkler layout for each zone.
    c. Show sprinkler and nozzle types.
    d. Provide section 32 84 00 specifications.
    e. Provide irrigation details.
    f. Coordinate related work, responsible parties, and cross references

11. 50% CONSTRUCTION DOCUMENTS – FUTURE STATE IRRIGATION
    a. Backcheck previous phase revisions.
    b. Show design calculations and schedules.
    c. Show mainline pipe size in the plans and Irrigation Schedule.
    d. Provide GPM and automatic control valve size for each zone and update the Automatic Control Valve Schedule.
    e. Provide lateral pipe sizes in the plans and Irrigation Schedule.
    f. Finalize Irrigation Schedules.
    g. Incorporate late logistics and other changes into the plans, specifications, and details. Exclude change orders and require the GC to be responsible for additional costs resulting from additional irrigation scope and related work resulting from Logistics plans provided after GMP.
    h. Complete relevant LEED and other rating system requirements.
    i. Provide and coordinate cross references between related work in the plans, specifications, details, & schedules.
    f. Verify completion of related work, responsible parties, and cross references.

12. 90% CONSTRUCTION DOCUMENTS – FUTURE STATE IRRIGATION
    a. Backcheck previous phase revisions.
    b. Incorporate late logistics and other changes.
    c. In addition to projects with multiple irrigation and planting sheets with match lines, and dedicated plantings sheets for trees, shrubs, and groundcovers, provide aggregate single sheet irrigation and planting single sheets with all features. These are especially helpful for digital review.
    d. Verify relevant LEED or other rating system compliance.

13. 100% CONSTRUCTION DOCUMENTS BACKCHECK – FUTURE STATE IRRIGATION
    a. Backcheck previous phase revisions.

14. ADDENDA
    a. Review, comment, resolve.
15. POST GMP
    a. Review, comment & resolve CDR, RFI, scope revisions, unforeseen conditions, ASI, & change orders.

D. Construction Submittals

1. Although Grounds generally provides and defers input through the architects and engineers on record via PDG, the opportunity for timely participation is required.
2. Grounds should review with at least (10) UW working days after the Landscape Architect and Irrigation Designer and other consultants for related work review and before final approval. Submittals should be communicated to Grounds and processed by the project and/or PDG.
3. Landscape-Irrigation Submittals Provided by the General Contractor
    a. An SPU Submeter Application submittal.
4. Irrigation Submittals Provided by the Landscape-Irrigation Trade Partner
    a. Pre-qualification submittal
    b. Irrigation product submittal
    c. Irrigation POC water pressure test.
    d. Irrigation as-built submittal per CAD & BIM standards requirements.
    e. Irrigation color coded laminated zone map and table. Two hardcopies and a pdf submittal of 11” x 17” zone map and table, landscape orientation, laminated reductions of as-built irrigation plans, color coded zones/piping, enlarged zone numbers, and highlighted or circled quick couplers if needed for clarity, and a color coded table on the reverse with zone numbers, plant type descriptions, e.g. shrubs, groundcovers, dedicated tree zone, lawn, type of sprinklers and nozzles, and zone precipitation rates. Provide and submit pdf as part of eO&M Manual and to Grounds.
    f. Planting as-built submittal per CAD & BIM standards requirements. Include all substitutions in place of deleted plant materials.
    g. Contractor maintenance period irrigation maintenance submittal.
    h. Contractor maintenance period landscape maintenance submittal.
    i. Electronical Operation & Maintenance Manual (eO&M) submittals per UW Records requirements.
    j. Owner & Grounds training video and related documents submittal per Division 1 requirements.
    k. Provide comprehensive site progress digital photos and brief descriptions including geolocated links to a plan markup to UW Records.
5. Landscape-Irrigation Submittals Provided by Landscape Architect & Irrigation Designer
    a. Package site observations reports and a start to finish completed punchlist submittal to UW Records.
    b. Provide the following irrigation metrics in spreadsheet formula including all calculations.
        i. Provide the square feet for each irrigation zone.
        ii. Provide the total square feet for on-grade irrigation.
        iii. Provide the total square feet for on-structure irrigation.
        iv. Provide the total square feet for all irrigation.
        v. Provide an engineer’s cost estimate for the irrigation POC assembly.
        vi. Provide an engineer’s cost estimate for the irrigation controller assembly.
        vii. Provide a dollar per square foot estimate for on-grade irrigation.
        viii. Provide a dollar per square foot estimate for on-structure irrigation.
        ix. Provide an estimate for annual irrigation consumption in gallons and CCFs.

x. Provide an estimate in dollars for an annual water budget for the aggregate irrigation system at current Seattle Public Utilities (SPU) commercial summer water rates.
xi. Provide an estimate in dollars for an annual sewer submeter credit at current SPU rates.
xii. Provide an estimate in dollars for a net annual water budget for consumption less wastewater credit.

E. Related Sections

1. Mechanical Design Standard
    a. For standard interior mechanical room irrigation POC assembly and related work, specifically detail SD-M-19B.
2. Metering & Monitoring Design Standard
    a. For irrigation deduct meters, see FDS Specification Section 23 05 19.31, Sewer Sub-Meter, 1.2.A.2.a & b
    b. Seattle Public Utilities (SPU) sewer submeter requirements at https://www.seattle.gov/utilities/construction-resources/sewer-and-drainage/sewer-submeter-program Sewer Submeter Requirements.
    c. For irrigation controller Ethernet provisioning, see Specification Section 26 08 00.11, Electrical Meter Startup, Commissioning, and Integration, 1.6
4. Electrical standards and standard specifications
5. UW-IT Design Guide
6. Civil Design Standard
7. Division 01 50 00 Temporary Facilities and Controls
8. Division 01 56 39 Temporary Tree and Plant Protection Temporary Conditions
9. Planting & Trees standard specifications
10. UW Integrated Pest Management Plan
11. Trees - additional standard specifications

F. Products, Materials, and Equipment

1. General
    a. The Products, Materials, and Equipment section applies to the products, materials and equipment for underground irrigation systems for landscaped areas, lawns, planting beds, green roofs and vegetated membranes, athletic fields, and related work. Irrigation content in this section applies to all other sections and the perspective of each sections.
    b. Also see Basis of Design including design phase meetings; Deliverables & Design Evaluation; Construction Submittals; Related Sections; and Installation, Fabrication, and Construction.
    c. Also see Basis of Design, Installation, Fabrication, and Construction, and Drawings. The guidance below is based upon previous projects, however, the GC determines work packages and which trade partners furnish and install irrigation products.
    d. Both the landscape-irrigation and electrical trade partners furnish and install controller related irrigation products. The landscape-irrigation trade partner furnishes the irrigation controller, the electrical trade partner installs the controller and related work including power, conduits, Ethernet connections, etc., and the landscape-irrigation trade partner installs and connects the low voltage control and spare wiring. Non-standard irrigation controllers with an approved variance might also include rough carpenter and masonry trade-partner support.
    e. Both landscape-irrigation and mechanical-plumbing trade partners furnish irrigation appurtenances for interior mechanical room irrigation POC assemblies, and the mechanical-plumbing trade partner installs these products. For non-standard exterior irrigation POC assembly with an approved variance, the utility trade partner furnishes and installs domestic waterworks to an irrigation POC and the landscape-irrigation trade partner furnishes and installs the exterior irrigation POC assembly
    f. The Landscape-Irrigation trade partner furnishes and installs all other exterior irrigation products in the landscape.
    g. Size piping, fittings, and appurtenances per the irrigation design requirements.
    h. All materials used throughout the system shall be new, unused, and in perfect condition except as noted. Refer to the irrigation materials legend, notes, detail drawings and these standards for specific equipment to be used. Equipment or materials installed or furnished without prior approval of the Owner's Representative may be rejected and the Contractor will be required to remove such materials from the site at his own expense.

2. Interior Irrigation Controllers
    a. The landscape-irrigation trade partner furnishes, the electrical trade partner and UW-IT installs.
    b. Also see FDS Electrical, UW IT Design Guide, and early outlet schedule.
    c. Also see CS3000 Designer's Guide
    d. Also contact Steve Budinich, Calsense Account Management, 206 396-7307, steve.budinich@calsense.com
    e. Controller
        i. CS3000, Part Number: CS3. No exceptions.
        ii. Provide a dedicated 120v circuit for fixed equipment.

f. Stations. Part Number: -8, -16, -24, -32, -40 & -48
g. Enclosure
    i. Wall Mount, Part Number: -WM
    ii. See Interior Mechanical Room Irrigation Controller – Wall Mount detail.
h. Communication
    i. Ethernet, Part Number: -EN. No exceptions.
    ii. Non-standard cellular requires an approved variance.
i. Ethernet Pathway & Enclosure
    i. Also see FDS Electrical and UW-IT Design Guide
    ii. Also see Basis of Design
    iii. See Interior Mechanical Room UW-IT Ethernet to Irrigation Controller detail.
j. Ethernet Provisioning
    i. Set up VLAN 2850, subnet, IP address, subnet mask, and gateway, and termination and testing. No Exceptions.
k. Control Wiring Modules, Conventional, Default (no part number)
    i. Conventional, Default (no part number). No exceptions.
    ii. Non-standard 2-Wire and decoders with an approved variance.
l. Transient surge protector, Part Number: TP-100. No exceptions.
m. Provide an additional locking enclosure often mounted below the controller for wire splices, spare wire bundles, and other features such as transient surge protection and a power disconnect switch. If a separate enclosure is not necessary, provide a lock on the power disconnect switch.
n. Provide adhesive alphanumeric labelling to denote zone numbers, common wire names/descriptions, and spare wire names/descriptions on low voltage control wiring in controller.
o. Provide sufficient control and spare wire conduit sizes based upon the total wire quantity to use a maximum of 50% of conduit volume and to provide sufficient pull boxes per electrical code. For quantity, identify quantities of all wiring per the project irrigation plan including all common wires (white), dedicated master valve common (white), dedicated master valve hot (yellow), automatic control valve hot wires for each zone (red), looping spares per quantities noted herein (orange), non-looping spares per quantities noted herein (black), and a dedicated common (white) and hot (red) for the master valve.
p. Design, specify, and coordinate control and spare wire primary and spare conduits to be 2-inch in diameter minimum.

3. Non-Standard Exterior Controllers with an Approved Variance

a. The landscape-irrigation trade partner furnishes and the electrical trade partner and UW-IT installs. Note rough carpenter and mason trade partners provide support to furnish formwork and a concrete pad for pedestal models.
b. See Non-Standard Exterior Irrigation Controller with Approved Variance – Wall Mount and Non-Standard Exterior Irrigation Controller with Approved Variance – Pedestal drawings.
c. Also see FDS Electrical, UW IT Design Guide, and early outlet schedule.
d. Also see https://www.calsense.com/wp-content/uploads/2021/08/Designers-Guide-2025.pdf
e. Also contact Steve Budinich, Calsense Account Management, 206 396-7307, steve.budinich@calsense.com

f. Adapt all interior products, materials and equipment for exterior weather-rated conditions.
g. Enclosures
    i. Stainless Steel Pedestal, Part Number: -S
    ii. Wall Mount, Part Number: -WM
h. Additional enclosure requirements
    i. Provide a separate, locking NEMA 3 enclosure by others, often mounted below the controller, for wire splices, spare wire bundles, and other features such as transient surge protection and power disconnect switch. If a separate enclosure is not necessary, provide a locking power disconnect switch.
i. Provide exterior rated rigid conduits with secure connections. See Interior Irrigation Controller for addition information for Ethernet and conduit sizes.
j. Provide controllers and related work to be theft and vandal resistant.
k. Provide adhesive alphanumeric labelling to denote zone numbers, common wire names/descriptions, and spare wire names/descriptions on low voltage control wiring in controller.

4. Bronze Full Port Ball Valves

    a. See FDS Mechanical-Plumbing for bronze full port ball valve models for interior mechanical room installation. The plumbing trade partner furnishes and installs.
    b. For interior mechanical room irrigation POC assembly, mainline pipe size, upstream and downstream of irrigation POC assembly, for drains plumbed to a floor drain on the POC assembly, ¾-inch, and as isolation valves upstream and downstream of interior mechanical room manifolded automatic control valves, lateral pipe size.
    c. Furnished and installed by the landscape-irrigation trade partner as part of standard quick coupler valve keys.
    d. Furnished and installed by the landscape-irrigation trade partner with a non-standard exterior POC assemblies with an approved variance.
    e. NIBCO Two-Piece, Full Port, Bronze Ball Valve, or approved substitute.

5. Wye Strainer

    a. See FDS Mechanical-Plumbing for backflow models for interior mechanical room installation. The plumbing trade partner furnishes and installs.
    b. Also used with non-standard exterior POC assembly with an approved variance. The landscape-irrigation trade partner furnishes and installs.
    c. Zurn/Wilkins SXL.

6. Backflow Prevention Assembly

    a. See FDS Mechanical-Plumbing for backflow models for interior mechanical room installation. The plumbing trade partner furnishes and installs.
    b. Also used with non-standard exterior POC assembly with an approved variance. The landscape-irrigation trade partner furnishes and installs.
    c. Febco LF850-QTDC double check valve assembly.

7. Pressure Reducing Valves (PRV)
    a. See FDS Mechanical-Plumbing for the install drawing and FDS irrigation for product information for interior mechanical room installation. The landscape or plumbing trade partner furnishes and the mechanical-plumbing trade partner installs.
    b. A PRV for a non-standard exterior POC assemblies with an approved variance is furnished and installed by the landscape-irrigation trade partner.
    c. Also see Basis of Design and Installation, Fabrication, and Construction for designer and installer notes regarding pressure settings.
    d. Wilkins 500XL-HLR pressure reducer, 10 – 125 psi range (do not exceed 80 psi without Owner approval), no strainer, or approved substitution.

8. Master Valve
    a. See FDS Mechanical-Plumbing for the install drawing and FDS irrigation for product information for interior mechanical room installation. The landscape-Irrigation trade partner furnishes this appurtenance and the plumbing trade partner installs. A master valve for a non-standard exterior POC assembly with an approved variance is furnished and installed by the landscape-irrigation trade partner.
    b. Superior 3300 Normally Open Master Valve. No exceptions.

9. Flow Sensor
    a. See FDS Mechanical-Plumbing for the install drawing and FDS irrigation for product information for interior mechanical room installation. The landscape-Irrigation trade partner furnishes this appurtenance and plumbing trade partner installs. A flow sensor for a non-standard exterior POC assembly with an approved variance is furnished and installed by the landscape-irrigation trade partner.
    b. Using the table below, size flow sensors to capture the system flow range comprised of the zone with the lowest flow (5 GPM or greater for optimal automatic valve performance) to the highest flow condition represented by the zone with the highest flow in GPM operating concurrently with a quick coupler valve at 20 GPM. For example, if the lowest flow zone is 5 GPM and the highest flow condition is 50 GPM with the concurrent operation of the highest zone at 30 GPM and a quick coupler valve at 20 GPM, the flow sensor should be sized at 1.5-inch. In the case of planned expansion, consider size of future zones when sizing the flow sensor. Do not use plastic flow sensors for interior installations. No exceptions.

Exterior	Interior	GPM	Size	Model	Type
Yes	Yes	2 - 35	1-inch	Calsense 1” tee flow sensor, model FM	Brass
Yes	Yes	3 - 55	1.25-inch	Calsense 1.25” tee flow sensor, model FM	Brass
Yes	Yes	4 - 80	1.5-inch	Calsense 1.5” tee flow sensor, model FM	Brass
Yes	No	4 - 80	1.5-inch	Calsense 1.5” tee flow sensor, model FM	Plastic
Yes	Yes	10 - 250	2-inch	Calsense 2” tee flow sensor, model FM	Brass
Yes	No	10 - 250	2-inch	Calsense 2” tee flow sensor, model FM	Plastic

10. Irrigation Sewer Submeter or Deduct Meter
    a. See Mechanical Plumbing for interior mechanical room installation. The mechanical-plumbing trade partner typically furnishes and installs this appurtenance. For non-standard exterior irrigation POC assemblies with an approved variance, the landscape-irrigation trade partner furnishes and installs.
    b. For additional information
        i. Provide Waterflux 3070
        ii. Rick Kendal, Branom Instrument Company, Outside Sales – NW Washington, 360 791-2185, rkendall@branom.com
    c. Krohne Waterflux 3070F battery powered electromagnetic water meter with a combined short lay length flow tube and flow converter (register) configured to meet the Seattle Public Utilities (SPU) Itron standard for Automatic Meter Reading (AMR) with a factory potted cable connection and cable to a 100W Encoded Radio Transmitter (ERT) in Hard to Read (H2R) mode to upload monthly consumption data by SPU for wastewater credit to UW and for setup, testing, and remote data collection by UW end users. Specify ERT cable length at 15, 30, or 70-feet with the 15-foot option most common. No exceptions.
    d. Non-standard Krohne Waterflux 3070C with an approved variance. Same as above but with a separate flow tube with a factory potted connection and cable to a separate front facing converter for use where conditions require. For example, for interior mechanical room installations, if the top of a meter cannot be installed at a maximum of 4-feet above the finished floor per SPU meter reader requirements, or for exterior installations where the register cannot easily be read or where a permit required confined space entry is needed, the remote converter can be mounted in an easy to read elevation at eye level or in a utility enclosure for a non-standard exterior irrigation POC assembly with an approved variance. Specify ERT cable length at 15, 30, or 70-feet with the 15-foot option most common. Specify converter cable length at 15, 30, or 70-feet with the 15-foot option most common.
    e. Size. Size the deduct meter for the pipe diameter of the POC assembly, most commonly 1.5-inch but also 1-inch, 1.25-inch, and 2-inch, within the system flow range, and manufacturers recommendations. A ½-inch reduction in meter size relative to pipe size is allowable if needed to capture a lower flow range. Note that savings are negligible for smaller meters with the delta between a 2-inch and 1-inch meter at $46 list price based on a recent quote.
    f. 100W Encoded Receiver Transmitter (ERT) in Hard to Read (H2R) mode – see above.

11. Water Hammer Arrestor
    a. See Mechanical Plumbing for interior mechanical room installation. The mechanical-plumbing trade partner furnishes and installs this appurtenance. For a non-standard exterior irrigation POC assembly with an approved variance the landscape-irrigation trade partner furnishes and installs.

12. Solvent Welding
    a. Primer, Weld-On P-70 Purple for PVC, or approved equal.
    b. Cement, Weld-On 711 Gray for PVC, heavy bodied, medium setting, or approved equal.

13. Mainline Pipe & Fittings
    a. For size, see Basis of Design.
    b. Type K Copper. From the building mechanical room penetration to the landscape transitioning in planting soil in a serviceable irrigation gate valve assembly to PVC pipe. See Basis of Design.
    c. Brass & Bronze Nipples. A connection option from the domestic water supply irrigation POC to a non-standard exterior POC assembly with an approved variance and to connect appurtenances within a non-standard exterior POC assembly with an approved variance.
    d. Schedule 80 PVC
        i. For a non-standard exterior irrigation POC assembly with an approved tertiary variance with valve box enclosures, Furnish and install this option from the domestic water supply irrigation POC to a non-standard exterior POC assembly with an approved variance, for automatic control valve assemblies including Sch. 80 threaded-on-one-end (TOE) non-extruded nipples, Sch. 80 MIPT x MIPT unions, and Sch. 80 FS x MIPT unions, for connections to non-standard HDPE pipe with an approved variance, and 3-feet upstream and downstream of 125# AWWA gate valve assemblies for irrigation systems with mainlines larger than 2.5-inches.
        ii. Marked with the manufacturer's name, class of pipe, NSF seal and date of manufacturing run. Pipe shall bear no evidence of interior or exterior extrusion marks. Conform to US Standard PS 22-70, ASTM D2241, ASTM D 1784, D3139, and D1869.
    e. Schedule 40 PVC
        i. Irrigation mainline piping in the field for underground on-grade and on-structure irrigation.
        ii. Marked with the manufacturer's name, class of pipe, NSF seal and date of manufacturing run. Pipe shall bear no evidence of interior or exterior extrusion marks. Conform to US Standard PS 22-70, ASTM D2241, ASTM D 1784, D3139, and D1869.
    f. Non-Standard High-Density Polyethylene (HDPE) with an approved variance, SDR 11, possibly SDR-9, on a case-by-case basis. Applications include but are not limited to the following.
        i. For unavoidable directional changes under hardscapes, or within deep bioretention cell profiles where piping is not easily serviceable, for soil conditions with differential settling, or on hillsides at risk of soil creep, pipe routing can be mitigated by use of HDPE pipe and bending within allowable manufacturer deflection limits and with transitions configured to avoid stress on PVC pipe and fittings.
        ii. Connections between PVC to HDPE SDR 11 can be made with special fused fittings or with conventional fittings using a Sch. 80 socket by FIPT coupler to a brass MIPT x barb fitting inserted into HDPE pipe after heating to a slightly malleable condition in non-boiling water or with a temperature controlled heat gun per industry standards and best practices, with each connection immediately secured with (2) stainless steel marine grade hose clamps, to a brass barb fitting x MIPT, then same as above in reverse process.
        iii. Full scale non-standard HDPE mainline installations require an approved variance including dedicated design, product and execution specifications based on industry standards, best practices, and required installer certifications.

14. Mainline Repair Couplers
    a. Design and specify solvent welded mainline couplers.
    b. Where solvent welded connections are not possible and with Owner and Grounds approval, provide Romac Style 511 Couplings, with 5-inch barrel length for sizes 1 – 1.5-inch and 7-inch barrel length for pipe sizes 2-inch to 2.5-inch. Provide stainless steel marine grade bolts. Install per manufacturer's instructions including torque wrench settings to tighten bolts. No substitutions.
    c. Do not use PVC slip fixes or PVC compression couplers on mainline or lateral piping. Provide similar but restrained fittings for 3-inch and above.

15. Mainline Sleeves
    a. Schedule 80 PVC pipe under roads, road rated pathways, and pedestrian pathways.
    b. Non-Standard HDPE pipe with an approved variance to contain variance approved internal HDPE piping.
    c. Size twice the volume of internal contents and a minimum of 4-inches in diameter.

16. Mainline Gate Valves
    a. Nibco T-113 with bronze hand wheel or approved substitution. 2.5-inch and smaller diameter shall be bronze (ASTM B-62) valve, FIPT x FIPT, with bronze solid wedge, integral taper seats with a non-rising stem.
    b. AWWA #125. All gate valves larger than 2.5-inch diameter shall be threaded iron body, brass trimmed, resilient wedge, integral taper seats with non-rising stem, and square operating nut.

17. Quick Coupler Valves
    a. Buckner QB44LRC-10 or Rain Bird 44-LRC, 1-inch NPT, two-piece, single-slot quick coupling valve. No substitutions.
    b. Enclosures
        i. Enclose quick coupler valves in furnished by owner installed by contractor (FOIC) concrete protective rings – see Exterior Quick Coupler Valve Assembly drawing. No Exceptions.
        ii. For non-standard enclosures with an approved variance, quick coupler valves can be enclosed in Carson 910 valve boxes, tee lid, black, labelled irrigation, with 5/8-inch clear rock inside and under the valve box to stabilize the assembly.

18. Quick Coupler Keys
    a. Buckner or Rainbird 44K to a Nibco 1-inch, two-piece, full port, bronze ball valve, or approved substitute, to a 3-inch brass nipple, to a brass 1-inch FIPT by ¾-inch male hose swivel SH-1. No substitutions.

19. PVC Ball Valves
    a. Spears Sch. 80 PVC True Union (TU) 2000 Standard Blocked Ball Valve. Part of an automatic control valve assembly upstream of an automatic control valve. Size same as automatic control valve size. Kit contains FS and FIPT connections up to 2-inch. No Substitutions.
    b. Sch. 40 PVC ball valves, FS x FS, for separating new and existing zone laterals for pressure testing and to be opened and direct buried when testing is completed.
    c. Sch. 40 PVC ball valves, FIPT x FIPT, ½-inch, ¾-inch, and 1-inch, to temporarily connections on swing assembly outlets to vent air and close for pressure testing.

20. Automatic Control Valves
    a. Also see Exterior Irrigation Automatic Control Valve Assembly drawing and Interior Irrigation Automatic Control Valve Assembly to Green Roofs or to Non-Standard Underground On-Grade Landscape Zones with an Approved Variance drawings.
    b. Rain Bird PEB Series automatic control valves for all sprinkler zones. No Substitutions.

21. PRS-Dial.
    a. Provide PRS-Dial pressure regulating units for each automatic control valve per the manufacturer's flow & pressure loss chart. For best performance, design system for a 15-psi operating pressure differential upstream and downstream of the automatic control valve.

22. Lateral Pipe & Fittings
    a. Sch. 40 PVC.

23. Valve Boxes & Extensions
    a. Provide Carson Polyethylene valve boxes and extensions with solid, locking tee lids, non-hinged, no meter reader door, black, labeled irrigation. No substitutes.
    b. As an alternative to extensions, provide nested with a minimum 1/3 or greater overlap to prevent soil intrusion. Do not 'clamshell' a valve box with an inverted valve box underneath.
    c. Provide polyethylene valve boxes with extensions or nested valve boxes shall be used to enclose the following exterior appurtenances.
        i. Carson 910: 6 or less control wire splices, non-standard quick coupler valve assemblies with an approved variance.
        ii. Carson 1419: Gate valve assemblies.
        iii. Carson 1220: 1 to 1.5-inch automatic control valve assemblies, 7-18 control wire splices, and low voltage control wire conduit assemblies with up to 18 control wires.
        iv. Carson 1328: 2-inch automatic control valve assemblies, 19 or more wire splices, and low voltage control wire conduit assemblies with 19 or more control wires.
    d. Non-Standard Exterior POC Assemblies, Approved Variance Required, case-by-case basis
        i. Oldcastle, precast, 25-TA concrete enclosure with open bottom, with No. 38 hinged, non-skid, lockable, double hatch cover with adjustable frame. Provide no bottom option for drainage and ground heat for freeze protection.
        ii. Provide a minimum of two perpendicular stainless steel adjustable Unistrut framing and hardware supports per enclosure to support the weight of the assembly appurtenances.

iii. Also see Non-Standard Exterior Irrigation Point of Connection Assembly with Approved Variance, Part 1 of 2 drawing, and Non-Standard Exterior Irrigation Point of Connection Assembly with Approved Variance, Part 2 of 2 drawing. Note detail shows two enclosures with 1.5-inch pipe, fittings, and appurtenances, and larger sizes might require additional enclosures. Scaled shop drawings required for review and approval prior to installation.
iv. With secondary non-standard variance approval, it might be possible to use high density polyethylene valve boxes and extensions or nested boxes in conjunction with 25-TA enclosures.
v. With tertiary non-standard variance approval, it might be possible to exclusively use high density polyethylene valve boxes and extensions or nested boxes for applications with clearance constraints. Note the boxes below are for 1 to 2-inch appurtenances, and 2.5-inch might need larger enclosures.
1. Carson 1419: POC gate valve assemblies.
2. Carson 1419: Master valves assemblies, flow sensor assemblies, pressure regulating valve assemblies, water hammer arrestor assemblies.
3. Carson 1220, oriented sideways: Wye strainer assemblies, drain valve assemblies.
4. Carson 1328: Deduct meters
5. Carson 1730-24: Backflow assemblies

e. AWWA C509 Gate Valves for Connection to Water Distribution System
i. See FDS Civil
ii. These waterworks valves require a two-piece adjustable cast iron frame and lid labeled water.

24. Sprinklers & Nozzles

b. Dedicated Tree Zones
i. Rain Bird 1804-SAM-PRS sprinklers.
ii. SQ Series nozzle, depending on zone GPM, see detail.
iii. 5 Series MPR Stream Bubbler, depending on zone GPM, see detail.

c. Short Range Sprinklers & Spray Nozzles
i. Lawns, Rain Bird 1806-SAM-PRS sprinklers.
ii. Planting beds or long grasses, Rain Bird 1812-SAM-PRS sprinklers.
iii. MPR Series nozzles, 8-foot minimum to 15-foot. Do not use 5-foot.
iv. HE-VAN Series nozzles, mix with MPR where MPR arc patterns do not fit.
v. 18 Series VAN nozzles, mix with MPR where longer radii needed.

d. Short to Medium Range Sprinklers & MP Rotator Nozzles
i. Lawns, Rain Bird 1806-SAM-PRS-45 sprinklers.
ii. Planting beds or long grasses, Rain Bird 1812-SAM-PRS-45 sprinklers.
iii. MP800SR nozzles at 8 – 10 feet.
iv. MP815 nozzles at 12 – 15 feet.
v. Standard MP Rotator 1000 nozzles at 10 – 14 feet, 2000 at 16 – 20 feet, 3000 at 24 – 30 feet, and 3500 at 28 to 35 feet.

e. Medium Range Sprinklers
i. Lawns, Hunter I-20-06-SS at 25 to 44-feet.

f. Long Range Sprinklers
i. Lawns, sports fields, Hunter I-40-06 at 35 to 67-feet.

g. Non-standard Temporary Irrigation with an Approved Variance
    i. Designed on a case-by-case basis.
    ii. Temporary on-grade systems might utilize Sch. 40 PVC pipe and fittings, double Marlex, 6-inch Sch. 80 risers, shrub adapters, MP Rotator nozzles, secured with stakes, rubber ramps to provide ADA access, reduce trip hazards, and protect piping crossing pathways, with supply and control using exterior frost-free hose bibbs or quick coupler valves and Wi-Fi battery valves.
    iii. Tree watering bags as part of a 1-year contractor maintenance period or plantings with 2 or less trees.

25. Swing Joints

a. For ½-inch sprinklers, provide Rain Bird SA-125050 with two separate ½-inch Marlex street ells at the inlet and one separate ½-inch Marlex street ell at the outlet.
b. For ½-inch sprinklers requiring custom swing assemblies, provide maximum 24-inches in length, comprised of two ½-inch Marlex street elbows, one ½-inch barb x MIPT fitting, Rain Bird SPX-FLEX flexible low density polyethylene pipe, one ½-inch barb x MIPT fitting, and two ½-inch Marlex street elbows to the sprinkler inlet
c. For ¾-inch inlet sprinklers, provide Rain Bird TSJ-12075, 12" (30.5 cm) long, 3⁄4-inch M NPT x M NPT swing joint with two ¾-inch Marlex street elbows at the inlet and two ¾-inch Marlex street elbows to the sprinkler inlet, or approved substitution.
d. For 1-inch inlet sprinklers, provide TSJ-12: 12" (30.5 cm) long, 1" M NPT x M NPT swing joint with two separate 1-inch Sch. 40 street ells at the inlet and one separate 1-inch Sch. 40 street ell at the outlet or approved equal substitution.
e. For quick couplers valves, provide Dura 1-A4-1-11-18 swing joint with DL-010 quick lock. No exceptions. or approved substitution.

26. Conventional Low Voltage Control Wire

a. For exterior control wiring, provide insulated, solid copper, 14-gauge, designated for 20 to 50 volts (low voltage), UL approved as Type U.F. (underground feeder), copper conductor must meet or exceed ASTM B-3 specifications. No exceptions.
b. For interior control wiring, provide 14-gauge UF home runs from the controller throughout the landscape if acceptable. If not, inside, use 14-gauge THHN, same colors, provide a serviceable splice box serviceable at 5 feet or lower above the interior finish floor.
c. Provide EMT conduit for all interior control wiring.
d. For exterior control wire, tape the wire harness every 5 feet on center, route with the irrigation mainline in a direct bury condition at a 5 or 7 o'clock position along the side but not affixed to the mainline, and provide 18-inch expansion coils at pipe directional changes.
e. For exterior control wiring that cannot run adjacent to the mainline, provide serviceable Sch. 80 conduit and sweeps at mainline cover depth, sized at twice the diameter of the contents, seal conduit ends with compressed filter fabric to inhibit soil intrusion as described with sleeves, and route conduit to a location where it can be paired with the mainline.
f. Terminate all spare or staged wiring in boxes at mainline terminations.
g. Control wire colors
    i. White: Dedicated common wire, controller to master valve.
    ii. White: Dedicated common wire, controller to flow sensor.

iii. White: Dedicated common wire(s), controller to field or mechanical room automatic control valves with each mainline branch.
iv. Red: Dedicated hot wire to each automatic control valve with each mainline branch.
v. Yellow: Dedicated hot wire to master valve.
vi. Orange: Dedicated spare wires looping through each field automatic control valve box with each mainline branch.
vii. Black: Non-looping wires with a designated mainline branch(es) to a staged location for future expansion.

h. Control Wire Splices
   i. 3M-DB Series, for conventional control wire and dedicated trace wire direct bury splices sized for wire size & quantity per manufacturer's recommendations. No exceptions.
   ii. 3570GN Scotchlok Seal epoxy filled splices, for non-standard 2-wire control with an approved variance for direct bury splices. Although these splice kits are more difficult to install, they are essential to significantly reduce the risk of moisture intrusion into the splices because unlike conventional control wire systems, 2-wire control systems have continuous electrical current which with moisture intrusion results in electrolysis, corrosion of the wire and splices, and catastrophic, difficult to repair damage to the control system.

27. Trace Wire

a. Also see Exterior Dedicated Non-Overlapping Trace Wire Layout drawing.
b. Insulated, soli copper, 14-gauge, designated for 20 to 50 volts (low voltage), UL approved as Type U.F. (underground feeder), no exceptions.
c. Wire color: blue.
d. Provide dedicated trace wire for the mainline and each zone lateral pipe. Do not connect the dedicated mainline trace wire to dedicated zone lateral trace wires. Do not connect dedicated zone lateral trace wires together.
e. For the mainline or each separate mainline run, start the trace wire(s) in the gate valve assembly box at the transition between the Type K copper pipe from the mechanical room or in a separate adjacent enclosure if needed, tape to the top of the mainline every 5 feet on center, and route to all automatic control valves via a direct bury splice, to all mainline terminations, and termination box assemblies with 36-inches of serviceable wire above the finish grade inside the respective valve box to allow for connection to an electromagnetic locator. Provide a direct bury splice to cap all trace wire terminations to prevent moisture intrusion.
f. For dedicated mainline trace wire splices at each automatic control valve, provide a splice on the mainline trace wire with 36-inches of serviceable wire above the finish grade inside the respective valve box to allow for connection to an electromagnetic locator. Provide a direct bury splice to cap all trace wire terminations to prevent moisture intrusion.
g. For dedicated lateral trace wire for each zone, starting at each zone automatic control valve, provide a 36-inch serviceable leg of lateral trace wire above finish grade inside the valve box, tape trace wire to the top of the respective lateral pipe every 5 feet on center, provide direct bury splices at control wire tees, do not overlap the insulated wire as this nulls an electromagnetic locate signal, and route along the zone lateral piping to all terminations, cap the wire ends to prevent moisture intrusion, and bury with the pipe without an enclosure.

28. Dedicated Tree Zones
    a. See Dedicated Tree Bubbler Zone drawings.

G. Installation, Fabrication, Construction

1. General
    a. This section applies to the installation of underground irrigation systems for landscaped areas, lawns, planting beds, green roofs and vegetated membranes, athletic fields, and related work. Irrigation content in this section applies to all other sections and the perspective of each sections.
    b. Also see Basis of Design including design phase meetings; Deliverables & Design Evaluation; Construction Submittals; Related Sections; and Products, Materials and Equipment.
    c. Do not install landscape-irrigation and related work during saturated soil conditions as this can severely damage and compact the subgrade and topsoil.
    d. Do not install landscape-irrigation during or when freezing conditions are anticipated to prevent damage to irrigation, other property, and safety hazards such as ice on hardscapes.
    e. The Contractor shall meet with the project team, the Owner, and Grounds for final review, evaluation, and approval of the irrigation prior to final acceptance.

2. Construction Meetings, Milestones, Testing & Inspections.
    a. Testing and inspections
        i. The GC and project shall provide and the Owner and Grounds shall evaluate and approve irrigation and planting testing and inspections including but not limited to subgrade preparation, soil preparation, rough grade, irrigation mockups, irrigation installation, irrigation pressure testing, finish grade, tree pit infiltration testing, tree and plant delivery inspection, tree and plant layout, planting mockups, planting inspection, coverage testing, and mulching.
    b. Pre-Mobilization Meeting, Walk & Refreshers After Inactivity
        i. The GC and project shall provide a meeting and site walk prior to mobilization, after periods of 60 calendar days of landscape-irrigation inactivity as is common with phased construction, or before a new foreperson starts, including but not limited to the protection of trees, vegetation, soil, irrigation, and other site features, vehicle and pedestrian detours, site logistics including access routes, construction trailers, staging areas, overview of existing conditions and preliminary design strategy options, site, irrigation and landscape workflow and schedule milestones, and landscape-irrigation as built, interim conditions, and future state plans.
        ii. Prior to mobilization, field verify as-built information updated during design and test and document performance of existing irrigation to remain or be modified prior to construction. Document and markup updated as-built information, zone numbers, zone flow in GPM, operating conditions and damage prior to mobilization, early works and demolition, and future state irrigation. Identify, document, tag and protect control, spare, and trace wiring and at both ends of splices if wiring is cut.
    c. Mockups
        i. The GC shall provide in-place mockup inspections for review and approval of each initial assembly before proceeding with the installation of additional assemblies to allow for adjustments and to minimize corrective work. Mockups occur over time with progress and often consist of two parts at two distinct points in time. For

example, for a gate valve assembly, part 1 is inspecting the assembly for proper installation in an excavated condition, and part 2 is inspecting the assembly later in the project after installing enclosures and backfilling.

ii. The GC and landscape-irrigation trade partner should try to batch mockups and other testing and inspections to maximize site visits.

iii. In the interest of production, the minimum advance notice for mockups is (3) UW business days, and if the landscape architect-irrigation designer is not available, with approval of the project, Grounds in coordination with PDG can inspect, document, and approve mockups for the project.

iv. Irrigation point of connection assemblies.

v. Solvent welding, pipe fitting, and pipe sizing.

vi. Low voltage control and spare wiring conduit assemblies.

vii. Low voltage control and spare wiring splice box assemblies.

viii. Dedicated trace wiring and splices.

ix. Gate valve assemblies.

x. Quick coupler valve assemblies.

xi. Automatic control valve assemblies.

xii. Sprinkler assemblies.

xiii. Tree bubbler assemblies.

xiv. Sleeves and sealing sleeves

xv. Pipe bedding and backfill.

xvi. Non-standard assemblies with approved variances.

e. Controller Pre-Installation Meeting

i. The GC and project shall provide a dedicated pre-installation meeting for the irrigation controller with the Owner, Grounds, the architect, electrical engineer, UW-IT, the electrical trade partner, and the landscape-irrigation trade partner to mount the controller and coordinate all pathways and conduits for 120v power, Ethernet and enclosures from the MDF/IDF, low voltage conduits in the mechanical room and to the landscape, green roof, or vegetated membrane via the foundation, wall, or ceiling penetrations from the mechanical room.

ii. The GC and project shall provide a separate dedicated irrigation controller meeting with UW IT to provision Ethernet including setting up VLAN 2850, a subnet, IP address, subnet mask, and gateway on VLAN 2850, ensuring this information is included on the early outlet schedule, termination and testing, and confirmation of connection with the Grounds irrigation central control system.

iii. For efficient coordination and installation, it is helpful to combine the irrigation electrical irrigation controller and mechanical-plumbing irrigation POC assembly pre-install meetings.

f. POC Assembly Pre-Installation Meeting

i. The GC and project shall provide a dedicated pre-installation meeting for the irrigation POC assembly with the Owner, Grounds, the architect, mechanical-plumbing engineer, the plumbing trade partner, and the landscape-irrigation trade partner to install the irrigation POC assembly.

ii. For efficient coordination and installation, it is helpful to combine the irrigation controller and mechanical-plumbing irrigation POC assembly pre-install meetings.

g. Progress Meetings
    i. The GC and project team shall schedule regular meetings during site, landscape, and irrigation work including the Owner and Grounds.
    ii. Site Observation Reports or Field Reports shall be published and distributed with meeting findings including tracking and resolution of issues with the goal of resolving issues in real-time to avoid corrective invasive work after finish work and punchlist.
h. Hydrostatic Pressure Testing
    i. The contractor shall successfully pre-test before testing with PDG and Grounds.
    ii. Pressure test lateral piping at 80 psi with 5 psi of allowed loss over 15 minutes, source pump off, valve downstream of source pump closed, automatic control valve in a hydraulically closed condition with flow control open and isolation ball valve open, and swing assemblies with Marlex street ells installed without sprinklers with temporary Sch. 40 FIPT caps and inexpensive temporary FIPT x FIPT ball valves on swing assemblies at lateral terminations to vent air. Document all results by color coding and dating a working copy of the irrigation plan, in site observation reports, and other project correspondence.
    iii. Pressure test mainline piping at 125 psi with 0 psi loss over 30 minutes, using the new permanent water supply, or a non-standard temporary supply with an approved variance, with source pump off, valve downstream of source pump closed, automatic control valve in a hydraulically closed condition with flow control open and isolation ball valve open, with quick coupler valves installed, and with all other permanent irrigation installed, with a temporary means of venting air at mainline terminations. Although incremental mainline testing by the landscape-irrigation trade partner is acceptable for internal QA/QC, official mainline pressure testing must test the entire system. Document all official testing results by color coding and dating a working copy of the irrigation plan, in site observation reports, and other project correspondence.
    iv. For testing existing and new mainline connections, provide a gate valve assembly between existing and new mainline and a quick coupler valve(s) to safely vent stored air energy. In addition to pressure testing new mainline pipe, visually inspect the existing mainline for leaks during testing.
    v. For pressure testing existing & new lateral piping connections, provide a Sch. 40 line size solvent welded PVC ball valve at the transition, provide a means of venting stored air energy such as a sprinkler swing assembly with a temporary ½" FIPT ball valve, and after successful testing, open and direct bury the inline ball valve with no enclosure.
    vi. Pressure Testing Existing Lateral Piping with Sprinklers
        1. Remove sprinklers, temporarily cap swing assembly outlet fittings with ½-inch Sch. 40 PVC FIPT caps, and pressure test as described above.
        2. With approval of Owner and Grounds, remove sprinkler nozzles and temporarily replace with PA-80 fittings on sprinkler risers and Sch. 40 PVC FIPT caps and provide a line pressure test without a gauge. Due to the flow-by at the sprinkler wiper seal and riser, a formal pressure test will not be meaningful, however, by mostly closing the system leaks can be more easily identified and repaired.

i. Coverage Testing
    i. The contractor shall successfully pre-test and adjust prior to testing.
    ii. Coverage test each zone by activating zones via the controller or remote handheld device via the cloud using the new permanent water supply. Also test all quick coupler valves by inserting a key to activate and removing a key to close the valve. Last, program and test a simulation to demonstrate that the controller and flow sensor will shut off the master valve in an alarm flow condition.

j. Controller Testing
    i. Certification. Coordinate with the controller manufacturer representative to inspect and certify the proper installation of new controllers and to review basic programming including but not limited to flow sensor, flow limits, master valve, and irrigation scheduling.
    ii. Test for Ethernet communication and connection to the central control system.

k. Owner Training. Owner training shall not occur until the entire irrigation system and associated planting are fully completed and functional.

l. Punchlist & Backpunch. Aggregate new and unresolved issues in a punchlist and backpunch until issues are resolved. Goal is to minimize punchlist by identifying and resolving issues in real time.

m. Contractor Maintenance Period. See content at end of this section.

n. Contractor Warranty Period. See content at end of this section.

3. Irrigation Controllers

a. Interior wall mount irrigation controllers
    i. Also see Interior Mechanical Room Irrigation Controller – Wall Mount and Interior Mechanical Room UW-IT Ethernet to Irrigation Controller details.
    ii. Also see FDS Electrical and UW-IT Design Guide.
    iii. Also see Basis of Design and Products, Materials, and Equipment.
    iv. Also see cross references between related work.
    v. Coordinate with the electrical trade partner to furnish and install the irrigation controller adjacent to the irrigation POC assembly.
    vi. Coordinate with the electrical trade partner to furnish and install the top of a wall mount controller enclosure to be 67.25-inches above finished floor.
    vii. Coordinate with the electrical trade partner to furnish and install the controller access conflicts or obstructions on the wall a minimum of 18 inches adjacent to the left side of the controller to allow the hinged door to fully open, 12 inches to the right side of the controller, with the same open clearances below the controller to the floor with the exception of supplemental controller related enclosures and conduits that do not project beyond the depth of the controller, and no floor access conflicts or obstructions a minimum of 4 feet in front of and to 1 foot to each side of the controller such as pipes, drains, conduits, or changes in floor elevation such as housekeeping pads.
    viii. Furnish and install all low voltage connections between the controller, master valve, flow sensor, and automatic control valves via EMT terminated with single gang metal boxes with protective bushings at wiring outlets.

ix. Furnish and install alphanumeric adhesive labels 2-inches from control and spare wire terminations to denote zone numbers, names/descriptions for common wires, and names/descriptions for spare wire harnesses that correspond to the irrigation as-built plan and 11" x 17" color coded zone map/table.

x. Coordinate with the electrical trade partner to furnish and install Ethernet Cat6 cable from MDF/IDF via cable tray or EMT to an enclosure adjacent to the controller, typically a UW-IT Milbank box, a secure, NEMA 3R-rated metal enclosure, part number 12126-LC1 or similar, 12"x12"x6" with hinged cover, with a padlock ready three-point latching mechanism for a specific key, part number 2233, with a patch cord via EMT to a factory knock out on the controller. Coordinate with the project and UW-IT to utilize one of the ports in the Milbank box. If a multiport Milbank enclosure is not available, provide a dedicated junction box enclosure, NEMA-3, 16-gauge steel, 6"x6"x4" with a solid screw plate, with a biscuit jack inside and patch cord to the controller via EMT conduit.

xi. Coordinate with the electrical trade partner to furnish and install sufficient control and spare wire conduit sizes based upon the total wire quantity to use a maximum of 50% of conduit volume and to provide sufficient pull boxes per electrical code. For quantity, identify quantities of all wiring per the project irrigation plan including all common wires (white), dedicated master valve common (white), dedicated master valve hot (yellow), automatic control valve hot wires for each zone (red), looping spares per quantities noted herein (orange), non-looping spares per quantities noted herein (black), and a dedicated common (white) and hot (red) for the master valve. Coordinate with the electrical trade partner to furnish and install sufficient control and spare wire conduit sizes based upon the total wire quantity to use a maximum of 50% of conduit volume and to provide sufficient pull boxes per electrical code. For quantity, identify quantities of all wiring per the project irrigation plan including all common wires (white), dedicated master valve common (white), dedicated master valve hot (yellow), automatic control valve hot wires for each zone (red), looping spares per quantities noted herein (orange), non-looping spares per quantities noted herein (black), and a dedicated common (white) and hot (red) for the master valve.

xii. Coordinate with the electrical trade partner to furnish and install control and spare wire primary and spare conduits to be 2-inch in diameter minimum Coordinate with the electrical trade partner to furnish and install control and spare wire primary and spare conduits to be 2-inch in diameter minimum

b. Non-Standard Exterior Controllers with an Approved Variance

i. Also see Non-Standard Exterior Irrigation Controller with Approved Variance – Wall Mount and Non-Standard Exterior Irrigation Controller with Approved Variance – Pedestal drawings.

ii. Non-standard exterior irrigation controllers with approved variances are only acceptable when conditions require, and not because of budget constraints. Examples include an athletic field or open space with no suitable adjacent building for mounting, a building with limited access, or where an exterior controller offers clear end user and lifecycle maintenance advantages.

iii. Also see FDS Electrical standards and UW-IT Design Guide

iv. Also see Basis of Design and Products, Materials, and Equipment.

v. Also see cross references between related work.
vi. Coordinate with the electrical trade partner to furnish and install to furnish and install the irrigation controller adjacent to the irrigation POC assembly when both are exterior installations.
vii. Coordinate with the electrical trade partner to furnish and install to furnish and install a wall mount controller with top of cabinet at 67.25-inches above finish grade. Coordinate with rough carpentry and mason trade partners to furnish and install formwork and a concrete base with a bolt template for a pedestal mount controller.
viii. Update interior controller products, materials, and equipment for exterior weather rated conditions.
ix. Coordinate with others to provide penetrations, seals, conduits and sweeps from the building into the controller, exterior rated rigid conduit with secure connections where above grade, and Ethernet connected to the campus central control system. Note that it is acceptable for exterior controllers to terminate Ethernet inside locking controller enclosures or supplemental locking NEMA-3 enclosures. See Interior Irrigation Controller for additional information for Ethernet and control and spare wire conduit sizes.
x. Coordinate with the electrical trade partner to furnish and install to furnish and install controllers and related work to be theft and vandal resistant.
xi. Furnish and install all low voltage connections between the controller, master valve, flow sensor, and automatic control valves, preferably underground and if above grade in rigid conduit with secure connections.
xii. Furnish and install alphanumeric adhesive labels 2-inches from control and spare wire terminations to denote zone numbers, names/descriptions for common wires, and names/descriptions for spare wire harnesses that correspond to the irrigation as-built plan and 11” x 17” color coded zone map/table.

4. Irrigation POC Assemblies

a. Interior POC Assemblies
i. Most information for his item is included in FDS Mechanical standards – Potable and Nonpotable Water section. See the Water Header Configuration for Lab and Non-Lab Buildings drawing.
ii. Also see Interior Mechanical Room Irrigation Point of Connection Assembly detail and specification narrative for additional information.
iii. Also see Basis of Design and Products, Materials, and Equipment.
iv. Coordinate with others to furnish and install irrigation POC assembles as part of building systems modelling, provide a project specific enlarged plumbing detail, provide a shop drawing, and coordinate with related work including electrical for irrigation controller power, low voltage control and spare wiring, Ethernet, and pathways, cable trays, and conduits.
v. Coordinate with others to furnish and install the deduct meter a maximum of 4 feet above the finished floor, all other appurtenances a maximum of 5 feet above finished floor, and ball valves shall be a maximum of 6 feet above the finished floor. Note that a compact, hardwired, front-facing remote meter register model can be

mounted away from the flow tube at the acceptable elevation if a workaround for a higher meter mounting is needed.

vi. Coordinate with others to furnish and install mechanical room irrigation POC assemblies with Type L copper pipe and fittings, a tie-in upstream of the building pressure regulating valve, a full port ball valve or butterfly valve, a wye strainer (unless there is already an upstream building wye strainer), a backflow prevention assembly, a pressure reducing valve (PRV) assembly with upstream and downstream oil filled 0-150 psi pressure gauges, a normally open master valve, a flow sensor, a drain with a ball valve plumbed to a floor drain, a water hammer arrestor, a deduct meter, a full port ball valve or butterfly valve, and Type L copper pipe and fittings transitioning to Type K copper pipe and fittings a minimum of 2-feet from the foundation, wall, or ceiling penetrations and seals, to a serviceable direct bury condition in soil in the landscape and green roof.

vii. Coordinate with others to not install a PRV bypass as this does not provide value and can be inadvertently left open putting the irrigation system at risk of damage from excessive pressure.

viii. PRV installer note – PRVs with a maximum 75 psi setting are common for irrigation installations but may not offer sufficient pressure range, especially after losing up to 10 psi through POC assembly appurtenances. Although an irrigation pressure reducing valve is typically set not to exceed 80 psi given the risk of lag from automatic control valves with pressure reducing units, UW FDS Irrigation specifies a 10 – 125 psi range model to offer flexibility. For example, pressure reducing automatic control valves and sprinklers with pressure reducers allow for optimal nozzle performance at or below 30 psi, at 45 psi such as with MP Rotator nozzles, 60-psi for gear driven rotary stream nozzles, and maximum mainline pressure for quick coupler valve output. Or, for elevation changes where higher pressure is needed, for example, in a scenario with a minus 1 level mechanical room irrigation POC assembly and a 6th floor green roof with irrigation, at 6.3 floors (0.3 for raised planters on the 6th floor) * 0.43 psi loss per foot * 13-feet per story, this results in a 35 psi loss. So, if the primary mechanical room PRV is set at 108 psi (pressure at UW ranges from 75 to 120 psi depending on elevation, pressure zone, and if PRV control station settings), losing 5 psi through the remaining downstream POC assembly appurtenances and losing 35 psi for the increase in vertical elevation, the pressure on the 6th floor green roof will be 68 psi, which is sufficient to operate MP Rotators at 45 psi with a 15 psi upstream to downstream differential for optimal performance. Next, pressure at lower elevation green roofs and on-grade plantings would be controlled with pressure zones using inline pressure reducing valves on the warm side for each elevation pressure zone. Or, similarly, for variable landscape topography, based on maximum pressure at the highest topographical elevation, dedicated mainline runs or pressure zones might be needed at lower elevations where decreases in vertical elevation result in increases in pressure.

ix. Coordinate with others to furnish and install Type K copper piping through the penetration and seal to the landscape or green roof, terminated in serviceable planting soil with a brass female adapter, to an irrigation gate valve assembly(s), to PVC piping, fittings, an initial quick coupler valve(s), and other appurtenances,

adjacent to a low voltage control and spare wire assembly. For planting areas in opposite directions from the penetration, provide two mainline branches, each with a gate valve assembly

b. Non-Standard Exterior Irrigation POC Assemblies with Approved Variances
    i. Non-standard irrigation POC assemblies with an approved variance are only acceptable when conditions require, and not because of budget constraints. Examples include an athletic field or open space with no suitable adjacent building with interior plumbing infrastructure.
    ii. Also see Non-Standard Exterior Irrigation Point of Connection Assembly with Approved Variance, Part 1 of 2 drawing, and Non-Standard Exterior Irrigation Point of Connection Assembly with Approved Variance, Part 2 of 2 drawing.
    iii. Also see FDS Mechanical standards – Plumbing section, Electrical standards, and Civil standards.
    iv. Also see cross references between related work.
    v. Coordinate with others to furnish and install non-standard irrigation POC assemblies with approved variances as part of building and site modelling, with project specific details in the civil plans, the irrigation plans, and electrical and site electrical plans, and develop shop drawings based on actual field conditions for review and approval by the project, Owner and Grounds.
    vi. Coordinate with others to furnish and install non-standard exterior irrigation POC assemblies with approved variances to be supplied by a domestic water source from an interior mechanical room or a dedicated exterior connection to a domestic water distribution system per the Civil sheets and not a building domestic service pipe or fire service pipe with a fully restrained mechanical connection or hot tap, followed by an AWWA C509 gate valve immediately adjacent to the connection, pipe and fittings, typically ductile iron, all fully restrained, per UW FDS Civil, Irrigation, and Seattle Public Utilities standards, to an irrigation POC with an FIPT service size connection.
    vii. Furnish and install non-standard exterior irrigation POC assemblies with approved variances with bronze and brass pipe, nipples, and fittings to an irrigation gate valve assembly, into concrete vaults with a bronze full port ball valve, a wye strainer, a backflow prevention assembly, a pressure regulating valve with upstream and downstream oil filled 0-150 psi pressure gauges, a normally open master valve, a flow sensor, a drain with a hose connection and ball valve, a water hammer arrestor, a deduct meter, and a bronze full port ball valve, enclosed in a concrete vaults, or with a secondary variance, also in valve boxes and extensions, and with a tertiary variance, exclusively in valve boxes and extensions. Note that the number of enclosures will be contingent upon the size of the irrigation service and sizes and lay lengths of POC assembly appurtenances most commonly ranging from 1 to 2.5-inches.
    viii. Pressure Reducing Valves (PRV) – Installer Note, see above under Interior POC assemblies.
    ix. The irrigation system downstream of non-standard exterior POC assemblies with approved variances shall consist of underground piping to gate valve assemblies, quick coupler valve assemblies, and automatic control valve assemblies, to sprinkler zones and sprinkler assemblies and other irrigation assets in the landscape.

5. Full Port Ball Valves
    a. Furnish and install as part of standard quick coupler valve keys.
    b. For non-standard exterior irrigation POC assemblies with an approved variance, furnish and install, see above.

6. Wye Strainer
    a. For non-standard exterior irrigation POC assemblies with an approved variance, furnish and install, see above.

7. Backflow Prevention Assembly
    a. For non-standard exterior irrigation POC assemblies with an approved variance, furnish and install, see above.

8. Flow Sensors
    a. For non-standard exterior irrigation POC assemblies with an approved variance, furnish and install, see above.
    b. For non-standard exterior irrigation POC assemblies with an approved variance, furnish and install a flow sensor with 10 inlet diameters of Sch. 80 PVC pipe or brass nipples with MIPT ends, straight with no fittings, upstream of the flow sensor, and 5 inlet diameters of Sch. 80 PVC pipe or brass nipples with MIPT ends, straight with no fittings, downstream of the flow sensor.

9. System Layout
    a. Furnish and install piping, control wiring, sleeves, and other irrigation to avoid installation and lifecycle maintenance and serviceability conflicts with other work and features.
    b. Furnish and install piping, control wiring, and other irrigation with new and existing trees. Do not route piping in tree protection zones. Provide 8-feet of clearance between mainline and control wiring and 5-feet between lateral lines and new trees. For small planters surrounded by hardscapes that are used as mainline and control wiring distribution nodes with incoming and outgoing sleeves to accommodate changes in direction, ONLY plant groundcovers, small grasses, and small shrubs but not trees because the maturing tree weight breaks the pipe and wiring and the maturing tree root mass makes it impossible to service the piping and wiring without removing the trees. For narrow street planters where trees are required, provide as much clearance as possible and use sleeves to protect pipe and control wiring in the anticipated mature root zones. For irrigation that needs to enter existing and anticipated tree protection areas, layout piping radially between known and anticipated root growth to avoid trenching and piping perpendicular to roots. Last, specify that trenching in tree protection areas shall be done by air spading, or by hand if permitted by the project and UW arborist. See FDS Tree Protection for additional requirements.

10. Trenching
    a. Coordinate with others to furnish and install an approved subgrade prior to starting irrigation trenching as this elevation can be used to determine finish grade based on soil

cover depth requirements allowing some trade partners to layout piping and control wiring on the subgrade and cover it with import topsoil in lieu of trenching in rough grade import topsoil. Note that contingent upon soil depths, mainline and control wiring might need shallow subgrade trenching, and lateral pipe might need to be lifted and compacted underneath when covering with import topsoil.

b. Furnish and install straight trenches with uniform flat trench bottoms.
c. In tree protection areas, install trenches with an air spade or careful hand excavation per arborist requirements.
d. Remove all sharp objects, rocks greater than 1-inch, and debris from trenches.

11. Pipe Cover Depths

    a. Water Supply
        i. Furnish and install a minimum 24-inch and maximum 27-inches of soil cover (not including mulch) over water supply pipe from the domestic water distribution connection to the irrigation POC assembly for non-standard variance approved exterior POC assembly installations. Adjust for hardscape soil equivalent cover depths per examples above.
    b. Mainline
        i. In planting soil, furnish and install a minimum of 18-inches and a maximum 21-inches of soil cover (not including mulch) for mainline pipe.
        ii. Where pipe crosses under hardscapes, furnish and install equivalent soil cover adjusted for hardscape material equaling 0.2-inches of 1-inch soil R-value. For example, a 4-inch deep concrete path with 2-inches of compacted crushed rock base course is 6 * 0.2 = 1.2-inches of equivalent soil depth, thus, in addition to the 6-inches of concrete and crushed rock, 16.8 inches of soil is needed to achieve the minimum 18-inch soil cover depth with a total profile depth of 22.8-inches.
    c. Lateral Pipe
        i. In planting soil, furnish and install a minimum of 12-inches and a maximum 15-inches of soil cover (not including mulch) for lateral pipe.
        ii. Where pipe crosses under hardscapes, furnish and install equivalent soil cover adjusted for hardscape material equaling 0.2-inches of 1-inch soil R-value. For example, a 4-inch deep concrete path with 2-inches of compacted crushed rock base course is 6 * 0.2 = 1.2-inches of equivalent soil depth, thus, in addition to the 6-inches of concrete and crushed rock, 10.8 inches of soil is needed to achieve the minimum 12-inch soil cover depth with a total profile depth of 16.8-inches.
    d. Cover On All Sides
        i. Furnish and install pipe cover depth requirements for all sides of the pipe – above, below, and on the sides. For example, an irrigation lateral pipe with 12-inches of soil above but only 2-inches of soil between it and a 4-inch thick concrete biofiltration planter wall has only 2 + (4 * 0.2) = 2.8-inches of equivalent soil cover and this is unacceptable.

12. Pipe Bedding

    a. Furnish and install 3 to 4-inches of sand or import topsoil bedding below and above irrigation piping.

b. Do not bed and backfill piping until pressure testing is completed and approved by Landscape Architect, Owner and Grounds.

13. Pipe & Assembly Backfill

a. Furnish and install topsoil backfill or approved native backfill free of debris rocks greater than 1-inch compacted in 6-inch lifts to planting bed density and to accommodate specified topsoil depths.
b. Do not backfill piping, valve boxes, quick coupler valves, sprinklers and other irrigation until pressure testing is completed and approved by Landscape Architect, Owner and Grounds.

14. Solvent Welding

a. Furnish and install solvent welded socket connections for pipe, fittings, and appurtenances unless otherwise specified per Weld-On Solvent Welding Guide and Technical Resources https://weldon.com/product-literature/tech-tips/ and related ASTM standards. In summary, cut PVC pipe ends at 90 degrees to the pipe length and clean all cutting burrs prior to solvent welding. Use of a deburring tool is highly recommended. Wipe pipe ends clean. Apply primer to both fitting and pipe end. Apply a light coat of cement on the inside of the fitting and a heavier coat on the outside of the pipe. Provide a quarter turn while inserting pipe into the fitting and hold for 30 seconds. Wipe excess cement from the outside of the pipe.
b. Solvent welded joints shall be given at least fifteen (15) minutes set-up time before moving or handling. Pipe shall be partially center loaded to prevent arching and slipping. No water shall be permitted in pipe until a period of at least 24 hours has elapsed for solvent weld setting and curing. Test pipe as indicated elsewhere in these standards

15. Mainline & Lateral Pipe & Fittings

a. Bronze and Brass Nipples. Furnish and install this option from the domestic water supply irrigation POC to a non-standard exterior POC assembly with an approved variance and between appurtenances within an exterior POC assembly and for a flow sensor with flow sensor sized straight pipe, no fittings, 10 inlet diameters upstream and 5 outlet diameters downstream of the flow sensor,
b. Schedule 80 PVC. For a non-standard exterior irrigation POC assembly with an approved tertiary variance with valve box enclosures, furnish and install Sch. 80 PVC from the domestic water supply irrigation POC to a non-standard exterior POC assembly with an approved variance, for automatic control valve assemblies including Sch. 80 threaded-on-one-end (TOE) non-extruded nipples, Sch. 80 MIPT x MIPT unions, and Sch. 80 FS x MIPT unions, for connections to non-standard HDPE pipe with an approved variance, and 3-feet upstream and downstream of 125# AWWA gate valve assemblies for irrigation systems with mainlines larger than 2.5-inches
c. Schedule 40 PVC. Furnish and install for mainline for underground on-grade and on-structure landscapes.
d. Non-Standard High-Density Polyethylene (HDPE) with an approved variance, SDR 11, possibly SDR-9, on a case-by-case basis. Applications include but are not limited to the following.

i. For unavoidable directional changes under hardscapes, or within deep bioretention cell profiles where piping is not easily serviceable, for soil conditions with differential settling, or on hillsides at risk of soil creep, furnish and install HDPE pipe and bending within allowable manufacturer deflection limits and with transitions configured to avoid stress on PVC pipe and fittings.
ii. Furnish and install connections between PVC to HDPE SDR 11 with special fused fittings or with conventional fittings using a Sch. 80 socket by FIPT coupler to a brass MIPT x barb fitting inserted into HDPE pipe after heating to a slightly malleable condition in non-boiling water or with a temperature controlled heat gun per industry standards and best practices, with each connection immediately secured with (2) stainless steel marine grade hose clamps, to a brass barb fitting x MIPT, then same as above in reverse process.
iii. Full scale non-standard HDPE mainline installations require an approved variance including dedicated design, product and execution specifications based on industry standards and best practices and required installer certifications.

e. If piping needs to enter the outer area of a tree protection zone, furnish and install the pipe radially between known roots to avoid trenching across roots. All trenching in tree protection areas shall be done by air spading, or by hand if permitted by the project and UW arborist. See FDS Tree Protection for additional requirements.
f. Temporarily seal pipe opens during installation to prevent contamination of soil, debris, animals.
g. Furnish and install straight piping. Do not bend piping. Use fittings for all vertical or horizontal directional changes.
h. Furnish and install pipe to utilize common 45 and 90-degree fittings. When necessary, use 11 and 22.5-degree fittings or double 45-degree fittings.
i. Furnish and install a minimum of 4-inches of exposed pipe between fittings to allow for lifecycle repairs. For automatic control valve assemblies and non-standard POC assemblies with an approved variance provide a minimum of 2-inches of exposed pipe between threaded fittings.
j. Place pipe adjacent to other pipes. Do not vertically stack pipes. Furnish and install a minimum of 3-inches of lateral and vertical separation between adjacent pipes in common trenches.
k. For mainline, furnish and install horizontal facing fittings to appurtenances including quick coupler valves and automatic control valves.
l. For lateral pipe, furnish and install horizontal facing fittings to sprinkler swing assemblies and face fittings to the outside of planting areas.
m. For metallic to PVC connections, furnish and install Sch. 80 PVC nipples between threaded connections, and a threaded-on-one-end (TOE) Sch. 80 non-extruded nipple in a PVC socket fitting to an FIPT metallic fitting. Do not use male adapters.
n. For male threaded connections, furnish and install Teflon tape for threaded connections. Use a maximum of 3 to 4 wraps of Teflon tape. Do not use Teflon paste.
o. For non-standard exterior POC assemblies requiring an approved variance, for flow sensors, furnish and install flow sensor size Sch. 80 pipe or brass nipples, straight, no fittings, 10 inlet diameters upstream and 5 outlet diameters downstream of the flow sensor.

p. For non-standard HDPE sleeves and piping with an approved variance, most likely where curved serviceable pipe and sleeves under hardscapes are needed, furnish and install without exceeding the manufacturer's recommendation for maximum deflection, and configure to avoid excessive stress on PVC pipe and fittings at transitions.
q. Completely flush all piping prior to installing gate valves, quick coupler valves, automatic control valves, other appurtenances, and sprinklers. Control discharged water when flushing to prevent erosion, washouts, or getting people or property wet.

16. Mainline Repair Couplers

    a. Furnish and install solvent welded mainline couplers.
    b. Where solvent welded connections are not possible and with Owner and Grounds approval, furnish and install Romac Style 511 Coupling, with 5-inch barrel length for sizes 1 – 1.5-inch and 7-inch barrel length for pipe sizes 2-inch to 2.5-inch, with . stainless steel marine grade bolts, per manufacturer’s instructions including torque wrench settings to tighten bolts.
    c. Do not use PVC slip fixes or PVC compression couplers on mainline or lateral piping. Provide similar but restrained fittings for 3-inch and above.

17. Sleeves

    a. Furnish and install sleeves to utilize common 45 and 90-degree fittings.
    b. Furnish and install straight continuous sleeves sized at twice the aggregate diameter of the contents. Do not install sleeves with directional changes.
    c. Do not install curved sleeves. If curved serviceable sleeves are unavoidable under hardscapes, furnish and install HDPE sleeves and internal HDPE pipe not to exceed the manufacturer's recommendations for maximum deflection and transitions that minimize stress on PVC pipe and fittings.
    d. Furnish and install fully serviceable sleeves that extend a minimum of 6” beyond hardscapes.
    e. Temporarily seal sleeves with compressed filter fabric immediately upon installation to keep sleeves free of soil, rock and other debris. If contents are incrementally installed over time, provide temporary seals until installation of contents is completed.
    f. Permanently seal sleeves with compressed filter fabric immediately upon placement of internal contents to keep free of soil, rock, and other debris.
    g. Furnish and install temporary and permanent filter fabric seals on ends of sleeves with sufficient compression to not become dislodged and to be removable with moderate force. Furnish and install with 4 to 6-inches of filter fabric extending beyond sleeves ends to provide a grab point for removal.
    h. Furnish and install sleeves with a single piece of pipe. For sleeves exceeding 20-feet that require two section of pipe, furnish and install with a solvent welded connection including primer and joint compound.

18. Flow Sensor Assemblies

    a. For non-standard exterior irrigation POC assemblies with an approved variance, furnish and install a flow sensor with 10 inlet diameters of bronze or brass nipples with MIPT ends, straight with no fittings, upstream of the flow sensor, and 5 inlet diameters downstream of flow sensor. For tertiary variances, substitute Sch. 80 PVC nipples.

19. Gate Valve Assemblies
    a. See Exterior Gate Valve Assembly detail.
    b. The landscape-irrigation trade partners may install additional 'elective' gate valves and quick coupler valves to safely vent stored air energy at their expense to facilitate workflow and unofficial incremental QA/QC pressure testing with advanced approval by Owner and Grounds.
    c. Upstream and downstream of non-standard exterior POC assemblies in HDPE valve boxes with primary and secondary approved variances.

20. Quick Coupler Valve Assemblies
    a. See Exterior Quick Coupler Valve Assembly drawing.
    b. Also see swing assemblies for installation instructions.
    c. Furnish and install quick coupler valve(s) immediately downstream of the lead off gate valve(s) from building penetration(s).
    d. Furnish and install quick coupler valves every 100 feet or less or as needed to avoid water hoses crossing walkways and roads, especially ADA building entrances.
    e. Furnish and install quick coupler valves upstream of gate valves and at all mainline terminations to allow for the safe discharge of stored compressed air energy when filling empty or partially drained mainlines.
    f. Enclose quick coupler valves in furnished by owner installed by contractor (FOIC) concrete protective rings – see Exterior Quick Coupler Valve Assembly drawing. No Exceptions.
    g. For non-standard enclosures with an approved variance, furnish and install quick coupler valves in Carson 910 valve boxes, tee lid, black, labelled irrigation, with 5/8-inch clear rock inside and under the valve box to stabilize the assembly.

21. Quick Coupler Keys
    a. Furnish and provide quick coupler keys to Grounds as part of attic stock.

22. Automatic Control Valve Assemblies
    a. Also see Exterior Irrigation Automatic Control Valve Assembly drawing and Interior Irrigation Automatic Control Valve Assembly to Green Roofs or to Non-Standard Underground On-Grade Landscape Zones with an Approved Variance drawings.
    b. It is acceptable to furnish and install exterior automatic control valves with horizontal mainline stub outs into the valve box instead of a vertical riser provided 1 to 2-inch clearances are provided between the pipe, valve box, cut out, and bricks, and that the cut out is sealed with filter fabric affixed to the exterior valve box to prevent soil intrusion.
    c. Furnish and install one automatic control valve for each zone.
    d. Furnish and install automatic control valves within or adjacent to the zones they control, lawn zones in lawn, planting bed and tree bubblers zones in planting beds.
    e. Furnish and install a single automatic control valve per enclosure.
    f. Furnish and install Christy's valve tags with permanent, exterior rated, alphanumeric characters of 1.25-inch height to denote zone numbers in each valve box and common wire and spare wire names/descriptions at wire assembly box terminations. Zip tie to valve or valve box in an easy to see location that does not inhibit serviceability.

g. Exterior automatic control valves furnished and installed by the landscape-irrigation trade partner are preferred for underground on-grade landscaping.
h. Interior automatic control valves are acceptable where the landscape-irrigation trade partner furnishes the automatic control valve and the mechanical-plumbing trade partner installs. This approach can maximize planting for sites with limited planting areas as opposed to competing with automatic control valve boxes in the landscape, and interior automatic control valves are required for green roofs or vegetated membranes without the specified soil cover to prevent damage from freezing. For interior installations, the mechanical-plumbing trade partner also furnishes and installs lateral sized bronze full port ball valves upstream and downstream of each automatic control valve for isolation and installs automatic control valves in a vertical, upward flow position.
i. Furnish, install, and adjust PRS-Dial units for optimal nozzles performance without misting.

23. Valve Boxes and Extensions

a. Also see Exterior Irrigation Automatic Control Valve Assembly drawing and Exterior Gate Valve Assembly detail.
b. Also see Products, Materials and Equipment.
c. Furnish and install valve boxes, extensions for each appurtenance and for low voltage wire conduits or splices. For non-standard exterior POC assemblies with an approved variance, larger enclosures can house multiple appurtenances.
d. Furnish and install valve boxes, valves, and quick coupler valves in beds at least 36-inches off hardscape edges.
e. Furnish and install valve boxes parallel or perpendicular to adjacent rectilinear features and with the same clearances between valve boxes.
f. As an alternative to extensions, two valve boxes can be furnished and installed in a nested configuration with a minimum 1/3 or greater overlap to prevent soil intrusion. Do not 'clamshell' valve boxes with an inverted valve box underneath.
g. Furnish and install valve boxes and extensions sized for serviceability, to allow room for testing, manual operation, calibration, removal, and maintenance of equipment.
h. Furnish and install valve boxes with 1 to 2 inches of clearance between piping, cut outs, openings, bricks, the automatic control valve including the PRS-Dial unit and bottom of valve box lid, and 3-inches of clearance between the bottom of the automatic control valve and finish elevation of pea gravel inside the valve box.
i. Furnish and install bricks on the corners of load bearing valve boxes.
j. Furnish and install filter fabric permanently affixed to the exterior of the valve box to prevent soil intrusion through cut outs and other openings. Keep filter fabric and method of affixing at least 3-inches below the top of the valve box and/or so that it is not visible with reveals on slopes.
k. Furnish and install valve boxes so that top of lids are at finish lawn elevation and 1-inch above the finish elevation of mulch in planting beds.

24. Sprinkler & Nozzles

a. Also see Exterior Irrigation Pop-Up Sprinkler Assembly drawing and Exterior Irrigation Pop-Up Sprinkler Clearances drawing.
b. Also see Basis of Design, 'Sprinklers and Nozzles.'

c. Furnish and install sprinklers with firm hand tightened threaded connections.
d. Furnish and install sprinklers by hand tamping and compacting soil around sprinklers to provide stability and to prevent them from moving with contact from foot traffic, landscape equipment, or landscape vehicles.
e. Furnish and install sprinklers to prevent misting, overspray onto hardscapes and outside of planted areas, and blockage from plant materials, light poles, benches, seat walls, utility enclosures, and other obstructions. Furnish and install sprinklers between parking stalls and with sufficient setbacks from wheel stops and curbs to prevent damage from vehicles.
f. Furnish and install sprinkler spacing with overlapping head-to-head coverage unless otherwise stated by the manufacturer. For example, Rain Bird SQ Series nozzle spacing uses coverage to coverage spacing. In areas with regular, above average wind conditions, space sprinklers at 45 percent of diameter.
g. Furnish and install sprinklers of the same manufacturer, model, and pressure ratings on the same zone.
h. On slopes, furnish and install sprinklers perpendicular to the average surrounding slope. Space sprinklers at 1% for every 1% increase in slope beyond 10%.[1] Percent of slope equals vertical rise in feet per 100 feet. [2] Reduce sprinkler spacing to the actual sprinkler radius at the crown of the slope and increase the spacing at the toe of the slope as to prevent overthrow beyond the bottom boundary of the slope. [3] Sprinkler design layout for slopes should be proportionate to the actual lineal feet of the hypotenuse (leg C), which would be misrepresented if scaled in plan view (leg A) resulting in stretched spacing. For clarification, call out actual spacing on the drawings. (Footnotes 1-3 reference Buckner Irrigation Systems Design Manual, 1st Edition 1988, page 2-6.)

25. Swing Joints

a. Also see Exterior Irrigation Pop-Up Sprinkler Assembly drawing.
b. Furnish and install swing assemblies with a 3-way range of movement at inlet and outlet connections for all sprinklers.
c. For ½-inch sprinklers, furnish and install pre-assembled swing assemblies with two ½-inch Marlex street elbows on the inlet and two separate ½-inch Marlex street elbows on the outlet to result in double elbow connections.
d. For ½-inch sprinklers requiring custom swing assemblies, furnish and install two ½-inch Marlex street elbows, a ½-inch barb x ½ inch MIPT elbow, a section of ½-flexible polyethylene piping not to exceed 24 inches, ½-inch barb x ½-inch MIPT elbow, and two ½-inch Marlex street elbow to the sprinkler connection.
e. For ¾-inch inlet sprinklers, furnish and install Rain Bird TSJ-12075: 12" (30.5 cm) long, 3⁄4-inch M NPT x M NPT swing joint with two ¾-inch Marlex street elbows at the inlet and two ¾-inch Marlex street elbows to the sprinkler inlet, or approved substitution.
f. For 1-inch inlet sprinklers, furnish and install TSJ-12: 12" (30.5 cm) long, 1" M NPT x M NPT swing joint with two separate 1-inch Sch. 40 street ells at the inlet and one separate 1-inch Sch. 40 street ell at the outlet or approved equal substitution.
g. For 1-inch quick couplers valves, furnish and install Dura 1-A4-1-11-18 swing joint with DL-010 Quick Lock. No exceptions. or approved substitution. Dry fit the upstream socket on a PVC pipe stub out, secure it from moving, fully tightening the O-ring connection, then

reverse the O-ring connection one full rotation to allow flexibility in positioning the quick coupler valve. Insert the inlet side of the quick coupler valve into the DL-010 Quick Lock fitting side with the recessed opening and hold it in position while tightening the quick coupler valve onto the swing assembly so that the connection is fully seated, secured, and aligned so that the the hexagonal female DL-010 Quick Lock fitting can be tapped onto the hexagonal male portion of the swing assembly then secured with zip ties.

26. Conventional Low Voltage Wiring Systems
    a. Furnish and install home runs for all conventional control wiring with the exception of splices at automatic control valves, master valves, and flow sensor, or as approved in the plans such as for modifications to extend existing wire for new irrigation. Do not install other control and spare wire splices without Owner and Grounds approval. Measure control and spare wireaccurately and protect staged wiring from construction damage to prevent having to replace control wiring. All control wire splices must be enclosed in valve boxes.
    b. Furnish and install conventional spare wiring with a minimum of 2 dedicated looping orange spare control wires and 1 white common wire for each mainline branch with up to 8 zones, 3 dedicated spare wires and 1 common wire for mainline branches with 9 to 16 zones, 4 dedicated spare wires and 1 common wire for mainline branches with 17 and more zones. For systems with known future expansion, stage the anticipated quantity of black non-looping spare wires and a common wire in a valve box.
    c. Furnish and install 24-inches of extra wire above finish grade inside the valve box for hot, common, and spare wires.
    d. Furnish and install the termination of all spare and common wiring in an enclosure at the furthest extent of each mainline branch and provide 36-inches of extra wire above finish grade inside the valve box.
    e. Do not exceed maximum runs of control wire for sufficient signal strength.

27. 2-Wire Low Voltage Wiring Systems
    a. 2-wire systems are non-standard and require an approved variance. 2-wire installations are used when flexibility and/or future expansion is needed.
    b. For 2-wire systems, furnish and install per approved submitted associated 2-wire products including but not limited to 2-wire controller circuit boards, single zone 2-wire decoders, 2-wire direct bury low voltage cable, and 3570GN Scotchlok Seal epoxy filled splices.

28. Trace Wire
    a. See Exterior Dedicated Non-Overlapping Trace Wire Layout drawing.
    b. Furnish and install dedicated, separate trace wires for the mainline and for each zone's lateral piping. Use direct bury splices at tees. Do not overlap trace wire.

29. Hand Watering
    a. Regularly hand water and protect plants and root balls while staged awaiting planting. Also protect staged plant materials by staging in the shade but where sun and heat exposure is unavoidable protect with shade cloth and misters.

b. Rehydrate dry and hydrophobic root balls prior to planting, particularly trees, by soaking root balls in water with 1-ounce of natural yucca surfactant per gallon of water to stimulate capillary action between dissimilar soils. If trees are too large to soak, carefully use a 3/8-inch nail to make 2-inch penetrations at 30-degrees off plumb and inward on the upper top quarter of the root ball at 12, 2, 4, 6, 8, and 10 o'clock positions for a 1.5 to 2-foot or larger root ball, half the penetrations for small root balls, and use a funnel that fits the penetrations to slowly pour in the surfactant mixture.
c. Hand water plants immediately following installation before and in conjunction with automatic irrigation to stimulate capillary action, ensure deep hydration of often disparate plant root ball soils and import soils which make lateral water transfer challenging, and to settle and remove air pockets from backfilled soils.

30. Contractor Maintenance Period

a. The landscape-irrigation trade partner shall furnish and execute 1-year of landscape, planting, and irrigation maintenance as outlined below, in 32 84, 00, 32 91 00, 32 93 00, and related sections, and per an approved submittal, after final acceptance of the irrigation system by the project, Owner, and Grounds.
b. The landscape-irrigation trade partner shall furnish and execute a maintenance submittal with maintenance tasks and frequency, adjusted for seasonality, with a means of reporting and documenting progress including dates, tasks, manhours, mapping of work areas, and photos as needed for each site visit, as well as tracking and resolving itemized issues, for review and approval by the project, Owner and Grounds.
a. The landscape-irrigation trade partner shall furnish and maintain the proper function of the irrigation system including repairs and adjustments.
b. The landscape-irrigation trade partner shall coordinate with Grounds to obtain online irrigation controller access.
c. The landscape-irrigation trade partner shall furnish and execute sole responsibility of programming, monitoring, and adjusting the irrigation controller and programs during their maintenance period.
d. The landscape-irrigation trade partner shall furnish, maintain, and manage the irrigation controller with programs including irrigation days per week, cycles per day, and run times, by grouping zones based on seasonal ET, similar plant water requirements, microclimate variables, and soil structure, texture, and drainage, and plant types, including but not limited to dedicated programs for lawns, planting beds, and tree bubbler zones, sun and shade exposure, unique soil and drainage conditions, slopes, and on-grade and on-structure plantings. Set up programs so that precipitation rates do not exceed soil infiltration rates. If this is not possible, allocate run time over two or more cycles to minimize run-off.
e. The landscape-irrigation trade partner shall furnish and execute frequent monitoring of root zone soil moisture with a soil core sampling probe relative to irrigation cycle intervals, and program adjustments to maintain sufficient soil moisture and for seasonal ET adjustments. For significant deficits or surpluses of suitable soil moisture, the landscape-irrigation trade partner shall take immediate action to provide suitable soil moisture. For example, if dry, temporarily provide manual and/or automatic cycle and soak programs until proper soil moisture is achieved and make permanent adjustments to the programs as needed.. Or if

saturated, temporarily remove a water day(s) until proper soil moisture is achieved and make permanent adjustments to the programs as needed.

c. The landscape-irrigation trade partner shall provide weekly maintenance visits March through September and monthly visits October through February.
d. The GC and PDG shall schedule monthly walk throughs with the project, landscape-irrigation trade partner, Owner, and Grounds during the growing season, and every two months during the winter.
e. The landscape-irrigation trade partner shall consistently replenish and maintain the specified depth of mulch and type of mulch including texture and coloration during the contractor maintenance period

31. Contractor Warranty Period

a. Provide a warranty against defects of installation and material for a period of 1-year after final acceptance of the irrigation system by the project, Owner, and Grounds. The warranty shall also cover repair or damage to any part of the premises resulting from leaks or other defects in material, equipment and workmanship to the satisfaction of the Owner. Repairs, if required, shall be done promptly upon notification at no additional cost.
b. The GC, landscape architect, and landscape-irrigation trade partner shall continuously track plant mortality and plants of concern by geolocating and identifying plant material types on the as-built planting plan including notation as needed and share this information with the project, Owner and Grounds.
c. The GC shall schedule a mid-warranty meeting and site walk with the landscape-irrigation trade partner, the project, the Owner, and Grounds to review, document, and resolve plant mortality, irrigation issues, and other items.
d. The GC shall schedule a final-warranty meeting and site walk with the landscape-irrigation trade partner, the project, the Owner, and Grounds to review, document, and resolve plant mortality, irrigation issues, and other items.
e. The GC and landscape-irrigation trade partner shall reasonably adjust plant material replacements to timeframes that facilitate sufficient evaluation of plant material, for examples, waiting until trees can produce buds, avoiding replanting during excessive heat, soil saturation, or freezing, and for sufficient plant materials availability from suppliers.

H. Drawings

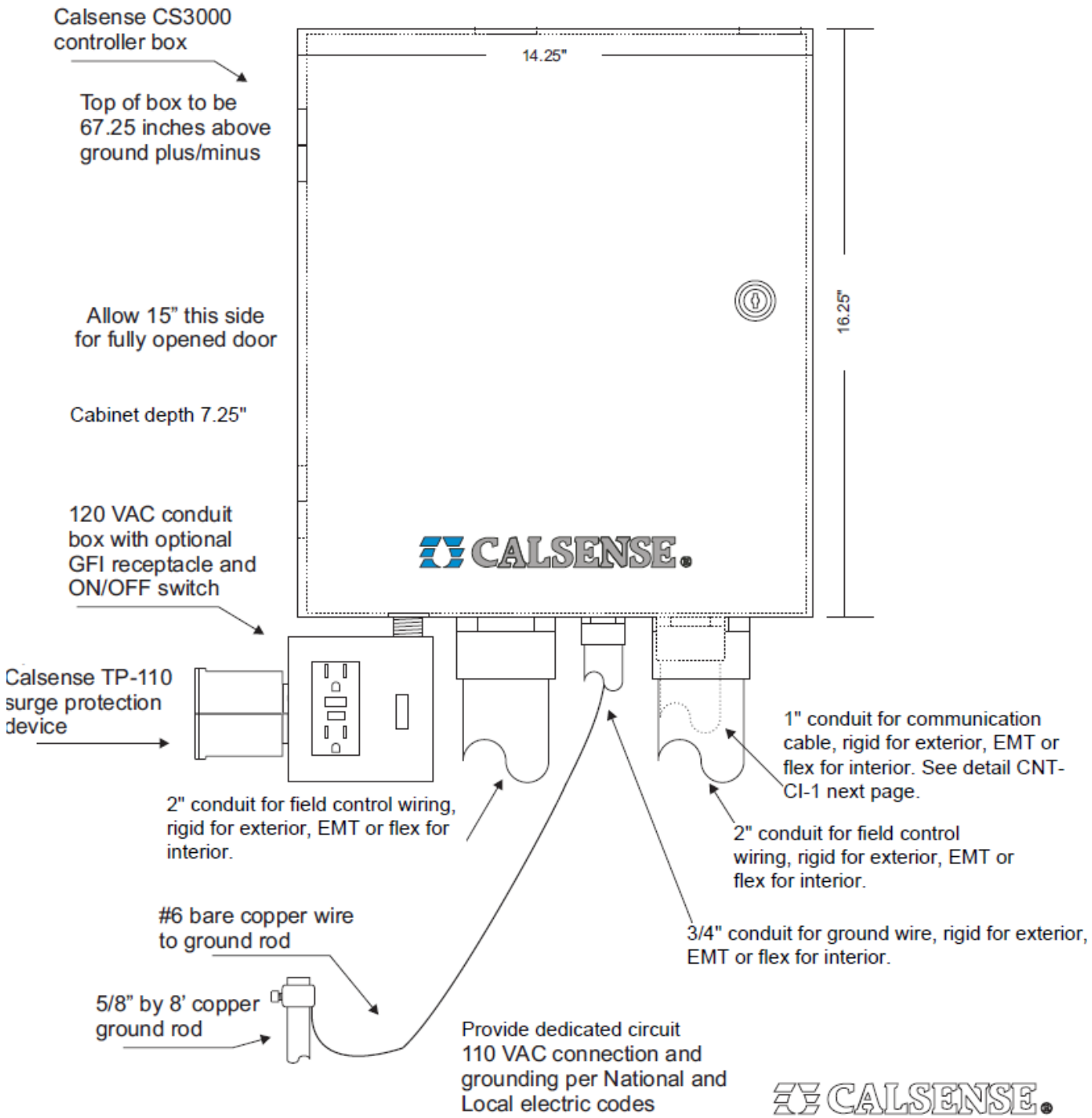
1. General

Drawings are not to scale, diagrammatic.
Also see narrative for additional details with equal weight.

2. Drawings List:

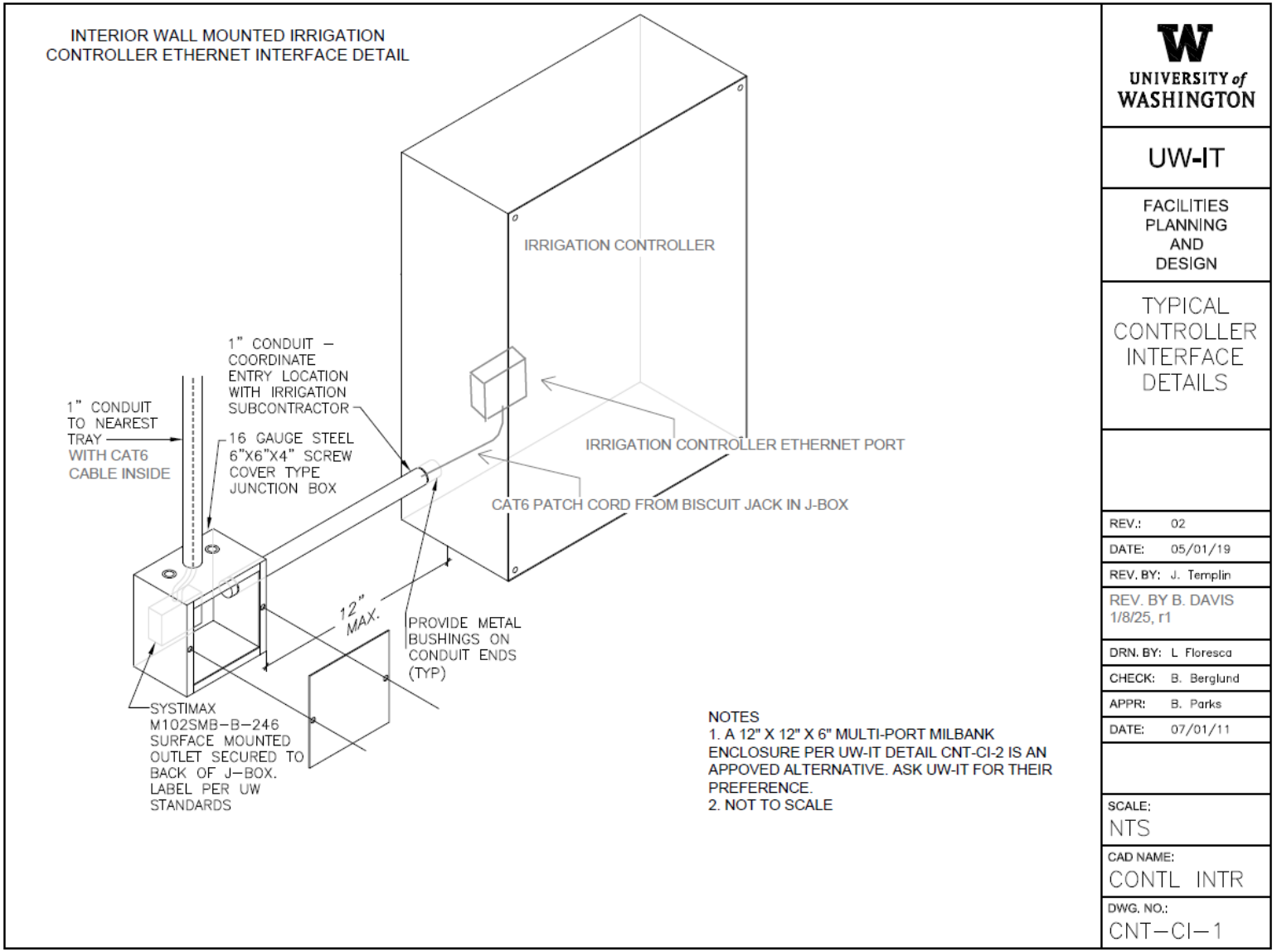
   a. Interior Mechanical Room Irrigation Controller – Wall Mount
   b. Interior Mechanical Room UW-IT Ethernet to Irrigation Controller
   c. Non-Standard Exterior Irrigation Controller with Approved Variance – Wall Mount
   d. Non-Standard Exterior Irrigation Controller with Approved Variance – Pedestal
   e. Interior Mechanical Room Irrigation Point of Connection Assembly
   f. Non-Standard Exterior Irrigation Point of Connection Assembly with Approved Variance, Part 1 of 2
   g. Non-Standard Exterior Irrigation Point of Connection Assembly with Approved Variance, Part 2 of 2
   h. Exterior Mainline, Control & Spare Wire Penetrations, & Gate Valve Assembly
   i. Non-Standard Control & Spare Wire Penetration Assembly with Approved Variance
   j. Green Roof or Vegetated Membrane Mainline, Control & Spare Wire Penetrations, & Gate Valve Assembly
   k. Exterior Irrigation Gate Valve Assembly
   l. Exterior Irrigation Quick Coupler Valve Assembly
   m. Exterior Irrigation Automatic Control Valve Assembly
   n. Interior Irrigation Automatic Control Valve Assembly to Green Roofs or to Non-Standard Underground On-Grade Landscape Zones with Approved Variance
   o. Exterior Irrigation Pop-Up Sprinkler Assembly
   p. Exterior Irrigation Pop-Up Sprinkler Clearances
   q. Dedicated Tree Bubbler Zones
   r. Exterior Dedicated Non-Overlapping Trace Wire Splice Layout
   s. Exterior Pipe Cover Depth
   t. Exterior Irrigation Mainline Termination Assembly

Interior Mechanical Room Irrigation Controller – Wall Mount

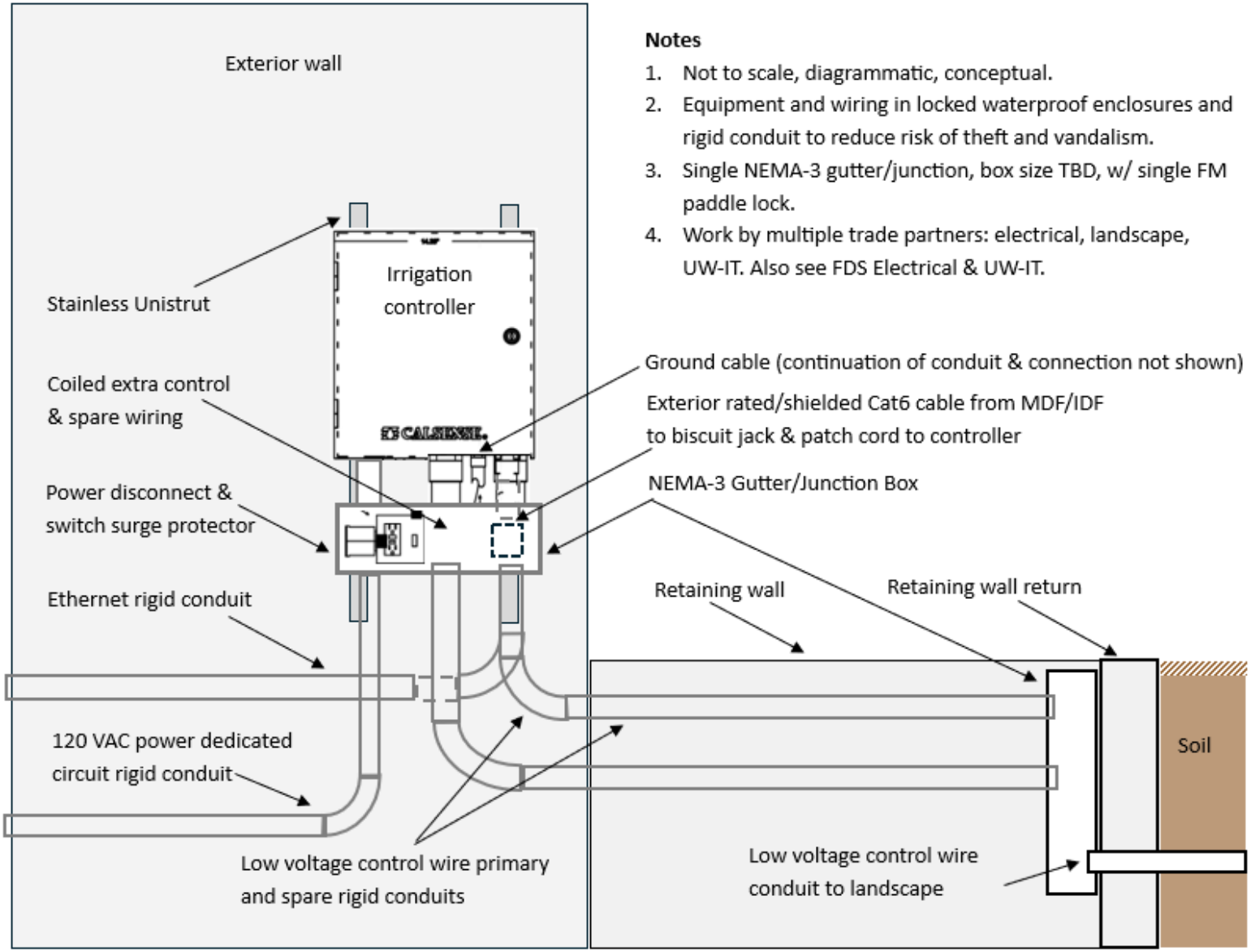


NOTES
1. Provide GFCI boxes to include locks for receptacle and switch, weather rated for exterior.
2. For interior controllers with interior master valves and flow sensors, coordinate custom cores with caution to protect controller contents for combined or separate 1" EMT or flex conduit pathways from controller to master valves and flow sensors terminating conduits with bushings. For exterior controllers with exterior master valves and flow sensors, utilize 2" conduit for field control wiring.
3. If necessary, use a separate junction box/gutter adjacent to controller for additional control, spare, master valve, and flow senor wire capacity.
4. All exterior cabinets and junction boxes to be NEMA waterproof rated.
5. Original Calsense detail revised by B. Davis, 1/8/25, r1

Interior Mechanical Room UW-IT Ethernet to Irrigation Controller



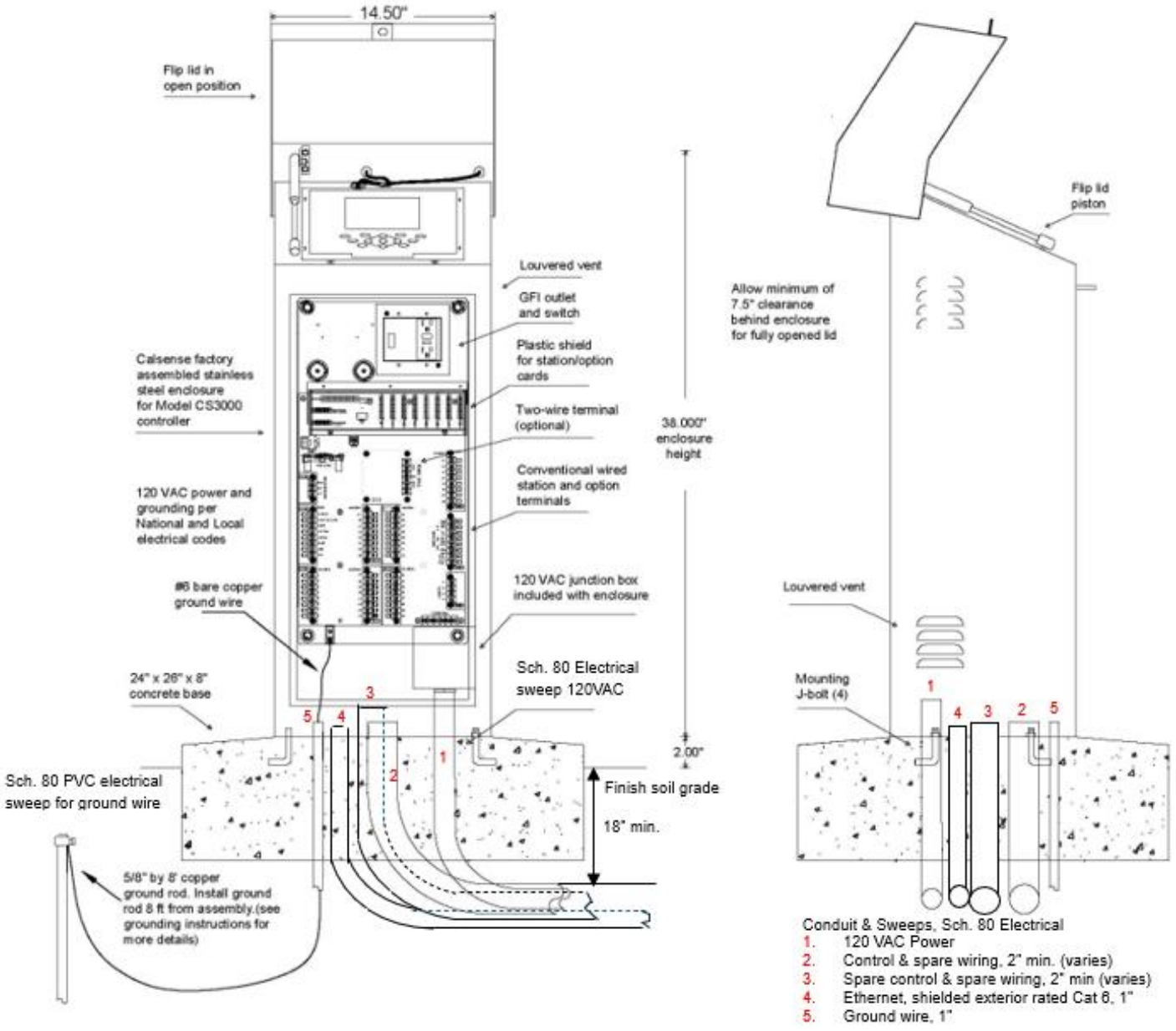
Non-Standard Exterior Irrigation Controller with an Approved Variance – Wall Mount



Notes

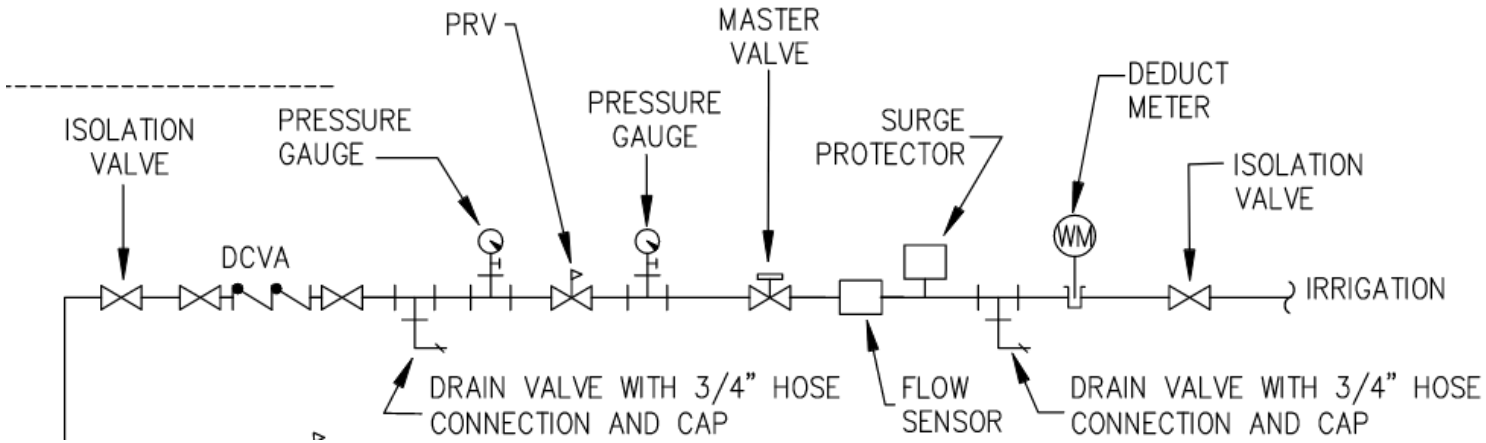
1. Not to scale, diagrammatic, conceptual.
2. Equipment and wiring in locked waterproof enclosures and rigid conduit to reduce risk of theft and vandalism.
3. Single NEMA-3 gutter/junction, box size TBD, w/ single FM paddle lock.
4. Work by multiple trade partners: electrical, landscape, UW-IT. Also see FDS Electrical & UW-IT.

Non-Standard Exterior Irrigation Controller with an Approved Variance – Pedestal

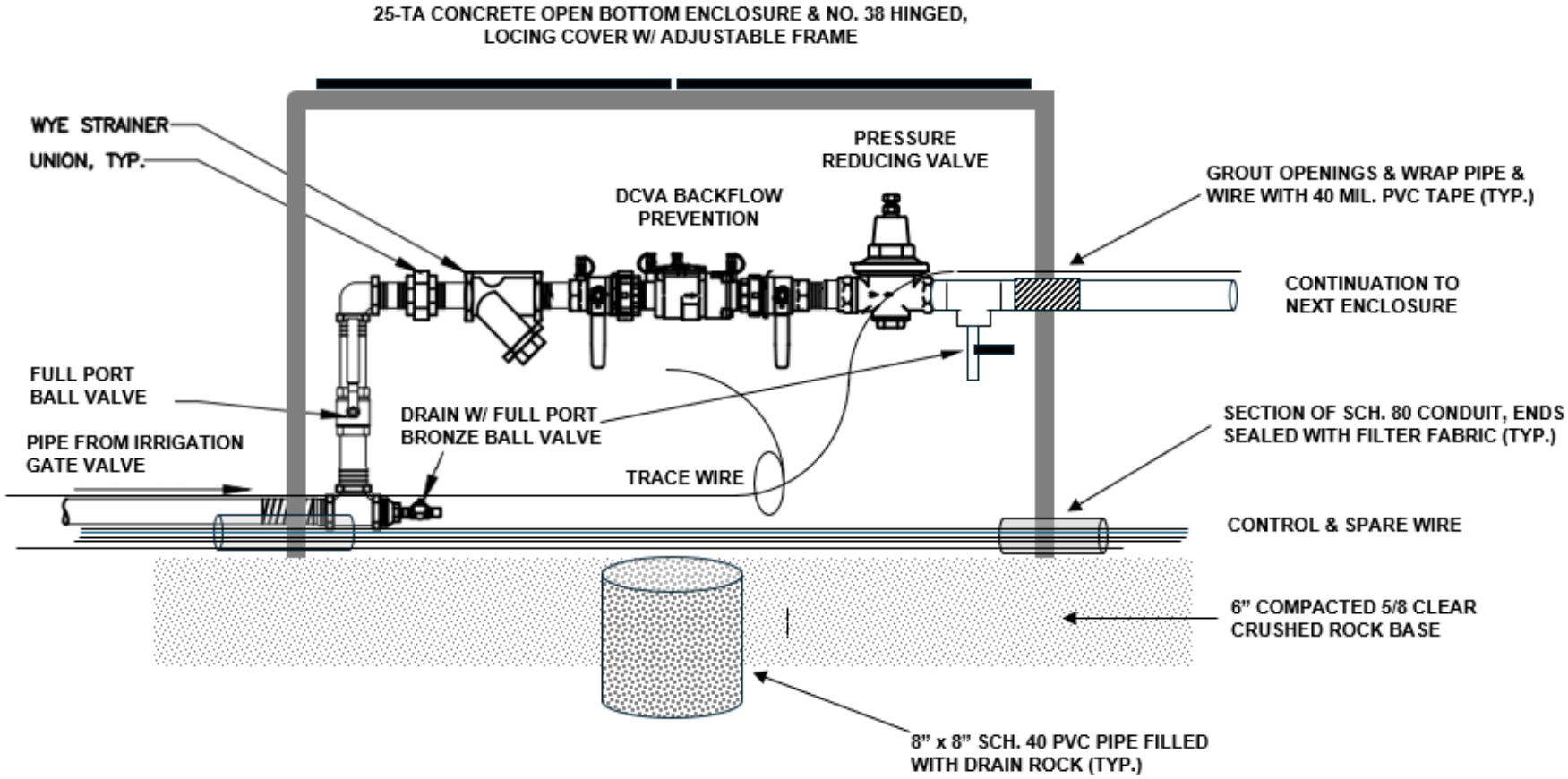


Interior Mechanical Room Irrigation Point of Connection Assembly

The below detail is a snapshot of only the Irrigation branch from the main building water header. See the Mechanical Standards "Water Header Configuration for Lab and Non-Lab Buildings" drawing in the "Potable and Nonpotable Water" section for the full water header schematic.

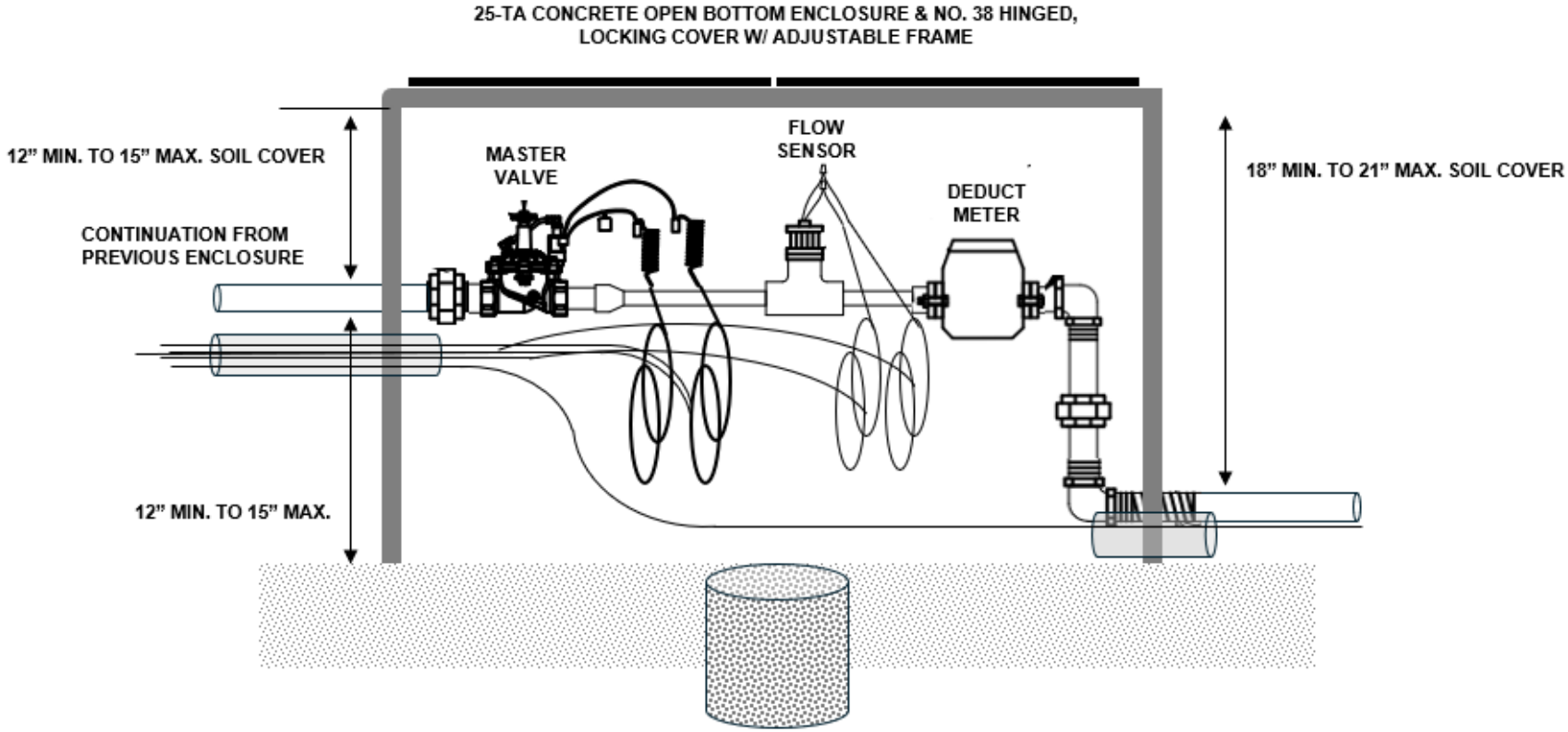


Non-Standard Exterior Irrigation Point of Connection Assembly with an Approved Variance – Part 1 of 2



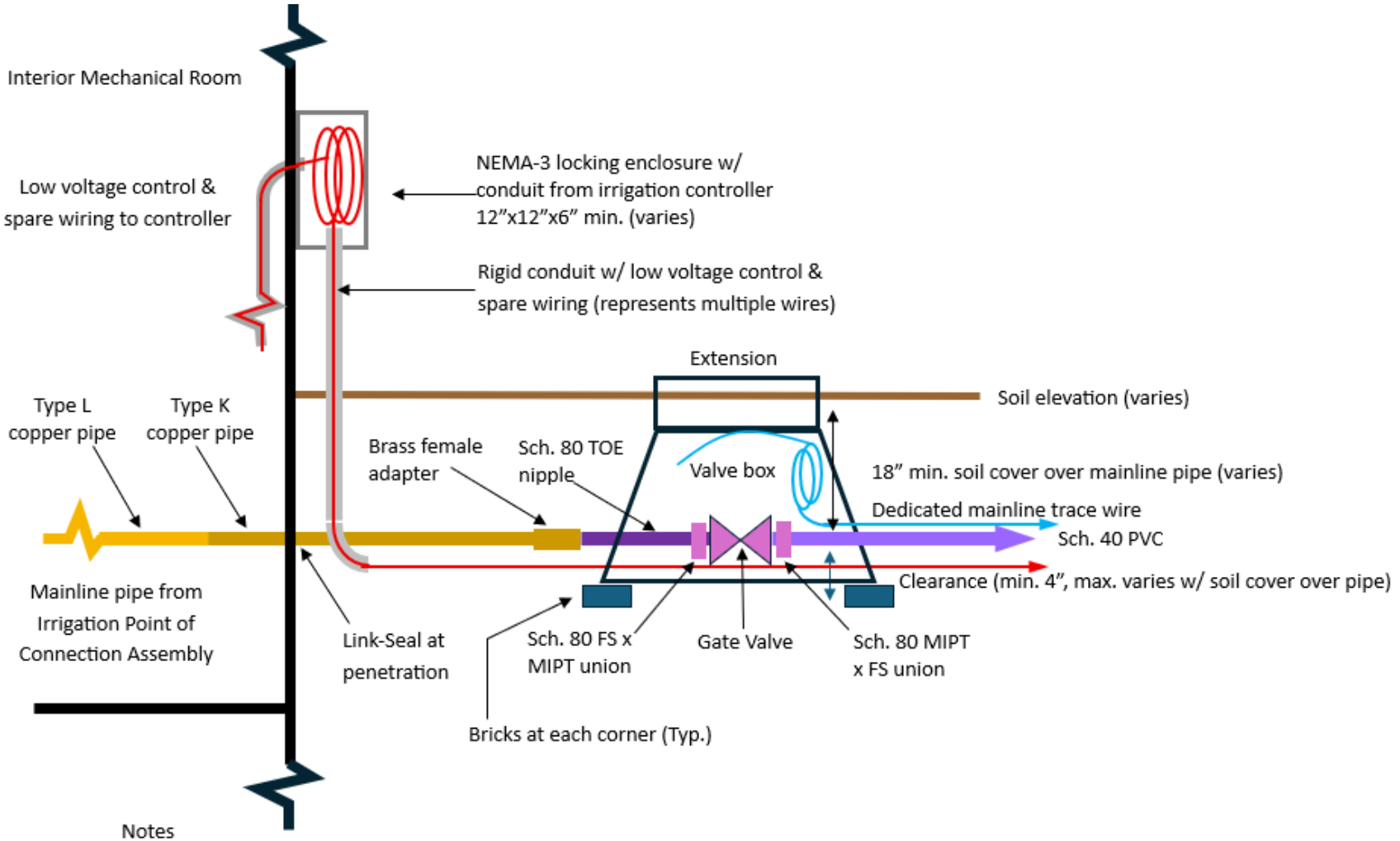
NOTES
1. DO NOT INSTALL WYE STRAINER IF THERE IS ALREADY ONE UPSTREAM.
2. CONTROL, SPARE, & TRACE WIRE ARE DIAGRAMMATIC.
3. ALL PIPE & FITTINGS BRONZE, BRASS, THREADED.
4. DETAIL BASED ON 1.5" PIPE, FITTINGS & SPECIFIED APPURTENANCES. LARGER SIZES MIGHT NEED ADDITIONAL ENCLOSURES. SCALED SHOP DRAWINGS REQUIRED FOR REVIEW PRIOR TO INSTALLATION.
5. NOT TO SCALE.

Non-Standard Exterior Irrigation Point of Connection Assembly with an Approved Variance – Part 2 of 2



NOTES
1. NOT INSTALL WYE STRAINER IF THERE IS ALREADY ONE UPSTREAM.
2. CONTROL, SPARE, & TRACE WIRE ARE DIAGRAMMATIC.
3. ALL PIPE & FITTINGS BRONZE, BRASS, THREADED.
4. DETAIL BASED ON 1.5" PIPE, FITTINGS & APPURTENANCES. LARGER SIZES MIGHT NEED ADDITIONAL ENCLOSURES. SCALED SHOP DRAWINGS REQUIRED FOR REVIEW AND APPROVAL PRIOR TO INSTALLATION.
5. STAINLESS UNISTRUT AND FITTINGS REQUIRED TO SUPPORT ASSEMBLY ARE NOT SHOWN.
6. NOT TO SCALE.

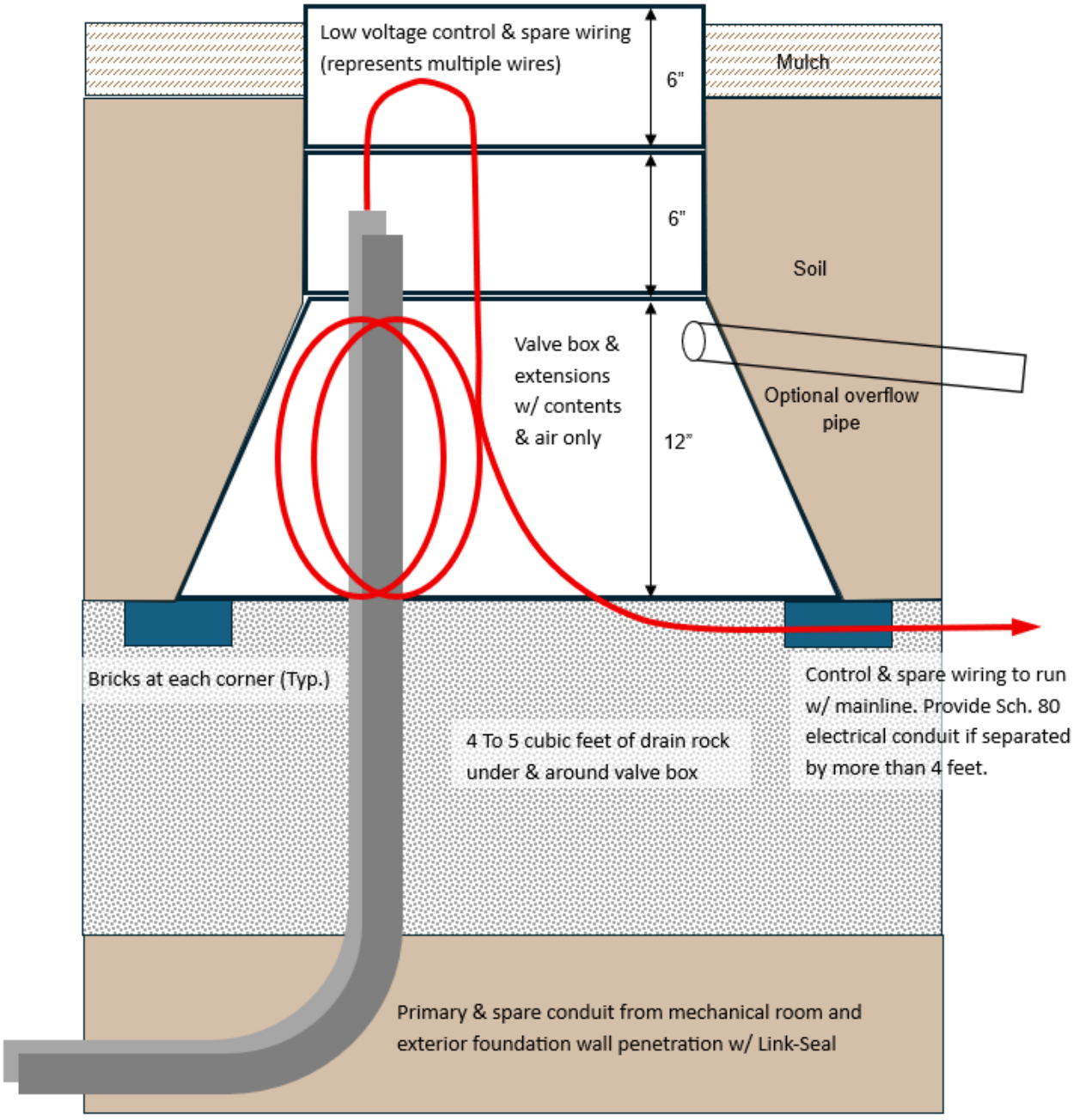
Exterior Mainline, Control & Spare Wire Penetrations & Gate Valve Assembly



Notes

1. Elevated low voltage penetration provides a water break to prevent water intrusion into conduit, into controller, and into mechanical room.
2. Refer to Exterior Irrigation Gate Valve Assembly for additional requirements including clearances and sealing of openings.
3. Not to scale, diagrammatic.

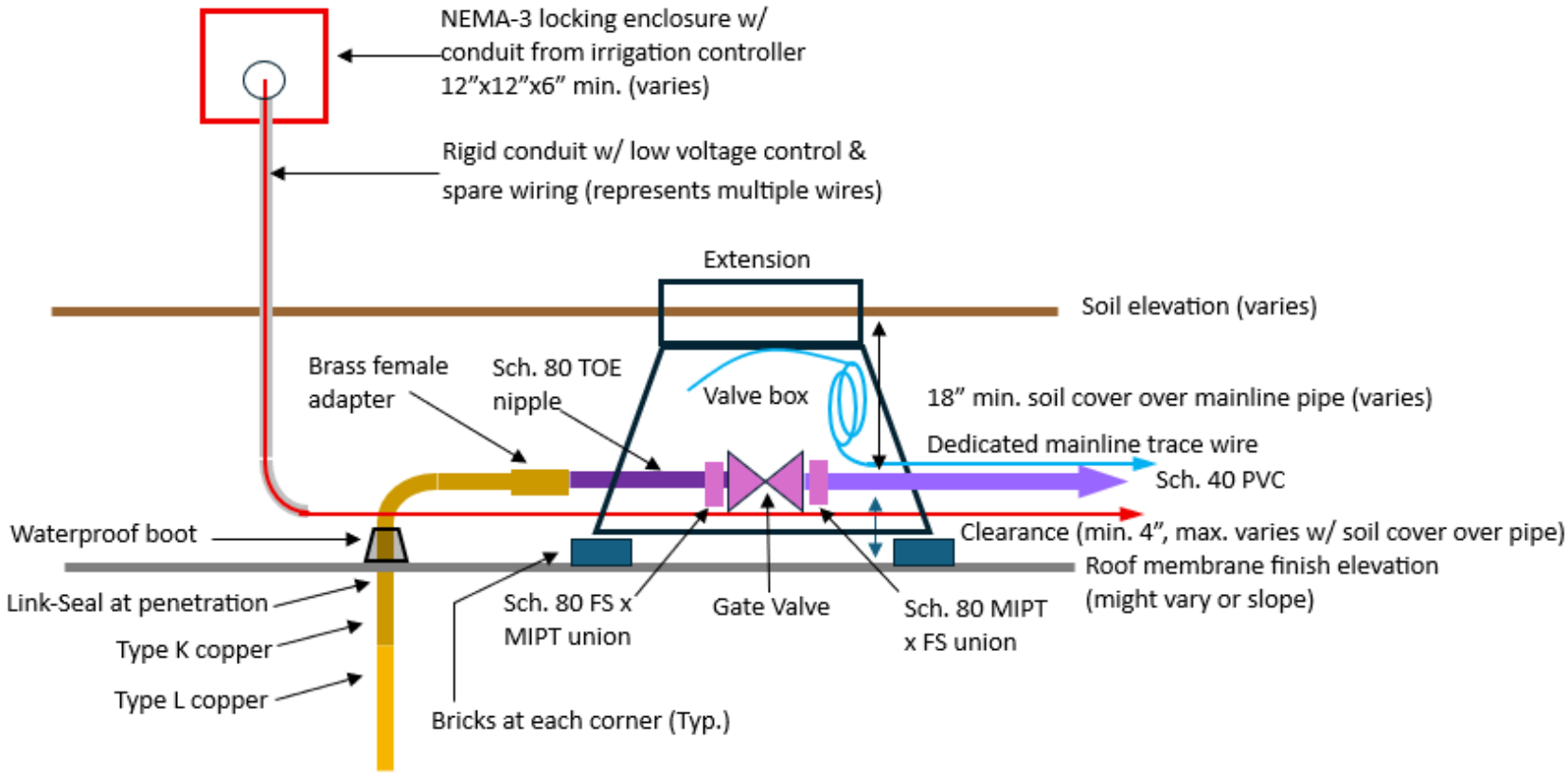
Non-Standard Control & Spare Wire Penetration Assembly w/ an Approved Variance



Notes

1. Seal conduit(s) ends w/ wiring w/ non-shrinking foam. Cap unused conduit with dry fit cap.
2. Locate box in elevated area. Do NOT locate box in low area. Place over foundation drainage if possible.
3. For controllers below the elevation of conduit terminations, provide interior conduit drains between controller and penetrations.
4. Option for overflow pipe with 2% drop (min.) with connection near top of valve box to outfall with rodent screen, discharging onto pond liner and cobbles, ideally into a non-infiltrating biofiltration cell or rain garden.
5. Not to scale, diagrammatic.

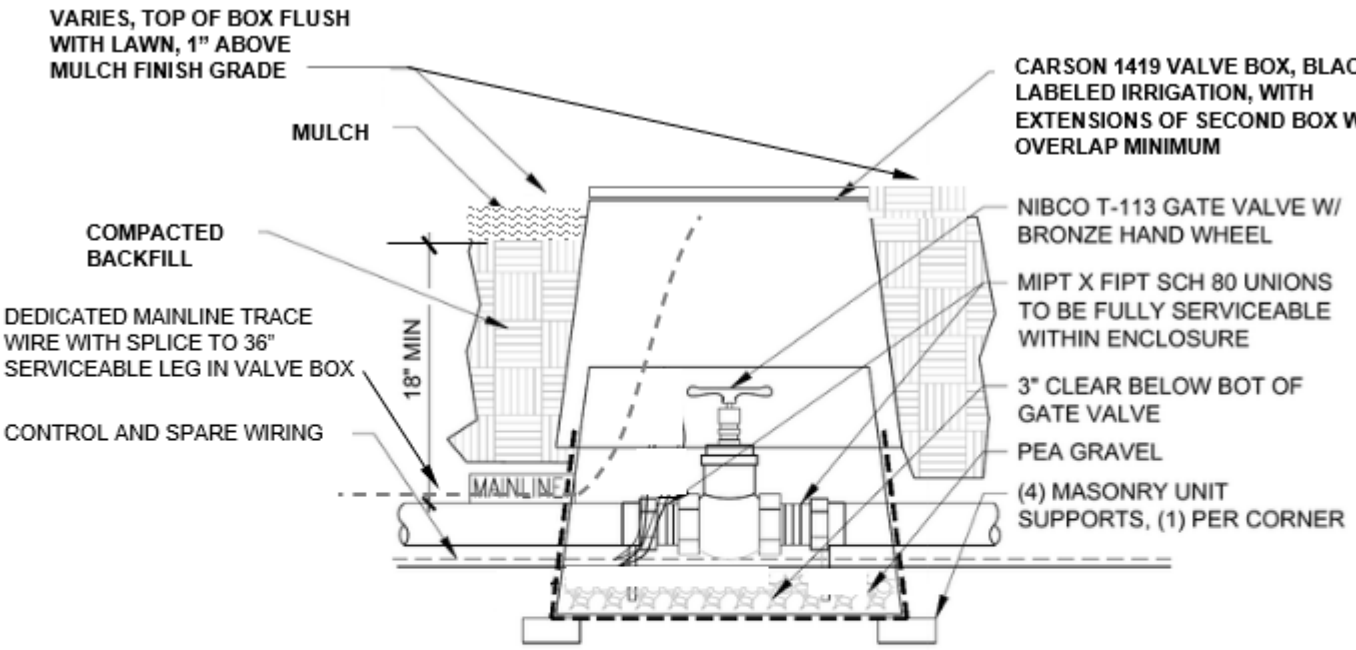
Green Roof or Vegetated Membrane Mainline, Control & Spare Wire Penetrations, & Gate Valve Assembly



Notes

1. Elevated low voltage penetration provides a water break to prevent water intrusion into conduit, into controller, and into mechanical room.
2. Refer to Exterior Irrigation Gate Valve Assembly for additional requirements including clearances and sealing of openings.
3. Low voltage and spare control wiring from controller via conduit inside building (not shown).
4. Not to scale, diagrammatic.

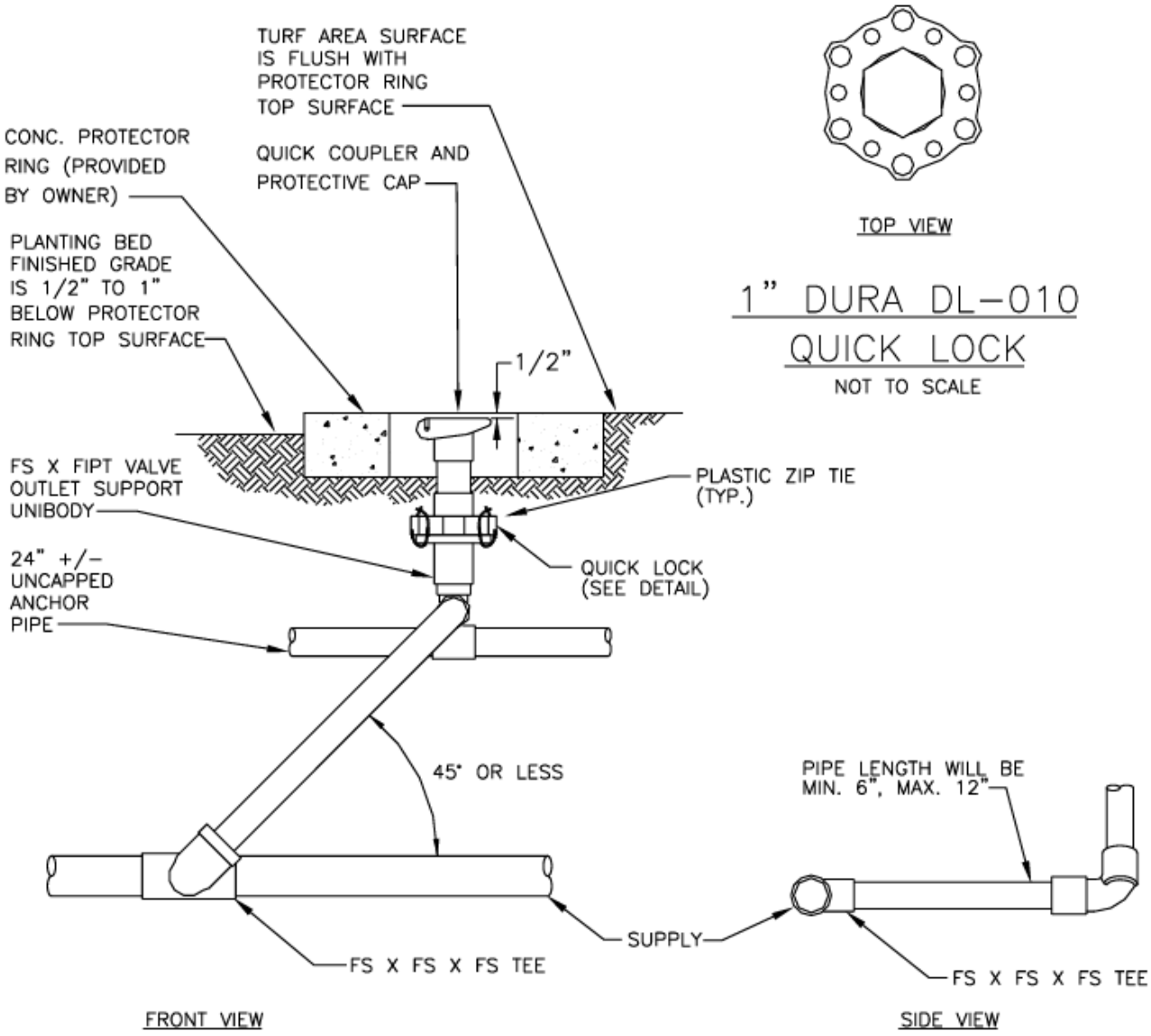
Exterior Gate Valve Assembly



NOTES:

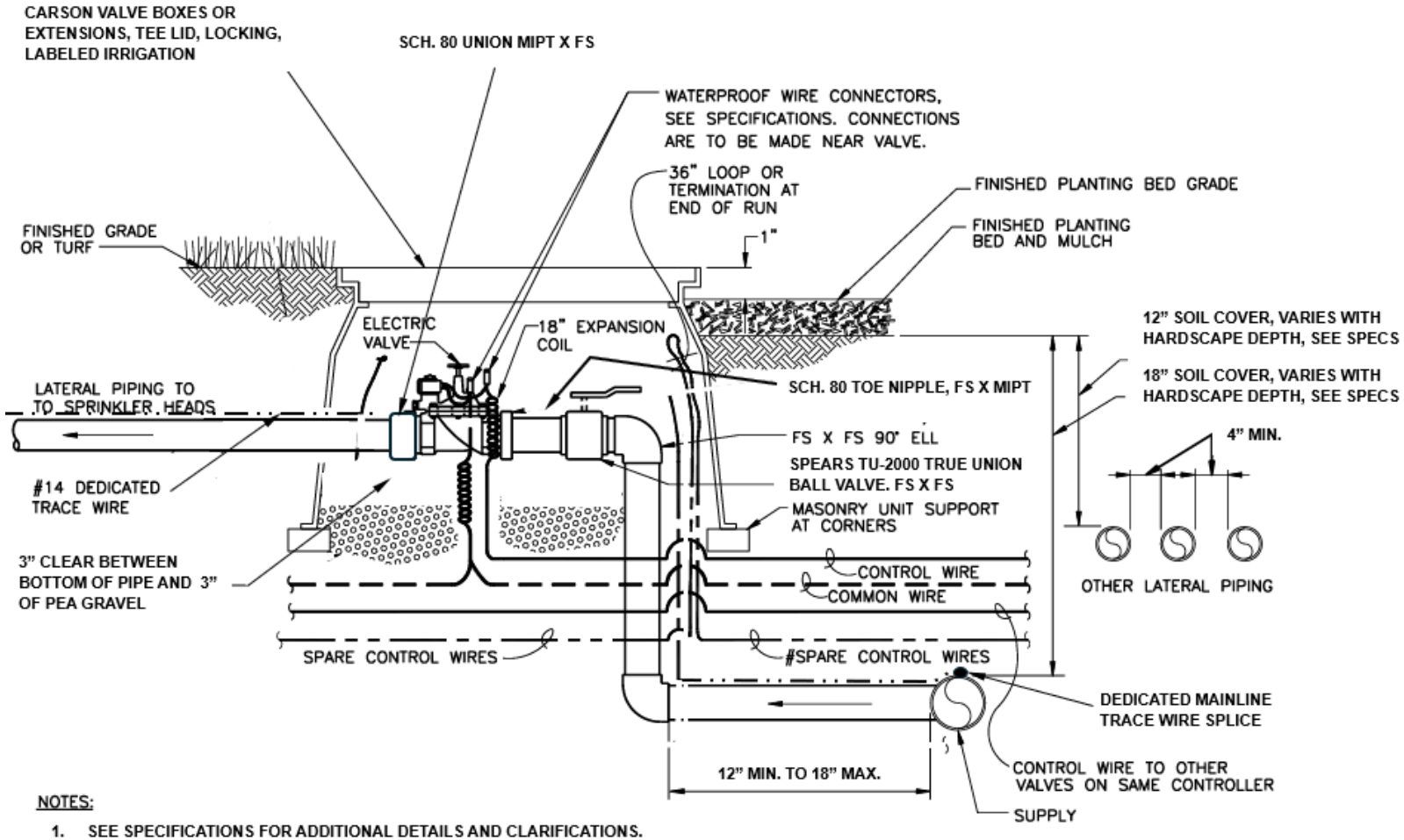
1. SEE SPECIFICATIONS FOR ADDITIONAL DETAILS AND CLARIFICATIONS.
2. PROVIDE 1 TO 2" OF CLEARANCE BETWEEN PIPE & FITTINGS, CONTROL WIRING, TRACE WIRES, VALVE BOX CUT OUTS, AND BRICKS.
3. SEAL OPENINGS WITH FILTER FABRIC AFFIXED TO EXTERIOR OF BOX TO PREVENT SOIL INTRUSION.
4. NO PIPING UNDER VALVE BOX EXCEPT MAINLINE SUPPLY PIPE.
5. FOR LEAD OFF GATE VALVE(S) DOWNSTREAM OF TYPE K COPPER PENETRATIONS FROM A MECHANICAL ROOM, PROVIDE AN MIPT X MIPT SCH. 80 UNION UPSTREAM OF THE GATE VALVE(S) TO ADAPT TO A BRASS FEMALE ADAPTER.
6. NOT TO SCALE.

Exterior Quick Coupler Valve Assembly



DURA QUICK COUPLER SWING ASSEMBLY 1-A4-1-11-18

Exterior Irrigation Automatic Control Valve Assembly

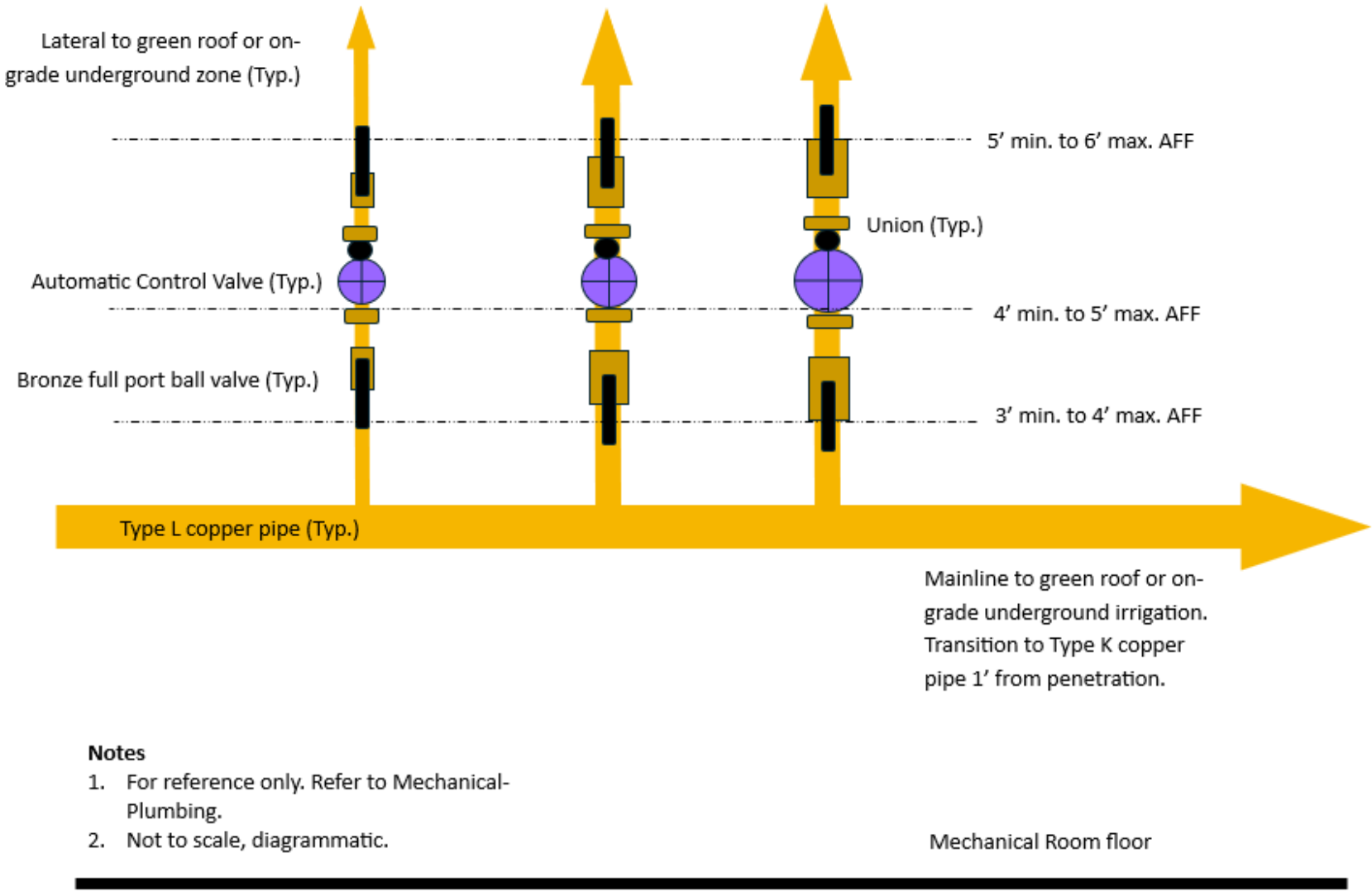


NOTES:

1. SEE SPECIFICATIONS FOR ADDITIONAL DETAILS AND CLARIFICATIONS.
2. 12" MIN. TO 18" MAX. HORIZONTAL MAINLINE STUB OUT IS CRITICAL.
3. PROVIDE 1 TO 2" OF CLEARANCE BETWEEN PIPE & FITTINGS, CONTROL WIRING, TRACE WIRES, VALVE BOX CUT OUTS, AND BRICKS.
4. SEAL OPENINGS WITH FILTER FABRIC AFFIXED TO EXTERIOR OF BOX TO PREVENT SOIL INTRUSION.
5. NO PIPING UNDER VALVE BOX EXCEPT INCOMING MAINLINE SUPPLY PIPE AND EXITING LATERAL PIPE.

NOT TO SCALE

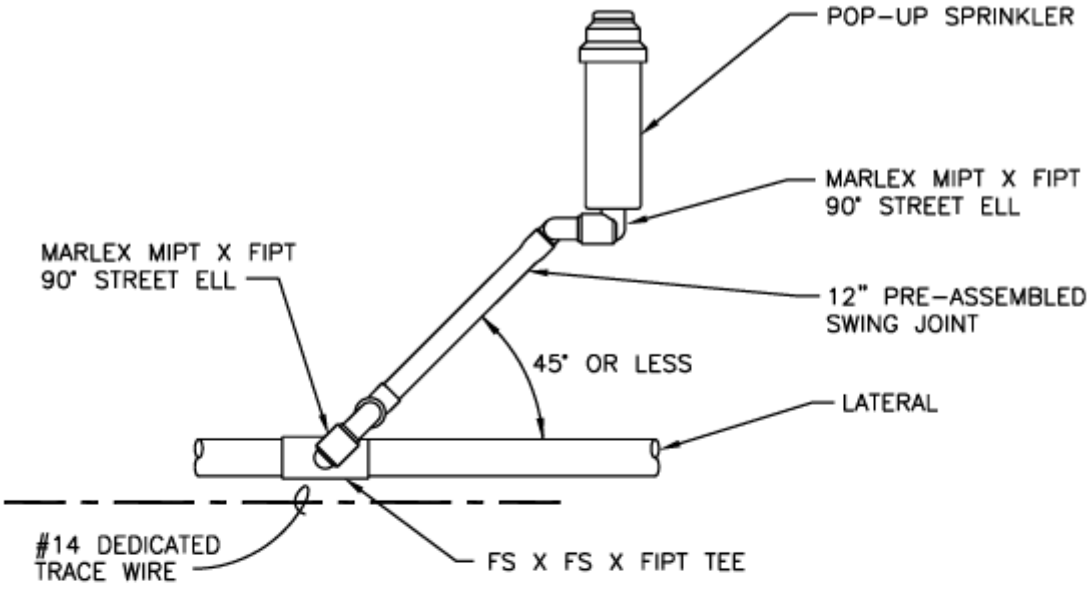
Interior Irrigation Automatic Control Valve Assembly to Green Roofs or to Non-Standard Underground On-Grade Landscape Zones with an Approved Variance



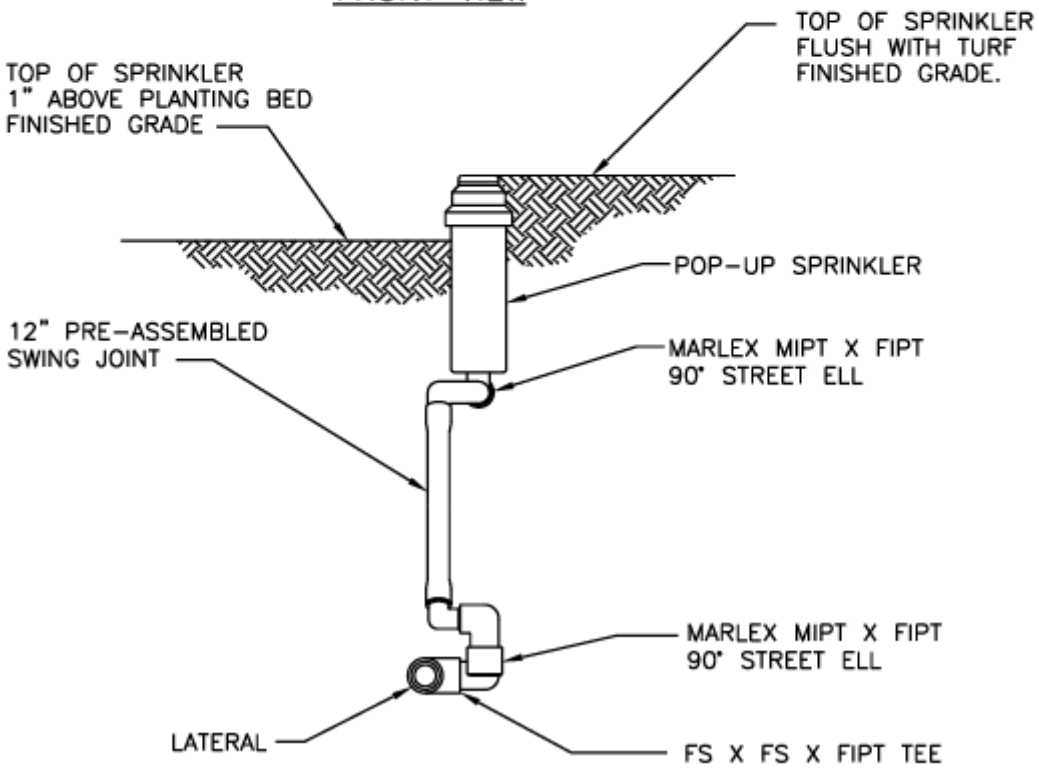
Notes

1. For reference only. Refer to Mechanical-Plumbing.
2. Not to scale, diagrammatic.

Exterior Irrigation Pop-Up Sprinkler Assembly

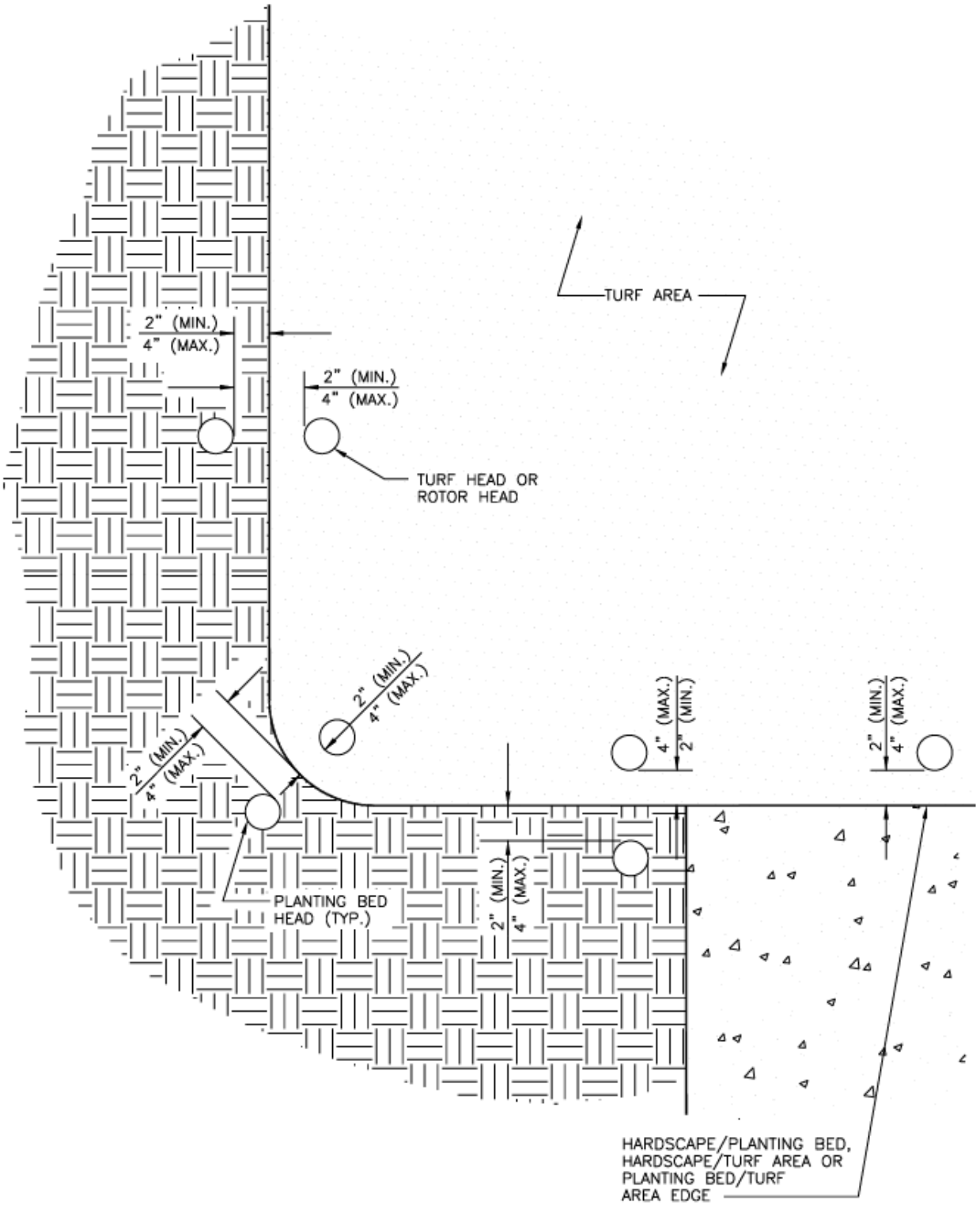


FRONT VIEW



SIDE VIEW

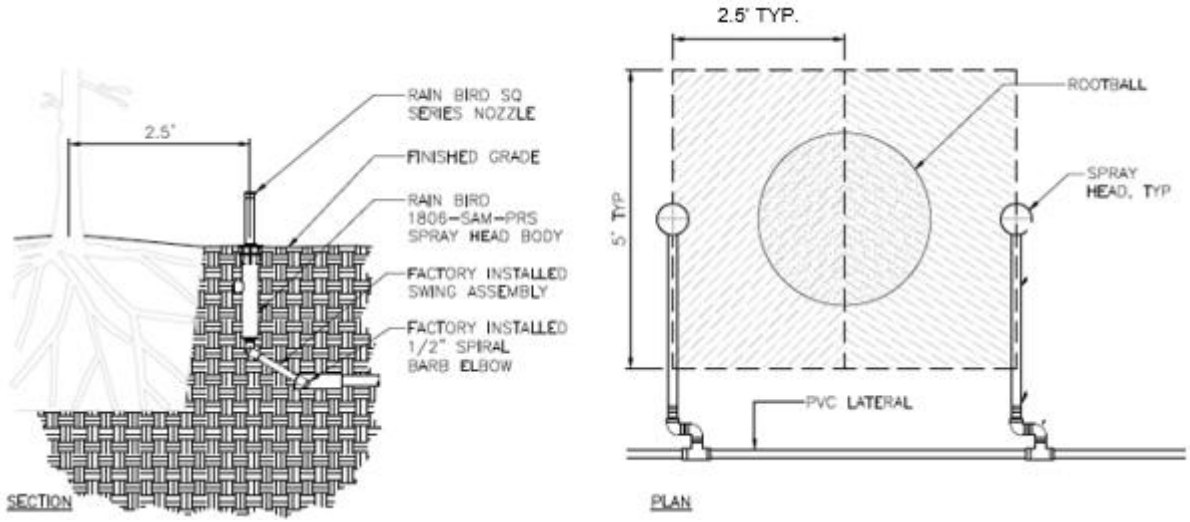
Exterior Irrigation Pop-Up Sprinkler Clearances



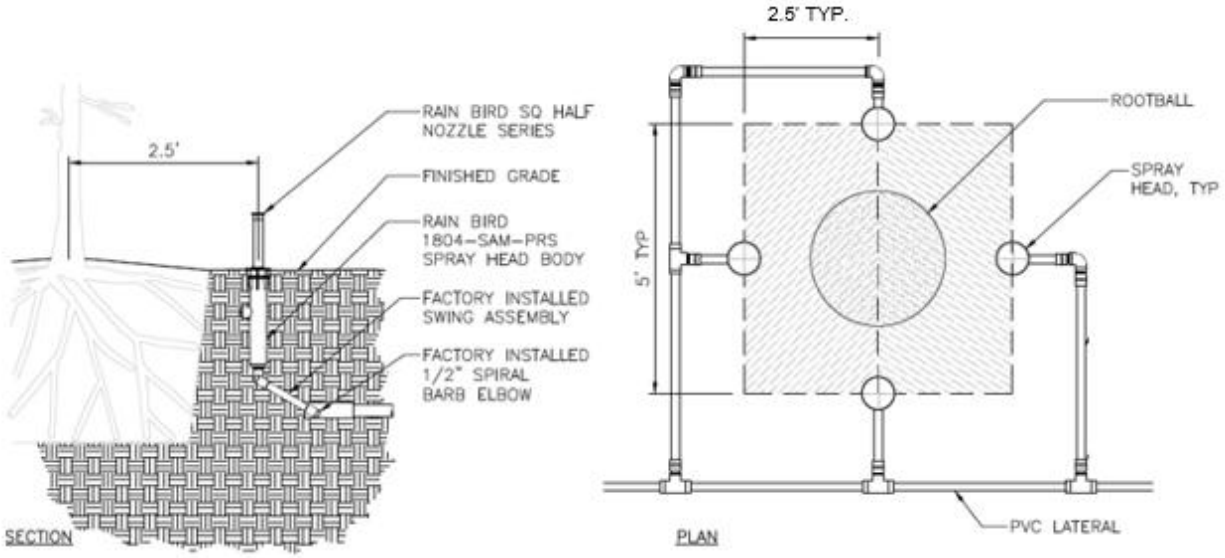
Dedicated Tree Bubbler Zones

General. Dedicated tree irrigation zones help establish new trees for three years and are then decommissioned. A minimum 5 GPM flow per zone is required for the optimal function of Rain Bird PEB valves without upstream filtration and is a function of nozzle output and tree quantity. The minimum flow also provides sufficient low resolution for flow sensors and central control alarms. Next, for slopes, install a temporary partial mulch covered soil berms in the bubbler coverage area to minimize runoff. Last, all dedicated tree zones on a system must have the same number of sprinklers and nozzle types per tree to provide uniform irrigation controller programming.

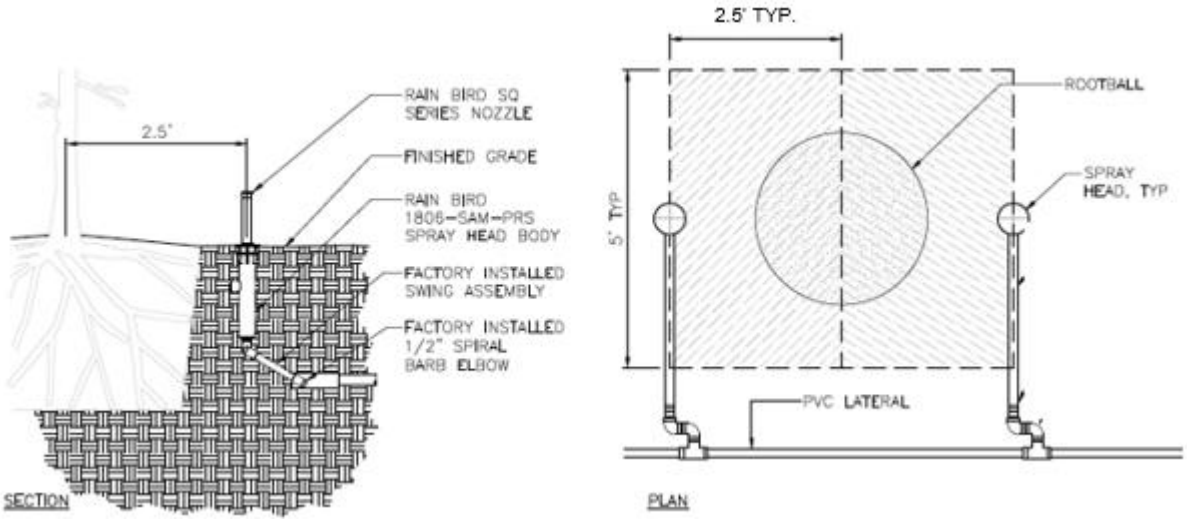
2 to 5 Trees: This detail utilizes 2 Rain Bird 5H-B MPR stream bubbler nozzles with head-to-head spacing for a minimum of 2 sprinklers * 1 GPM * 2 trees = 4 GPM which is sufficiently close to the 5 GPM per zone minimum requirement. For a single tree, use slow-release water bags.



6 to 11 Trees: This detail utilizes 4 Rain Bird SQ nozzles set at 2.5 feet with coverage-to-coverage spacing for a minimum of 4 sprinklers * 0.2 GPM each = 0.8 GPM per tree * 6 trees = 4.8 GPM which is sufficiently close to the 5 GPM per zone minimum requirement.



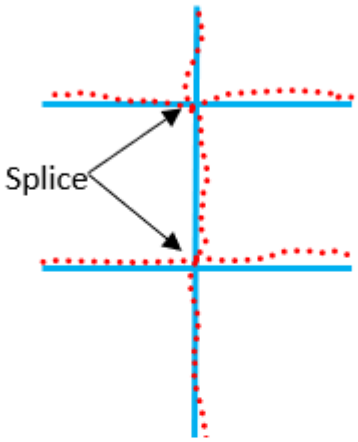
12 or More Trees. This detail utilizes 2 Rain Bird SQ nozzles set at 2.5 feet with coverage-to-coverage spacing for a minimum of 2 sprinklers * 0.2 GPM each = 0.4 GPM * 12 trees = 4.8 GPM which is sufficiently close to the 5 GPM per zone minimum requirement.



Exterior Dedicated Non-Overlapping Trace Wire Layout

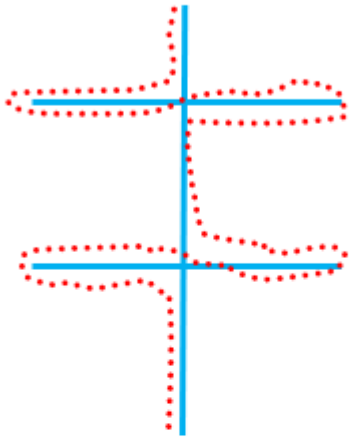
Trace wiring using 14-gauge, solid copper, UF, blue insulated wire

Okay



Single run of trace wire on each pipe only. Use waterproof direct bury splice kit at tees. No doubling back, looping or overlapping

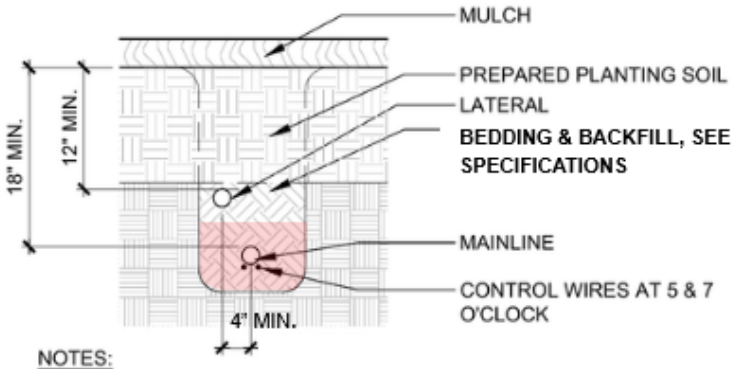
Not Okay



Multiple trace wires per pipe, doubling back or overlapping is not acceptable because they null electromagnetic locate signals.

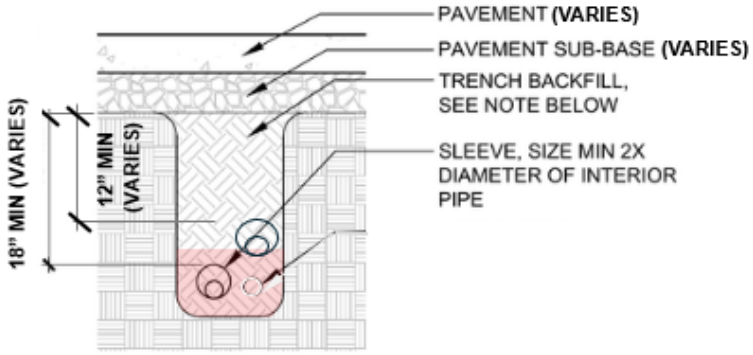
***Explanation**: Although the layout on the right is okay with non-insulated or bare 14 gauge solid copper trace wire, in the case of insulated wire the electromagnetic locate signal is nulled out where wiring is overlapped. The shift to insulated wiring is because bare copper trace wire degrades more quickly and has a shorter life. The tradeoff with insulated wiring is having more direct bury waterproof splices.*

Exterior Pipe Cover Depth



NOTES:

1. OFFSET PIPING A MIN. OF 4"
2. DO NOT STACK PIPE
3. NOT TO SCALE



NOTES:

1. COVER VARIES WITH HARDSCAPES AND UNDER ROADWAYS. SEE SPECIFICATIONS
2. OFFSET PIPING A MIN. OF 4"
3. DO NOT STACK PIPE
4. NOT TO SCALE

Exterior Irrigation Mainline Termination Assembly