



North Carolina Irrigation Contractors' Licensing Board General Statute 89G

Purpose

The purpose of this document is to present irrigation Best Management Practices (BMP's) and Minimum Standards (MS) for turf and landscapes. These support the design, installation, maintenance and management of turf and landscape irrigation systems in ways that save water and protect water quality.

The goal is to provide landscape irrigation stakeholders with tools to understand, implement, and manage efficient turf and landscape irrigation system. Stakeholders include landscape irrigation designers, consultants, landscape irrigation contractors, landscape contractors and maintenance personnel, landscape irrigation system owners, water purveyors, and the general public.

These BMPs and Minimum Standards become enforceable on July 1, 2009. They will be reviewed and evaluated periodically by the board. All comments and suggestions are welcomed by the board.

Turf and Landscape Irrigation Best Management Practice and Minimum Standard

A Minimum Standard (MS) is a required irrigation practice that is designed to ensure a properly designed, installed, and managed irrigation system.

A Best Management Practice (BMP) is a **recommended** irrigation practice that is designed to reduce water usage and protect water quality. A BMP is economical, practical and sustainable, and maintains a healthy, functional landscape without exceeding the water requirements of the landscape. **All BMP's are in bold print.**

North Carolina Irrigation Contractors Licensing Board

IRRIGATION DESIGN STANDARDS

All irrigation systems do not utilize all elements outlined herein. Consider only those items pertinent to the specific design.

I. Plan Standards

Standard - Provide a system checklist that includes enough information that the client/end-user fully understands the scope of work, including types of equipment, coverage standards, and warranty.

BMPs-Provide a plan to the following standards:

A. GRAPHIC STANDARDS

1. Accurately portray the site – show all pertinent site information
2. Legible
3. Reproducible
4. Drawn to scale
5. Contractor's seal
6. Contractor's/Designer's name/address/phone number
7. Client's name
8. Project name
9. Date of plan and all revisions

B. PLAN COMPONENTS

1. Site-specific Information
 - a. North arrow
 - b. Topography and/or key elevations where pertinent
 - c. Scale
 - d. Property lines and easements
 - e. All constructed site elements
 - f. Utilities
 - g. Planting plan
 - h. Existing trees – depict canopies to scale

2. Water Source Information

- a. Point of connection (i.e. well, pump, municipal system...)
- b. Type of connection (i.e. split tap water meter, stand alone water meter, well, pond, cistern...)Note: a split tap is created when an existing tap to a domestic meter is split to service a second meter for irrigation use.

3. Power Source Information and Location

4. Irrigation System Components (Note manufacturer/model number where allowable by law) – Show all pertinent items listed. Size items where appropriate

- a. Backflow prevention device
- b. Master valve
- c. Pressure regulation device
- e. Main line (dashed)
- f. Lateral lines (solid)
- g. Note pipe size and locations where pipe sizes change
- h. Control wire routing if not along the main line
- i. Isolation valve location
- j. Quick couplers, hydrants, or other points of connection
- k. Thrust blocking where appropriate
- l. Station/Zone valve location
- m. Sprinkler head locations
- n. Controller location(s)
- o. Controller sensors (i.e. rain switch, soil moisture sensors, flow sensors)
- p. Sleeves
- q. Special trenching areas (i.e. hand trench, direct bore)

5. Design Information

- a. Estimated GPM at POC
- b. Static pressure at POC
- c. Design criteria – pressure and volume
- d. Pipe type and sizing
- e. Backflow prevention device size and type of enclosure

- f. Control wire type and sizing
- g. Valve enclosure types and sizes
- h. Hydrozone information
 - Zone number and valve size
 - Estimated pressure
 - Estimated GPM
 - Estimated precipitation rate
 - Sprinkler type
- i. Special design considerations

6. Installation Information

- a. Construction details
 - Sprinkler/swing joint assembly
 - Backflow prevention device and enclosure
 - Sleeving
 - Isolation valves
 - Valve configuration
 - Thrust blocking on ring and gasket pipe
 - Grounding
 - Lightning Protection
 - Controller installation
 - Ditch cross section showing pipe and wire
- b. Construction notes
- c. Reference to locating and protecting underground utilities and improvements
- d. Specifications (if not presented elsewhere)
- e. Special construction techniques required

II. RECORD IRRIGATION DRAWING STANDARDS

A. All record drawings shall accurately portray the site, be legible and reproducible. Site information shall include all development (building edges, walks, walls, roads, etc.), irrigated areas, turf areas, and planted areas. The drawings shall show the sprinkler system as it is installed.

B. STANDARD - Include locations and product information regarding the location of the emergency shut-off valve, water source, backflow devices, all types of valves, wire splices, wire paths, controllers, sensors, grounding location and type, pumps, filters, quick couplers or any water connection points, and main line piping. All manual and automatic valve locations shall be shown with actual measurements to permanent reference points so they may be easily located in the field. Examples of permanent reference points include buildings, drainage inlets, sidewalks, curbs, light poles, etc.

BMP – Provide the plan to scale. Include locations and product information regarding the lateral piping, and sprinklers.-

(Note: Record drawings are often referred to as ‘as-built’ drawings. The term ‘as-built’ is generally used as a legal term to indicate a drawing that is an exact representation of a built project. As-built

drawings are usually prepared by a licensed land surveyor. For this reason, the use of the term 'record drawing' is preferred and recommended.)

III. DESIGN STANDARDS

A. The irrigation system shall be designed to be efficient and to uniformly distribute the water. Specific criteria that shall be considered in the design includes soil type, slope, root depth, differing plant material requirements, microclimates, weather conditions and water source (e.g., quantity, quality and pressure). The design and layout should also consider issues related to the long-term management of the system and the landscape it serves. To conserve and protect water resources, the irrigation designer shall select appropriate equipment components and installation techniques that meet state and local code requirements and site requirements.

B. A qualified irrigation designer or irrigation consultant shall design the system for the efficient and uniform distribution of water. "Qualified" means certified, formally trained, licensed or other similar qualification.

C. To ensure that the irrigation system is designed to efficiently and uniformly distribute the water, to conserve and protect water resources, and to function well as a component of the overall landscape, the irrigation designer shall:

1. Obtain direct knowledge of site conditions and not rely solely on plot plans to generate a design.
2. Meet all applicable state and local codes, including plumbing and electrical codes.
3. When allowable by law, specify manufacturer, model, type, and size of all components to eliminate ambiguity at construction and to facilitate management of the system. The selection of pipe, electrical wire and other materials shall be based on design parameters, environmental conditions, code requirements, and long-term management of the system.
4. Design the irrigation system to minimize installation and maintenance difficulties.

The selection and placement of shrub, tree, and groundcover sprinkler and drip/micro-irrigation components should be guided by the expected size of larger specimen plants through a minimum three-year establishment period for shrubs and ten years for trees.

5. Provide a complete irrigation design package to the owner of the system, including to-scale drawings, details, and product data.

6. Piping. Apply the following rules of maximum safe flow rate for municipal water suppliers, with the lowest safe flow rate prevailing as the design guideline.
 - a. The maximum allowable pressure loss through the meter should be less than 10% of the static pressure at the meter.
 - b. The maximum flow rate through the meter should not exceed 75% of the maximum safe flow rate through the meter.
 - c. Select main and lateral pipe sizes so that the velocity of water moving through the irrigation pipe remains below the industry standard of 5 fps.

- d. Follow manufacturer's recommendations for all pipe usage and fabrication.
- e. Minimum PVC pipe thickness shall be PR200 – SDR21 with sch 40 fittings.
- f. PVC piping from the above-grade backflow to below grade shall be a minimum of sch80.
- g. All PVC risers shall be a minimum thickness of sch80.
- h. For mainlines over 2.5", utilize bell and gasket piping.**
- i. Include blocking details and locations when using bell and gasket pipe.
- j. Include blocking details and locations when straight main line runs exceed 500 feet.**
- k. Protect exposed PVC piping from UV degradation per the manufacturer's recommendations.

7. Where applicable, specify a water source that meets peak demands for landscape water with an irrigation duration that is within the site's operational tolerances when the site is functioning at it's most intense use (often no more than 10-12 hours per day). Insure that the irrigation duration meets the user needs of the site. This guideline helps determine the correct size of the supply meter, cistern, lake, pump intake and pump size. Also consider local statutes and ordinances that dictate time of day and day of week watering, anticipated irrigation intervals, or site uses that may dictate different irrigation durations (for example, golf courses). This guideline is intended to match the system requirements to the particular site, not dictate the actual hours of operation on any given day.

8. Specify protection of the water source in accordance with state and local requirements. Where no requirements exist, assess the degree of hazard and specify the appropriate backflow prevention device. **Always recommend the use of a reduced pressure zone backflow prevention device.**

9. Consider the use of a solenoid-controlled master valve to prevent excessive water loss from a pipe burst or a defective solenoid.

10. When possible and available, specify a metering device that measures the total landscape water use separate from other use.

11. For systems on a municipal supply, allow for a reduction in static pressure of up to 10 psi to accommodate possible expansion in the supply network.

12. Specify pressure regulation where variable or excessive static pressure exists.

13. Specify the recommended operating (working) pressure at the maximum design flow rate of the system.

14. For zones with drip/micro-irrigation:

- a. Specify filtration at the control valve to remove particulate matter.

- b. Consider differing plant water requirements and root zone depths and use separate drip/micro-irrigation zones where practical.
- c. Specify pressure-compensated devices to improve overall uniformity.
- d. Specify pressure regulation upstream from the drip/micro-irrigation components. Typically, the pressure of city water sources may be increased periodically by the city for flushing or other purposes, and can potentially damage a drip/micro-irrigation system that has no pressure regulator on the zone controls. Pressure compensated emitters do not serve this function. Pressure regulating devices can be omitted only when the absolute maximum possible pressure is known to be lower than the maximum allowable pressure for all drip/micro-irrigation components.
- e. Connect (loop) the ends of individual laterals to improve system uniformity. This helps to equalize system pressure and can increase uniformity, and also allows water to flow from both sides of a damaged drip tube, thus flushing out any debris.
- f. Use air release valves to minimize ingestion of dirt or other contaminants into the emitters.
- g. Use flush valves to flush the laterals after completion of the irrigation cycle.**

15. Select components and design zones to achieve a minimum operational lower quarter distribution in the range of

- a. Spray Lower Quarter DU 55%**
- b. Rotor Lower Quarter DU 70%**
- c. Drip/micro-irrigation Emission Uniformity 80%**

16. Design the layout of heads and other emission devices for zero overspray across or onto a street, public driveway or sidewalk, parking area, building, fence, or adjoining property. Overspray may occur during operation of the irrigation system due to actual wind conditions that differ from the design criteria.

17. Specify in the plan notes when changes are required that any required equipment shall meet or exceed the design standards of the system.

18. Design sprinkler head spacing with an approximate minimum of "head-to-head" coverage (maximum 60% of diameter for sprays, 50% for rotors), unless the coverage is designed for wind derating. Wind derating should be based on wind criteria for the time period that the system is normally run, typically nighttime.

19. Use separate station/zones (hydrozones) for areas with dissimilar environmental conditions and/or dissimilar water or scheduling requirements. These conditions include sun exposure, plant type, soil type, varying wind conditions, grades, and dimensional issues. When not practicable due to accessibility, dimensional issues, or other constraints, practical modifications to this standard may be acceptable.

20. When selecting system components, place a high priority on avoiding surface runoff. Select components to keep the sprinkler precipitation rate below the infiltration rate of the soil and/or specify the use of repeat cycles to allow the water to soak into the root zone. Separate station/zones for sprinklers at the top and toe of sloped areas.

21. Locate sprinkler heads based on a thorough evaluation of physical, environmental, and hydraulic site conditions, including typical wind conditions during the normal irrigation period.

22. Zone irrigation systems per the types of sprinkler heads and nozzles being used in order to achieve an approximate matched precipitation rate.

23. Use drip/micro-irrigation where appropriate to reduce evaporation losses and surface runoff, and to avoid applying water on hardscapes.

24. In regions where a landscape water allowance applies, include an estimate of the future monthly landscape water allowance, based on historical reference ET, landscape area, and the landscape water adjustment factor provided by the purveyor or water provider.

25. Utilize the following water-conserving equipment:

- a. Check valves to minimize low-head drainage when grades exceed 5%.
- b. Pressure regulators or pressure compensating devices when pressures exceed manufacturer's recommendations.
- c. Rain sensors to suspend irrigation during rain events.
- d. A controller that has multi-program capability with at least four start times (for multiple repeat soak cycles) and run time adjustments in one-minute increments.
- e. To mitigate the effects of wind, use low-trajectory sprinkler nozzles along with the appropriate modified head spacing. Select components that do not mist when manufacturer's pressure specifications are met.

26. Recommend the following water-conserving concepts and equipment where appropriate and economically justified:

- a. Use an alternative non-potable water source (such as rain water) where practical and allowed by law. Special management practices and components may be required when using alternative water sources.**
- b. Install water-conserving devices such as:**
 - **Freeze, and/or wind sensors to suspend irrigation during weather conditions that are unfavorable for irrigation.**
 - **Environmental sensors that can actively measure weather conditions to determine daily plant water needs.**
 - **Soil moisture sensors to monitor soil moisture and suspend irrigation if the moisture reserve in the root zone is significantly above the allowable depletion limit.**

c. To simplify manual reading of the total landscape irrigation water use, a water meter with an electronic output signal that supports a remote display mounted at the controller.

d. For automated management of the landscape irrigation water use, a landscape irrigation meter with an electronic flow rate output signal that is compatible with the controller. This allows the controller to measure and control the amount of water use, as well as to indicate leaks (e.g., broken pipes or sprinklers).

e. For larger sites where a significant potential water savings may result, specify a controller that allows for flexible irrigation

Irrigation System Installation Standards

I. General

In cases where the irrigation contractor determines that the design provided by others fails to meet the minimum standards set forth by the NC Irrigation Contractors Licensing board, State Plumbing Code or local requirements, the irrigation contractor shall notify the designer in writing of such deficiencies. All irrigation system components should be installed in accordance with manufacturer's specifications, local code requirements and sound principles of efficient and uniform water distribution.

A. Site considerations

1. Confirm all property corners and lines that will determine the borders of landscaped/irrigated areas including any Right of Way (local, state or federal). Address any encroachment agreements and other easement requirements.

2. Before any excavation call 1-800-632-4949 or 811 or go to www.ncocc.org to have major utilities located by the appropriate utility companies. These utilities include but are not limited to natural gas lines low pressure, natural gas lines high pressure, electrical, telephone, cable, fuel transfer lines, water mains and taps and sewer mains and taps. State laws (and some Federal laws) require anyone who digs to notify utility companies before starting. Installation shall not be started until all underground utilities are located and marked. Review site with owner to identify private underground lines or structures and locate those that present a potential problem before digging (i.e. Low voltage lighting wires, Propane gas tanks and lines, private power lines to out buildings, Drainage lines, Septic field lines and tanks).

3. In the case of new landscape construction where a landscape plan is provided, verify that the landscape plan is the most current and is not subject to change before starting the installation. If no landscape plan exist or the landscaping is in place review the site with owner/designer to determine what the irrigation needs of the site are including but not limited to plant water needs, soil type, root depth, micro-climates and grades. Inform the owner/landscape designer of the importance of designing the irrigation system to meet the needs of the landscape. Review planting plans prior to installation to minimize conflicts between larger plants, existing root zones and irrigation heads. Also review construction plans for conflicts between hardscape and sprinkler head placement.

4. Inform the property owner and irrigation designer of unusual or abnormal soil conditions which may impact the design and management of the irrigation system.

5. Where deviations from the design are required (e.g., routing pipe around a tree or other structure or adding sprinklers to an area larger than the plan shows), consult with the designer prior to making the change to ensure that the change is within the design performance specifications.

B. Water Supply

1. Before commencing installation, verify that the point of connection, water supply, flow rate and static and dynamic pressures meet design criteria.

2. All new irrigation systems that have a pressurized water supply under continuous pressure must include an isolation valve. The location must be in the main line before the first zone valve or quick coupler. When the water source is a water meter the isolation valve must be located between the water meter and the backflow prevention device.

3. If a master valve is used it shall be installed on the discharge side of the backflow prevention device on all new installations.

4. Use a master valve on all systems with a pressurized water source to minimize water waste.

5. If the water supply is potable water verify that a backflow prevention device is installed upstream of the irrigation system before pressurizing the irrigation mainline.

C. System Layout

1. Install the irrigation system's components according to the design specifications and manufacturer's published performance standards.

2. The micro irrigation device spacing must meet the requirements of the plants.

3. The maximum spacing between sprinkler heads must not exceed the manufacturer's published radius. The radius is determined by referring to the manufacturer's published specifications for a sprinkler head at a specific operating pressure.

4. Irrigation systems shall not spray water on to or over surfaces made of concrete, asphalt, brick, wood or any other continuous impervious material, such as, but not limited to, walls, fences, sidewalks and streets. Some variances are granted for situations where water is sprayed onto impervious surfaces due to irregular shaped hardscapes, wind drift or fixed spray patterns of heads

5. The Irrigation Contractor is to insure that no water is allowed to run off a site onto impervious surfaces where the water flows for a distance of more than 15' during any irrigation day or into a storm water inlet. Use check valves and stronger springs to hold the water in the piping system. When the water pressure at the head is too low to operate a sprinkler use an alternative design. Design system so that sprinkler heads placed on the heel of a slope are not zoned with heads at higher locations of the slope and providing an irrigation schedule that limits the amount of water applied at any one given time period.

D. Trenching and Piping

1. Protect the root system of the trees on the site by avoiding trenching across the established root system of existing trees and shrubs. When necessary to trench into the root zone of an established plant do so with the intent of trenching at a right angle to the base of the tree or shrub. Damaged roots shall be cut clean at a right angle.

2. If serious damage could result consider boring as a less invasive procedure.

3. Piping in irrigation systems must be designed and installed so that the flow of water in the pipe will not exceed a velocity of five feet per second for polyvinyl chloride (PVC), PE and HDPE pipe and seven feet per second for metal pipe.

4. The main line and lateral line piping must be installed to provide a minimum of twelve inches between the top of the pipe and the natural grade of the topsoil. The bottom of the trench should be smooth and provide a flat bed for the pipe to rest on. Backfill material should be cleaned of any debris that may damage the pipe. All portions of the irrigation system that fail to meet this standard must be noted on the record drawing. If a utility, man-made structure or roots create an unavoidable obstacle, which makes the twelve inch depth coverage requirement impractical, the piping shall be installed to provide a minimum of four inches of select backfill between the top of the pipe and the natural grade if the piping is installed inside a larger section of pipe for added protection. When swing joints are used the depth of the pipe must allow the swing joint to operate as designed.

5. All trenches and holes created during installation of an irrigation system must be backfilled and compacted to the original grade. The trench shall be compacted in lifts no greater than 6" to insure proper compaction.

6. All new irrigation systems that are installed using PVC shall be cleaned with a PVC pipe cleaner or primer on the male and female ends prior to applying the PVC cement. When using PR 200 or thinner walled pipe do not use primer.

7. Use the proper lubricant when assembling Bell and Gasket Pipe and Fittings.

8. Teflon tape shall be used on all threaded fittings. The tape shall be rapped three times to insure a proper seal.

9. When using reclaimed water use purple pipe (or purple tape placed above all piping in the system. Tape must be within 6" of the top of the pipe. Use purple valve box covers, purple quick coupler flaps and place an eight inch by eight inch sign with purple background stating "RECLAIMED WATER-DO NOT DRINK" & "AQUA DE RECUPERION-NO BEBER"

10. Water contained within the piping of an irrigation system is non-potable. If a hose bib, yard hydrant, quick coupler or any other device is installed that might mistakenly allow water to be used from the irrigation system for drinking or domestic use the installer must install a purple colored valve box or paint the above ground piping and faucet purple and attach as label stating the following “non-potable, not safe for drinking.” An isolation valve must be installed upstream of a quick coupler connecting a hose bib to an irrigation system.

E. Electrical

1. Underground electrical wiring used to connect an automatic controller to any electrical component of the irrigation system must be listed by Underwriters Laboratories as acceptable for burial underground.

2. Electrical wiring that connects any electrical components of an irrigation system must be sized according to the manufacturer's recommendation.

3. Electrical wire splices which are exposed to moisture must be waterproofed using a UL Listed device.

4. Underground electrical wiring that connects an automatic controller to any electrical component of the irrigation system must be buried with a minimum of twelve inches of select backfill.

5. The wire connections on the two wire path of two wire control systems shall be made using devices rated for the higher voltage of the control system.

6. Multi-strand wire may be used if it is rated for underground application and if the splicing device used water proofs the outer most casing of the wire.

F. Grounding

1. Ground all components of the irrigation system per manufacturers recommendations

G. Sprinklers:

1. Emission devices must be installed to operate at the minimum and not above the maximum sprinkler head pressure as published by the manufacturer for the nozzle and head spacing that is used. Methods to achieve the water pressure requirements include, but are not limited to, flow control valves, a pressure regulator, or pressure compensating heads.

2. It is best for the sprinklers to operate at the midrange of pressures listed in the manufacturer's literature.

3. Sprinklers are to be set perpendicular to the grade. In turf areas sprinklers shall be set at a height recommended by the manufacturer. On athletic fields especially insure that the rubber cover is in place and the head is at or below grade.

H. Controller

1. All new automatically controlled irrigation systems must include sensor or other technology designed to inhibit or interrupt operation of the irrigation system during periods of adequate moisture or rainfall. Rain or moisture shut-off technology must be installed according to the manufacturer's published recommendations.

I. Initial system start up

1. Perform a post installation inspection to verify that the system meets the design criteria including but not limited to static water pressure at point of connection, working (dynamic) water pressure at sprinklers, head radius, head adjustment, all sensors are operational and that there are no leaks in system.

K. Owner's Manual

1. It is recommended that the contractor perform a final “walk through” with the irrigation system's owner or the owner's representative to explain the operation of the system, show the working system and to have the owner or the owner's representative system accept the system.

2. A permanent sticker which contains the irrigation contractor's name, license number, company name, telephone number Date of the completion of the installation and the dates of the warranty period shall be affixed to each automatic controller installed by the irrigator. The information contained on the sticker must be printed with waterproof ink.

3. The Irrigation contractor shall, upon completion of any irrigation system or addition to an existing irrigation system provide an owners manual to the owner of owner's representative containing the following:

- a. A maintenance checklist of items such as the nozzles, heads, micro irrigation components, pumps, filters and other such components; that require maintenance and the recommended frequency for the service to insure that the irrigation system remains in good working order.
- b. A report on the system's specifications and a performance by station/zone that includes the plant type, soil type, average root zone depth, precipitation rate, target gallons per minute flow rate, recommended operating pressure range, and maximum recommended cycle run time without runoff. Irrigation Contractor is to also maintain a copy of this report at his place of business for a period not less than 3 years
- c. A seasonal watering schedule based on monthly historical reference evapotranspiration (historical ET) data, monthly effective rainfall estimates, plant landscape coefficient factors, and site factors
- d. Manufacturer's manual for the automatic controller and all sensors
- e. Winterization instructions and precautions on protection of the potable water supply.
- f. A written explanation regarding the operation of the irrigation controller, valves, sensors, pressure regulators, backflow prevention device and sprinklers. Review advanced programming features such as multi-cycle irrigation to prevent run-off and the use of the percentage water increase/decrease function. Educate the owner on features and capabilities of the system including the maintenance requirements.
- g. The irrigation record drawing that accurately portrays the site, legible *and* reproducible, Site information shall include all development (building edges, walks, walls, roads, etc.), irrigated areas, turf areas, and planted areas. The drawings shall show the sprinkler system as it is installed. Include locations and product information regarding the location of the emergency shut-off valve, meters, backflow devices, valves, controllers, pumps, wire paths, wire splice locations and main line piping. All manual and automatic valve locations shall be shown with actual measurements to permanent reference points so they may be easily located in the field. Examples of permanent reference points include buildings, drainage inlets, sidewalks, curbs, light poles, etc. The statement, "This irrigation system has been designed and installed in accordance with all applicable state and local laws, ordinances, rules, regulations or orders. I have tested the system and determined that it has been installed according to the Irrigation Plan and is properly adjusted for the most efficient application of water at this time". Provide plan to scale. Include locations and product information regarding the lateral piping, sprinklers, and rain switches/sensors.

Irrigation System Management for Water Efficiency Standards

I. Description

Manage and maintain the irrigation system for optimum performance, ensuring efficient and uniform distribution of water. Modify the irrigation system operation as needed to accommodate the changing plant water needs.

II. Basic System Maintenance Practices

A. Establish a systematic maintenance schedule for inspecting, testing and reporting on performance conditions of the irrigation system. Report any deviations from the original design. As part of a systematic maintenance program, it is important to:

1. Check, adjust and repair irrigation equipment on a regular basis, ideally on a monthly schedule and, whenever possible. Identify irrigation system leaks and repair them promptly.

2. Post irrigation schedules, zone location map and other relevant programming information in each controller (or clearly identify where information is kept).

3. Inspect the irrigation system after annual activation in the spring, and bring the system up to intended operating conditions.

4. Make written notes of repairs so that a history profile can be developed to prioritize future improvements to the system and provide copies to owners or owner representative.

5. Employee a certified landscape-irrigation auditor at least once every two years to conduct a thorough and comprehensive check for efficiency of water application.

B. Make every effort to keep water off impervious surfaces. Immediately shut off zone in question or adjust sprinkler heads, if water flows for a distance of more than 15' from site during any irrigation day.

C. Repair all leaks immediately or shut zone with leak off, if leak is in main line turn water off at the point of connection. Signs of leakage include overgrown or particularly green turf areas, soggy areas around spray heads and above ground hoses, jammed spray heads and torn hoses. In drip systems, leakage problems may be due to damaged tubing from foot traffic or gnawing by animals. Flush pipes, valves, sprinkler heads, drip components and filters after repairs are completed.

D. Monthly inspections to include:

1. Verify that the water supply and pressure are adequate for proper operation

2. Differences in the irrigation system's required design operating pressure and actual water pressure can affect efficiency. Install pressure reducing valves (PRVs) where needed, and pressure regulating control devices on individual sprinklers to stop misting due to excessive pressure. Verify that pressure regulators are adjusted for desired operating pressure.

3. Verify that the backflow prevention device is working correctly; annual testing is ideal, but not required in all areas. All testing of backflows is to be conducted by certified backflow tester. Follow all local codes, rules, and regulation dealing with cross-connection.

4. Adjust valves and flow regulators for proper pressure and flow operation. Valves must shut off tightly to prevent leakage, and operate without abruptly opening or closing to prevent to prevent damage to the irrigation system caused by water hammer and pressure surges.

5. Verify that sprinklers are properly adjusted—check the nozzle, arc, radius, level and attitude with respect to slope.

6. Verify that sensors are working properly and are within their calibration specifications.

7. Look for debris (e.g., rocks, sand, and dirt) lodged in sprinklers and drip emitters. 8. Examine filters and clean filtration elements as required.

9. Verify proper operation of the controller. Confirm correct date/time input and functional back-up battery if needed.

10. Repair or replace broken hardware and pipelines with originally specified materials or equal, thereby restoring the system to the original design specifications.

11. Complete repairs in a timely manner to support the integrity of the irrigation design and to minimize the waste of water.

12. Notify the end-user (or owner) of any deviations from the original design.

13. Test all repairs.

E. Ensure that the replacement hardware used for system repairs matches the existing hardware, and is in accordance with the design.

F. As plants mature move sprinkler head to preserve system performance. Add additional sprinklers or other hardware as required to compensate for blocked spray patterns or changes in the irrigation needs of the landscape. Ensure that system modifications are in keeping with design specifications and do not cause landscape water demand to exceed the hydraulic capacity of the system.

G. Establish a “winterization” protocol (if required) Winterization primarily consists of removing all the water from the irrigation system and equipment to prevent cracked pipes, broken sprinklers and other problems. This is typically accomplished by turning off the main water supply, opening all drains, if necessary use compressed air to remove water from the irrigation system.

H. Establish an “activation/start-up” protocol. Activation consists of re-pressurization of the irrigation system, and inspection

I. Whenever possible, update and retrofit existing irrigation systems to take advantage of new water-saving technology. (e.g., rain shut-off devices, “Smart” controllers, rotator nozzles and drip/micro irrigation). Smart controller technology can be used if the system in question was designed properly and has been well maintained.

III. Scheduling

A. Manage the irrigation schedules to respond to the changing/seasonal requirements for plant water needs in the landscape. Reset automatic controllers according to the seasonal plant needs. Realize that different irrigation schedules are needed during the grow-in phase of a landscape and should be changed, as soon as possible. Irrigation controllers should be inspected at least monthly to change irrigation frequencies or run times. Avoid irrigation during rain events.

Whenever possible, irrigation scheduling should incorporate the use of evapotranspiration data, or soil moisture measurements, coupled with rainfall data.

B. Understand the capabilities of the irrigation controller and use these features to efficiently irrigate

C. Identify soil types micro climates, and root depths of each zone. Calculate the run-time of each zone to supply the needed water based upon precipitation rate of the sprinkler zones, the water-holding capacity of the soil, the changing weather conditions and the plant's water requirements. Set run times and intervals to minimize runoff.

D. Periodically verify that the plant material is healthy and that soil moisture is adequate. Use a soil probe to visually inspect root depth, soil structure and moisture.

E. Educate end users that plant material water needs change frequently. So should the watering schedule.

IV. Regional or Industry Considerations/Adaptations

A. In cases where maintenance BMPs cannot be met due to existing problems with the irrigation system, it may be necessary to recommend system renovation or replacement.

B. Large, managed landscapes, such as golf courses and parks, require trained managers for operating irrigation systems. This requires understanding of the irrigation equipment as well as parameters such as plant ET and soil infiltration rates. Water audits of these large systems are recommended every two years to ensure that the system is performing properly.

C. Large, managed landscapes and commercial operations should prepare a written irrigation management site plan that clearly identifies responses and priorities during water-limited situations such as various stages of drought. The plan should be part of a comprehensive landscape management plan that addresses other management practices such as mowing, fertilizing, weed, insect, and disease control.

D. Cross-connection and backflow prevention devices must be inspected on an annual basis by a certified cross-connection control technician if recycled (reclaimed) domestic water is used.



North Carolina Irrigation Contractors Licensing Board

GLOSSARY

This document is in continuing development. You are encouraged to submit definitions along with their source to the editor at the address located at the end of this document. The terms in this Glossary are presented in an effort to provide a foundation for common understanding in communications covering irrigation.

A * next to a term indicates variables and symbols that are preferred for use in the Irrigation Association Education and Certification programs. A date in small letters indicates the date when the Certification Board approved the term. General definitions of terms not used in mathematical equations are not flagged in any way. Quantitative terms have {units} indicating sample units. Three dots (...) at the end of a definition indicates that the definition has been truncated. Terms with strike-through are non-preferred usage. References are provided for the convenience of the reader and do not infer original reference.

[] symbols located within bracket indicates the IA preferred abbreviation of symbol for the term specified.

{ } symbols located within bracket indicates the IA preferred units for the term specified.

The NCICLB elected to use The Irrigation Association definitions, because it has been in development for over ten years and is constantly updated and revised. It has been adapted for landscape irrigation in North Carolina.

active root zone, effective root zone [RZ] {in.} See **root zone**.

allowable depletion [AD] {in.} The amount of total plant available water (PAW) that is to be depleted from the active plant root zone before irrigation is applied. (Water Mgt Committee 2001)

allowable stress factor [Kas]{dimensionless} See **coefficients**.

amount of irrigation water [I] (in.) Amount of irrigation water expressed in inches.

area [A]{sq. ft.} Area of the landscape.

as-built drawing- See record drawing

available water holding capacity [AWHC]{in. water per in. soil} Ability of the soil to retain water. Also see **field capacity**, **permanent wilting point**, and **plant available water**.

backflow []{} Any unwanted flow of used or non-potable water or substance from any domestic, industrial or institutional piping system into the pure, potable water distribution system. The direction of flow under these conditions is in the reverse direction from that intended by the system and normally assumed by the owner of the system. (USC, 1998)

backflow prevention device [BPD]{} Safety device which prevents the flow of water from the water distribution system back to the water source (ASAE, 1998)

Best Management Practice [BMP]{} A *Turf and Landscape Irrigation Best Management Practice* is a voluntary irrigation practice that is designed to reduce water usage and protect water quality. The Irrigation Best Management Practice is economical, practical and sustainable, and maintains a healthy, functional landscape without exceeding the water requirements of the landscape. (Water Mgt Committee 2001)

Certified Irrigation Contractor [CIC]{} The Certified Irrigation Contractor is an irrigation professional, who has met a set of minimum standards specified by The Irrigation Association, whose principle business is the execution of contracts and subcontracts to install, repair and maintain irrigation systems. The CIC must conduct business in such a manner that projects meet the specifications and requirements of the contract.

Certified Irrigation Designer [CID]{} The IA Certified Irrigation Designer is an irrigation professional, who has met a set of minimum standards specified by The Irrigation Association, and who engages in the preparation of professional irrigation designs. The CID evaluates site conditions and determines net irrigation requirements based on the needs of the project. The designer is then responsible for the selection of the most effective irrigation equipment and design methods. The objective of a CID is to establish specifications and design drawings for the construction of an irrigation project.

Certified Golf Irrigation Auditor [CGIA]

A Certified Golf Irrigation Auditor is involved in the analysis of turf irrigation water use tailored to the unique conditions found on golf courses. Golf Auditors collect site data, make maintenance recommendations and perform water audits on golf courses. Through their analytical work at the site, these irrigation professionals develop base schedules for greens/tees, fairways and roughs.

Certified Landscape Irrigation Auditor [CLIA]{} The Certified Landscape Irrigation Auditor is an irrigation professional, who has met a set of minimum standards specified by The Irrigation Association, and is involved in the analysis of landscape irrigation water use. Auditors collect site data, make maintenance recommendations and perform water audits. Through their analytical work at the site, these irrigation professionals develop monthly irrigation base schedules. Prior to certification examination, auditors are required to take an Irrigation Association approved preparatory course.

Certified Landscape Irrigation Manager [CLIM]{} The Certified Landscape Manager is an irrigation professional familiar with all areas of turf irrigation design and construction management. CLIMs must be certified as CICs, CIDs (all Landscape/Turf specialty areas), and either as a CLIA or CGIA. Certified Landscape Irrigation Managers have extensive experience in design, construction, construction management and auditing of turf irrigation systems.

Certified Water Conservation Manager – Landscape [CWCM-L]

Water Conservation Managers are irrigation professionals whose principal business is the evaluation, operation, management and improvement of irrigation systems to achieve the highest level of water conservation possible. They are involved in discussion with the end user regarding system use, particularly as it relates to scheduling, maintenance concerns and water conservation.

check valve, spring{} A spring loaded valve located in a lateral or at the base of a sprinkler and that prevents water from draining through the sprinkler lowest in elevation after the irrigation cycle is completed. Sometimes called an "anti-drain valve". (Water Mgt Committee 2001)

coefficients:

- **crop coefficient** [Kc]{dimensionless} A numeric value that relates reference crop ETo to the actual characteristics of the crop being grown. The crop coefficient value assumes a healthy crop, actively growing, without stress, and with optimum soil moisture. *Irrigation Best Management Practices* April 2005, Irrigation Association - Water Management Committee Glossary Page G-3

- **landscape coefficient** [KL]{dimensionless} Coefficient used to modify reference ET which includes species factor, density factor and microclimate factor.

KL = Ks x Kd x Kmc (Landscape, 2000)

- **plant species factor, species factor** [Ks]{dimensionless} Factor or coefficient used to adjust reference evapotranspiration to reflect plant species.

coefficient of uniformity [CU] { $\%$ } Christianson's coefficient of uniformity.

coefficient of variation, manufacturer's [Cv]{dimensionless} A measure of the variability of discharge of a random sample of a given make, model and size of microirrigation emitter, as produced by the manufacturer and before any field operation or aging has taken place; equal to the ratio of the standard deviation of the discharge of the emitters to the mean discharge of the emitters. (ASAE, 2002)

controller [] An automatic timing device used to remotely control valves or heads (valve in head) according to a set irrigation schedule. (Water Mgt Committee 2001)

crop coefficient. See **coefficients**.

cycle []{minutes or hours} The operating duration of one or more valves for one irrigation start time. (Water Mgt Committee 2001)

cycle [Cs]{dimensionless} Number of cycles to be applied to the station/zone per irrigation. (Water Mgt Committee 2001)

density factor. See **coefficients**.

distribution uniformity[DU]{ $\%$ } The measure of the uniformity of applied irrigation water over an area. (ASAE, 1998). (Water Mgt Committee 2001)

distribution uniformity, lower-half [DULH]{ $\%$ } A measure of the uniformity of applied irrigation water over an area. The average of the lowest fifty percent of measurements to the overall average measurement, gathered through the use of catch cans, commonly used to evaluate the coverage of one or more sprinklers. It is recommended that this value be calculated from DULQ values. (Water Mgt Committee 2001)

distribution uniformity, lower-quarter [DULQ]{ $\%$ } The average of the lowest twentyfive percent of measurements to the overall average measurement, gathered through the use of catch cans, commonly used to evaluate the coverage of one or more sprinklers or drip systems. (Water Mgt Committee 2001)

drought [] A period of dryness, especially when prolonged, that causes extensive damage to crops, landscape plants, turf or prevents their successful growth. (Webster, 1981)

drought response plan [] A pre-determined strategy to allow landscape plantings to survive periods of water shortage through a combination of steps that may include deficit irrigation, dormancy, modification of irrigation systems and changes in non-irrigation cultural practices. (Water Mgt Committee 2001)

dynamic pressure []{psi} See pressure, dynamic

effective rainfall [Re]{in.} The amount of total rain that is actually stored in the root zone. Some rainwater does not reach the soil profile because it is held in mulch or turf thatch or because it runs off. Some water may percolate below the root zone and be lost, depending upon the intensity and duration of the rain event and the water content of the soil prior to the rain event. (Scheduling, 1999)

efficiency, irrigation system [Es]{ $\%$ } The percent of irrigation water that is beneficially used for plant growth.

efficiency, water management [Ewm]{ $\%$ } quantifies how well the irrigation water is being managed; that is, how well the manager *minimizes* the additional amount of water needed by the landscape after accounting for non-uniformity and weather.

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evapotranspiration [ET] {in./ time period} Combination of water transpired from vegetation and evaporated from the soil and plant surfaces. (ASAE, 1998)

current evapotranspiration []{in. for the time period} Actual measured or calculated reference evapotranspiration for a period of time.

historical evapotranspiration [Historical ETo]

A multiple-year average of recorded historical reference ETo data from a weather station or evaporative pan in a given geographic location. This value is typically a monthly average of the specific month in a given multi-year time frame. This value, when corrected for plant species characteristics, can be used as a baseline to evaluate the expected water needs of a landscape planting in that geographic area.

reference evapotranspiration

• Reference ET is expressed using one of two reference types: ETo representing grass or ET_r representing tall vegetation similar to alfalfa.

- [ET_o] Rate of evapotranspiration from an extensive surface of cool-season grass cover of uniform height of 12 cm, actively growing, completely shading the ground, and not short of water. (FAO 1998; ASCE, 1990)

- [ET_r] Rate of evapotranspiration from an extensive surface of alfalfa or very similar agricultural crop of uniform height of approximately 50 cm, actively growing, completely shading the ground, and not short of water. (Wright, 1982; Allen et al., 1989; Walter et al., 2000; ASCE, 1990). Typically ET_r is 10 to 30% greater than ET_o.

field capacity [FC]{in./in.} Depth of water retained in the soil after ample irrigation or heavy rain when the rate of downward movement due to gravity has substantially decreased (usually one to three days after irrigation or rain). (Doorenbos & Pruitt, 1977)

Also see **permanent wilting point** and **plant available water**.

flow rate [Q]{gal/min, gpm, gph} Volume of flow per unit time, such as discharge from an irrigation sprinkler or emitter; or flow into a zone.

flow sensor []{} A device that measures the rate of liquid flow or the total accumulated flow. (Water Mgt Committee 2001)

HDPE/ High Density Polyethylene Pipe See AWWA C906

hardscape []{} Impervious surfaces within the landscape, such as concrete walkways or brick paving. (Water Mgt Committee 2001)

historical ET. See **evapotranspiration**.

historical rainfall [Rh]{in.} See rainfall, historical

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hydrozone []{} Grouping of plants with similar water (and environmental) requirements for irrigating with one or more common station/zone valves (Weinberg and Roberts, 1988; Water Mgt Committee 2001). Also see **microclimate**.

infiltration rate (intake rate) []{in./h} The dynamic rate at which irrigation water applied to the surface can move into the soil profile. The rate typically declines rapidly after an initial period of surface hydration. This value depends to a great extent on the texture of the soil and whether the soil is overly compacted. (Water Mgt Committee 2001)

intake rate. See **infiltration rate**.

irrigation []{} The intentional application of water for purposes of sustained plant growth. (Water Mgt Committee 2001)

The Irrigation Association® [The IA]{} A non-profit organization formed to improve the products and practices used to manage water resources and to help shape the worldwide business environment of the irrigation industry. The association's interest in water resources encompasses the application, conservation, drainage, improvement and recovery of water for economic and environmental enhancement in agriculture, turfgrass, landscape and forestry. The IA interacts with private and governmental organizations and other associations in the development of legislation and regulations to properly and appropriately ensure the availability, quality and accessibility of water supplies for, or affected by, irrigation and the efficacy of trade policies. The IA establishes and conducts authoritative educational programs to broaden and focus public awareness of issues related to water management, to provide professional certification of practitioners of irrigation-related disciplines and to ensure the accessibility of research information pertinent to industry practices and products. The IA positions itself as an effective catalyst and umbrella organization for outreach, communication and coordination among the diverse parties and interests involved in irrigation. The IA contributes to the establishment of recognized standards and guidelines dealing with irrigation-related products, engineering applications and practices worldwide.

irrigation audit []{} Procedure to collect and present information concerning the uniformity of application, precipitation rate, and general condition of an irrigation system and its components. (Water Mgt Committee 2001)

irrigation contractor []{}Any person who is in the business of installing, repairing, or maintaining landscape irrigation systems. See also **Certified Irrigation Contractor** (Water Mgt Committee 2001)

irrigation design []{}Drawings and associated documents detailing irrigation system layout, and component installation and maintenance requirements. (Water Mgt Committee 2001)
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irrigation designer []{}Any person who is in the business of designing irrigation systems. See **Certified Irrigation Designer**.

irrigation efficiency. See **irrigation system efficiency**.

irrigation interval [IN]{days}The number of full days between irrigation applications. (Water Mgt Committee 2001)

irrigation run time. See **run time**.

irrigation schedule []{}Set of data describing when and the amount of irrigation water to be applied to each station/zone. (Water Mgt Committee 2001)

irrigation system []{}Set of components which may include the water source, water distribution network, control components and other general irrigation equipment. (Rain Bird, 1997)

- **drip/trickle/micro/micro spary irrigation** Method where water is applied at, or below, the soil surface and at low pressure and low volume.

- **sprinkler irrigation** Type of irrigation using mechanical devices with nozzles (sprinklers) to distribute the water by converting water pressure to a high velocity discharge stream or streams.

irrigation system efficiency, overall irrigation system efficiency, irrigation efficiency

[Es]{%} Percent of irrigation water supplied to the landscape that is beneficially used for plant growth; that is, that contributes directly to the plant water requirement. (Water Mgt Committee 2001)

irrigation water budget [VIWR]{ccf, gallon}Volume of irrigation water required to maintain a functional, healthy landscape with the minimum amount of water. This volume of irrigation water is equivalent to the base irrigation water requirement. (Water Mgt Committee 2001)

irrigation water management, landscape []{} Process of comparing landscape irrigation water usage to an expected amount, and then making improvements to the landscape, irrigation system or schedule to achieve irrigation objectives. (Water Mgt Committee 2003)

irrigation water requirement, base [IWRbase]{in./period} The amount of irrigation water (in inches) required to meet the supplemental needs of the landscape. The irrigation water requirement includes the plant water requirement plus an extra amount to account for non-uniformity and other irrigation losses. (Water Mgt Committee 2003)

landscape coefficient. See **coefficients**.

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landscape contractor []{}Any person who is in the business of constructing, installing, and/or maintaining turf, trees, or ornamental plant material and associated hardscaping.

landscape irrigation water management. See **irrigation water management**.

landscape water allowance, landscape water allotment, landscape water allocation [LWA]{ccf, gallons} A volume of water allocated to the entire landscape area for some period of time. This allowance is established by the water purveyor for the purpose of ensuring adequate supply of water resources. (Water Mgt Committee 2003)

landscape water requirement [LWR]{ccf, gallons} A volume of water that is necessary for the landscape to be healthy and functional. (Water Mgt Committee 2003)

low-volume irrigation. See **irrigation drip/trickle/micro irrigation**.

management allowable depletion [MAD] {%} The percent of total plant available water (PAW) that can be depleted from the active plant root zone before irrigation is applied. (Water Mgt Committee 2001)

matched precipitation rate []{}System or zone in which all the heads have similar precipitation rates is said to have matched precipitation rates. (Monroe, 1993)

microclimate []{}A subdivision of a landscape characterized by environmental conditions that may differ from the typical site condition to a degree that ETo will be affected, either higher or lower than the

expected ETo for the site. Examples of conditions that might create a separate microclimate include reflected heat, breezeways, wind exposure, topography (slope) and shading. Also see **site conditions**. (Water Mgt Committee 2001)

microclimate factor. See **coefficients**.

moisture sensor [] Device that monitors or measures soil water content or tension. (Water Mgt Committee 2001)

net plant water requirement. See **plant water requirement, net**.

overall irrigation system efficiency. See **efficiency**.

PE Pipe (Polyethylene Pipe) See **AWWA C901** Typically black rolled pipe used for various water distribution applications.

PVC Pipe-Polyvinyl chloride Pipe A plastic pipe widely used in the irrigation industry and is available in various sizes and pressure ratings.

permanent wilting point [PWP] {in./in.} The amount of water in the soil, at or below which the plant may permanently wilt and not recover. Also see **field capacity** and **plant available water**. (Water Mgt Committee 2001).

permeability [] {in./h} Rate at which water moves downward through the saturated soil. *Irrigation Best Management Practices* April 2005, Irrigation Association - Water Management Committee Glossary Page G-9

plant available water [PAW] {in.} The amount of water held within the root zone after gravitational drainage has ceased, less the amount of water that adheres tightly to soil particles. Commonly expressed as $PAW = (FC - PWP) \times RZ$ where FC = amount of water (in. of water per in. of soil) held in the root zone at field capacity, PWP = amount of water (in. of water per in. of soil) held in the root zone at the permanent wilting point, and RZ = root zone depth (in.). Also see **field capacity** and **permanent wilting point**. (Water Mgt Committee 2001).

potable water [] Water from any source which has been investigated by the health agency having jurisdiction, and which has been approved for human consumption. It can be used as a source of irrigation water, but once water enters an irrigation system (and passes through the backflow device) it is no longer considered potable. (Cross Connection, 1988).

precipitation rate [PR] {in./h} Rate at which a sprinkler system applies irrigation water. Also known as the **application rate**. (Water Mgt Committee 2003)

pressure, dynamic [] {psi} Working or operating pressure at a point within the irrigation system.

pressure regulator [] Device which maintains constant downstream operating pressure (immediately downstream of the device) that is lower than the upstream pressure. (Rain Bird, 1997)

pressure, static [] {psi} Pressure in a closed system, without any water movement. (Rain Bird, 1997)

water rate [CR] {\$/ccf or \$/1000 gallons} Unit water rate.

rain amount [R] {in./period} Actual amount of rainfall during a period of time. (Water Mgt Committee 2001) See also **historical and effective rainfall**.

rainfall factor [RF] {%-} Factor used to convert historical rainfall to effective rainfall.

rainfall, historical [Rh] {in.} A multiple year average of recorded rain from a weather station in a given geographic location. This value is typically a monthly average of the specific month in a given multi-year time frame. (Water Mgt Committee 2001)

rain shut-off device, rain sensor, rain switch [] A device that causes the controller to suspend or override an irrigation cycle or that opens the circuit to a valve or set of valves when a preset amount of rain occurs. Ideally, the device will also override the irrigation cycle as long as rain is withheld in the root zone and is available to the plants. *Irrigation Best Management Practices* April 2005, Irrigation Association - Water Management Committee Glossary Page G-10. A soil moisture sensor may be considered a rain shut-off device if the sensor overrides or suspends an irrigation cycle based on the conditions above. (Water Mgt Committee 2001)

reclaimed water [] Partially treated municipal waste water, comes in varied levels of treatment. (Water Mgt Committee 2001)

record drawing [] Set of construction plans, mylar film, or computer file, including the original design and noting all design deviations. These drawings should also show the location of all major underground components, dimensioned from permanent features. (Water Mgt Committee 2001)

reference evapotranspiration [ET_o]{in./period} See **evapotranspiration**.

root zone [RZ]{in.,ft} The depth of the soil from which the crop roots extract water and nutrients. (USDA, 1993)

runoff [RO]{in.} Portion of irrigation or rainwater that leaves the target area, primarily due to slope or the precipitation rate exceeding the soil infiltration (intake) rate. (Water Mgt Committee 2001)

run time [RT]{minutes, hours} Length of time to operate an individual station/zone for a single cycle or single irrigation event. Can also be the run time of the station/zone for the entire month or other time period. (Water Mgt Committee 2001)

run time, cycle [RT_{cycle}]{minutes} Station/zone run time for one cycle start.

run time, event [RT_{event}]{minutes} Station/zone run time for one irrigation event based on whole day intervals between irrigations. (An event is all cycle start times for the irrigation.)

SDR/Standard Dimension Ratio The ratio of pipe diameter to wall thickness.

service connection []{} The terminal end of a service connection from the public potable water system, i.e. where the water purveyor may lose jurisdiction and sanitary control over the water at its point of delivery to the consumer's water system. (Cross Connection, 1988)

site conditions []{} Any physical or environmental factor that can affect the evapotranspiration rate of a site, or a microclimate within a site. Conditions can be dynamic (i.e. wind, reflected heat, seasonal shading, etc.) or static (i.e., finished topography, solar exposure and soil types). Also see **microclimate**.

(Water Mgt Committee 2001)

slope []{} Ground where grade varies or is not level. (Water Mgt Committee 2001)

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soil probe []{} A soil coring tool that allows an intact soil core to be removed from the soil profile for examination. (Water Mgt Committee 2001)

soil texture []{} The size and shape of individual soil particles such as sand, silt, or clay.

Soil texture largely determines the amount of water that can be stored in a soil as well as the soil **infiltration rate** and **permeability**.

soil texture class []{} Soil classification defined by the relative amounts of sand, silt or clay in a particular soil.

species factor. See **coefficients**.

static pressure []{psi} See pressure, static

velocity, water []{fps} The speed at which water moves through the system (pipe).

(Monroe, 1993)

water management factor [WMF]{dimensionless} Describes how much of the total run time of the controller is attributable to the performance of the water manager. (Water Mgt Committee 2001)

water purveyor []{} The public or private owner or operator of the water supplying an approved water supply to the public. (Cross Connection, 1988)

water rate [CR]{\$/ccf or \$/1000 gallons} Unit water rate.

watering window []{h} The hours and days of the week available for irrigation to be completed. Site uses and local statutes may limit the time and days on which irrigation can occur. (Water Mgt Committee 2001)

watershed []{} A region or area bounded peripherally by a divide and draining ultimately to a particular watercourse or body of water. (Webster, 1981)

xeric landscape []{} Alternate term is Drought Tolerant Landscape. An approach to landscape design that focuses on utilizing a plant palette limited to species that are adapted to local climate conditions. A xeric design stresses arid region adaptation, but does not limit a design to native species. This term is typically associated with arid geographic regions where natural rainfall is limited in quantity and/or to a narrowly defined 'rainy season'. As such it is generally applied to native plants, although not all native plants are xeric. (Water Mgt Committee 2001)

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