November 15, 2018

ORCHARD MEADOWS ASSOCIATION

STAGE II IRRIGATION AUDIT REPORT

WATER IN MOTION, INC.
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EXECUTIVE SUMMARY

Water in Motion (WiM), partnering with the Vermillion River Watershed Joint Powers Organization and the City of Lakeville, conducted a Stage II Irrigation Audits as a component of an Urban Water Conservation Pilot Program. The audit at Orchard Meadows Homeowner Association (HOA) was conducted on September 6th, 2018. Orchard Meadows is one of two homeowner associations participating in the Urban Water Conservation Pilot Program. The program is intended to reduce outdoor water use while simultaneously reducing costs to operate irrigation systems for communities in the City of Lakeville.

WiM completed the audit by conducting the following work:

- Gathering historical information about the system
- Discussing the current maintenance program
- Reviewing major system components including water supply, irrigation controls and sprinklers
- Assessing scheduling practices
- Operating each station of irrigation currently operated by Controller 1 and two stations operated by Hunter Nodes®
- Conducting a catch-can test on a representative irrigation station

WiM recommends the irrigation system at Orchard Meadows be abandoned and a new system be installed. Vital infrastructure elements of the irrigation system are deteriorated and are non-functioning, most notably wiring. Our recommendation is based primarily in observation of system age, deficiencies of the original installation, the overall condition of the irrigation system and years of deferred maintenance contrasted against the expected resources necessary to update the irrigation system.

Should Orchard Meadows HOA decide to continue operating the currently installed irrigation system the following high priority components of the irrigation system if improved or repaired, will decrease water usage and costs. The prioritized list of repairs and associated costs for Orchard Meadows can be found on page 21.

- Address temporary measures related to wiring and controls put in place in the past that have not been resolved.
- Repair broken sprinklers.
- Move sprinklers for changes in landscape over time.
- Adjust sprinklers that are pitched, out of alignment, or have improper arc.
- Install matched application rate sprinklers on each station of irrigation.
- Implement contemporary irrigation scheduling practices.
- Install at least basic rain sensing technology per Minnesota law.

There is not currently an irrigation maintenance program in place at Orchard Meadows. Current attention is reported to be based solely on basic spring start up, basic fall shut-down and break-fix repairs.

PURPOSE AND METHODOLOGY

PURPOSE

The Vermillion River Watershed Joint Powers Organization and the City of Lakeville are partnering to work on an Urban Water Conservation Pilot Program. The program has been designed with the goal of reducing outdoor water use in Lakeville. Landscape irrigation audits are the first step in addressing identified high water using irrigation systems, primarily at homeowner associations. WiM has conducted a Stage II Irrigation Audit in order to provide qualitative and quantitative data detailing the efficiency of the irrigation system.

This report illustrates observations resultant of the September 6th, 2018 Stage II Audit that took place at Orchard Meadows HOA.

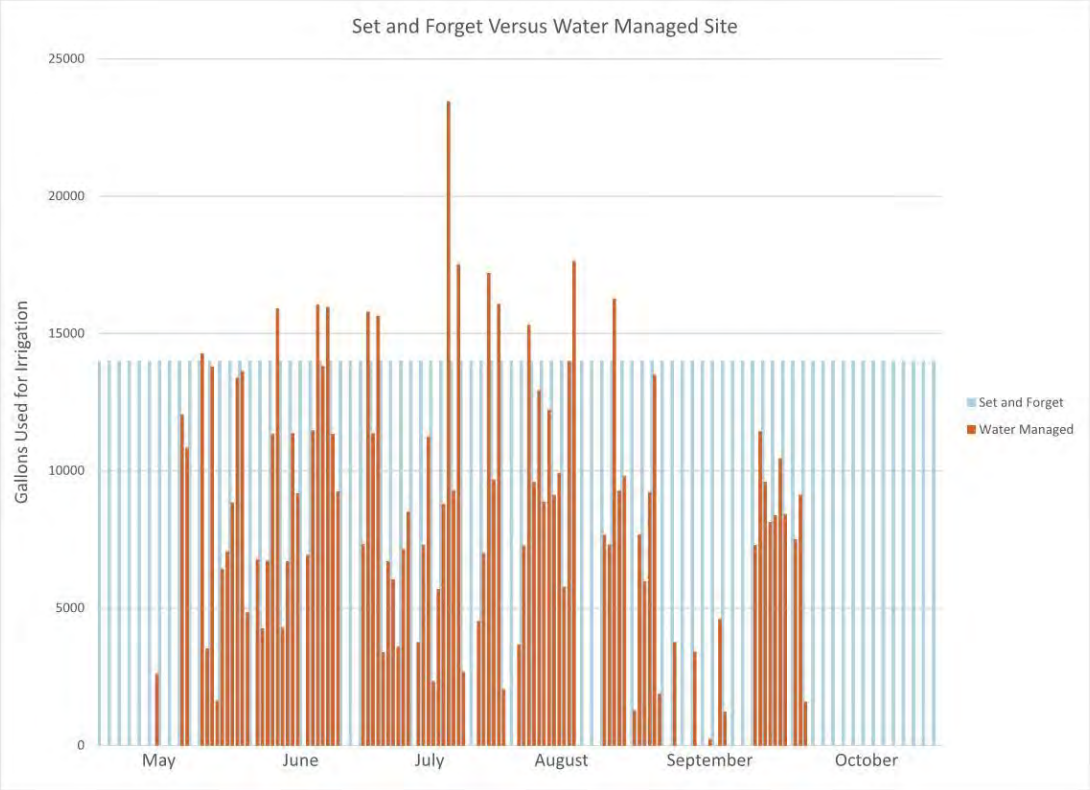
METHODOLOGY

A Stage II Landscape Irrigation Audit is an intensive, systematic and defensible overview of an irrigation system. The analysis of the performance of the irrigation system is based on generally accepted practices, processes and formal auditing procedures. The audit is conducted by an EPA WaterSense Partner who is also a Certified Landscape Irrigation Auditor (CLIA). WiM has catalogued major system characteristics and components including scheduled run time, station layouts, water flow, pipe sizing, nozzle selections, system wiring, and controls. Each station of irrigation was operated, observed and notes have been compiled in this report. At Orchard Meadows, one representative station was selected for catch-can analysis. This report includes the calculated application rates and distribution uniformity of the representative station.

GENERAL IRRIGATION SEASON

In Minnesota, most landscape irrigation takes place from late May through the end of September. However, April and early May, as well as the month of October, are generally reserved for seasonal start-up and shutdown routines. Well-managed landscape irrigation systems operate little, if at all, during the early and late season. Additionally, well-managed systems are adjusted regularly via periodic maintenance visits or by using SMART or remote irrigation controller technology.

The graph below represents the gallons used during an irrigation season of a water managed site versus a site that it started up in the spring and shut down in the fall with little to no adjustment of the irrigation schedule. The amount of water used for irrigation on the water managed site is 33% less than the “set and forget” site assuming every other day operation.



It is important to note Minnesota Law requires moisture-sensing technology, such as a rain sensor, to automatically interrupt irrigation during periods of sufficient rain events. Reference *Minnesota Statute 103G.298 Landscape Irrigation Systems* for more information.

BACKGROUND

Orchard Meadows Homeowner's Association consists of 6.68 total acres and is located northeast of Kabera Trail and south of 185th Street West in Lakeville, Minnesota.

Construction of the HOA began in 1999. The community was built in two phases, each phase has a separate and distinct irrigation system. One water supply assembly services both irrigation systems. At the time of the audit the irrigation system was 20 years old. The current irrigation service provider is Green and White Services. Green and White starts the system in the spring and does fall shut down annually. Aside from these events, Green and White is available to work on the irrigation system at Orchard Meadows upon request but does not have a contract to perform regular maintenance.

During the 2017 irrigation season, Green and White was often at Orchard Meadows "chasing problems" according to Maggie Mahmood, the community manager. During the season the HOA had discussed replacing the irrigation system, with Green and White leading the conversation. The community commissioned a third-party assessment of the irrigation system and general budget to do repairs of the system. At the time of the audit conducted by WiM, the Board of Directors had not approved a budget for system improvements nor a new irrigation system.

The irrigation system is intended to irrigate the cool season turf at Orchard Meadows. The HOA landscape includes cool season turf, shrubs and perennials alongside buildings, boulevard trees, two wetland areas and many wooded areas. Each building at Orchard Meadows has a station of irrigation watering the surrounding cool season turf. Turf areas in the greater lawn areas are irrigated by separate stations of irrigation.

At the time of the audit, turf areas located behind buildings and under tree canopies were oversaturated. Orchard Meadows residents noted significant occurrences of runoff. In at least one instance, a rock swale was installed between buildings to accommodate excess runoff. WiM believes this can be attributed to both downspouts and irrigation runoff resultant of an irrigation schedule with high runtimes. WiM observed runoff after 5 – 8 minutes of operation throughout Orchard Meadows.

AUDIT OBSERVATIONS

SYSTEM OVERVIEW

CONTROLLER	
Make and Model Number	Hunter I-CORE
Year Installed	2017
POINT OF CONNECTION	
Static Pressure	68 PSI
Backflow Preventer	2" Wilkins RPZ
MISCELLANEOUS	
Number of Stations	36
Sensors Installed	Rain Sensor – Non functional

IRRIGATION WATER SUPPLY

Orchard Meadows has one municipal water supply cabinet servicing the two landscape irrigation systems. The water source is tapped from the municipal supply and sized to a two-inch pipe. The water supply is located at 18523 Orchard Trail. The water supply cabinet contains a water meter and Reduced Pressure Zone backflow assembly (RPZ). By Minnesota plumbing code found in Section 603.4.2, backflow prevention assemblies are required to be tested annually by a certified professional. At the time of the audit, there was no evidence of when the RPZ was last tested.

The water supply is assembled with copper and brass piping (Figure 4). The water supply was shut off during the irrigation audit. According to Jim Berry, HOA Board President, after a rain event the water supply is manually closed because the rain sensor is not functional.

CONTROLLERS

There are two controllers at Orchard Meadows, each located behind the community monument on the corner of 185th Street West and Orchard Trail. Controller 1 operates the irrigation along Orchard Trail and Kalmar Trail generally on the east side of the HOA. The second controller is not functional but likely operated the irrigation along Kalmar Court and Kalmar Path generally on the west side of the community.

Controller 1 is a traditionally wired Hunter I-CORE, programmed to operate 21 stations of irrigation (Figures 1 and 2). Nineteen stations operate correctly on Controller 1, stations 8 and 17 do not operate from the controller. Field wire to these valves likely failed in the past. These stations are currently operated by Hunter Nodes located in each valve box (Figure 8). Controller 1 is located under foliage coverage and the transformer is housed in a weather-proof box. The conduit for the irrigation field wiring does not go directly to the controller. The majority of field wire and controller wire is therefore exposed to the elements. The field and controller wire splices are not housed in water-proof wire nuts. The rain sensor, if connected, is bypassed on Controller 1. A rain sensor is located along the roofline of 18519 Orchard Trail.

Controller 2 is located next to Controller 1 behind the monument (Figure 3). Controller 2 is also a Hunter I-CORE. The controller is not operational and was no longer connected to a power supply at the time of the audit. According to a note on the controller, the controller was programmed to operate 15 stations of irrigation.

Controller 2 had an Irritrol wireless rain sensor receiver installed in the past. The receiver was not mounted, it was hanging from the controller and has debris on the inside of the cover (Figure 6).

Stations that had been operated by Controller 2 are now being operated by Hunter Nodes. The Hunter Nodes are located in the valve boxes, hardwired to the valves they are operating (Figures 7 and 8). WiM attempted to find various valve boxes in the second phase of the HOA but was unable to find many. Two of the valve boxes that were located during the audit are situated north of 19720 Kalmar Court. One contains the valve for station 15. The other is a service box that contains field wire splices (Figure 9). WiM staff believe the field wiring originates at Controller 2. The wire to each valve is spliced in the service box. When communication from the controller failed it appears the irrigation contractor attempted to repair wiring at this location without success. WiM staff therefore believe the field wire between the controller and this service box is broken.

The Hunter I-CORE controllers at Orchard Meadows have SMART capabilities such as automatic adjustment of the irrigation systems in response to changing weather conditions and flow monitoring. These features are currently not being used. Additional technology and programming is necessary to utilize the full capabilities of the controllers.

CONTROLLER 1 IRRIGATION SCHEDULE

At the time of the audit the following programming was present in Controller 1 at Orchard Meadows. There are four programs available for scheduling: A, B, C and D. These programs can operate multiple times or once during an irrigation cycle, indicated by the "Start Times". These irrigation cycles can be programmed to take place at various times in a month, generally irrigation operates on "Odd/Even" cycles. Seasonal adjust is available to adjust the run times assigned to each station. A program operating at 70% indicates the run time will decrease by 30% of what is scheduled in that program.

Controller 1 has scheduling in Programs A and C. Program A operates throughout the irrigation season, indicated by the start time programmed into the controller. Program C is a test program that is most likely manually operated by Green and White to walk through the irrigation system when necessary.

IRRIGATION CONTROLLER PROGRAMS			
PROGRAM	START TIME	ODD/EVEN DAYS	SEASONAL ADJUST
A	12:15 AM	Even	100%
B	OFF	-	-
C	OFF	-	-
D	OFF	-	-

IRRIGATION STATION RUN TIMES				
STATION	PROGRAM	RUN TIME	PROGRAM	RUN TIME
1	A	30	C	2
2	A	30	C	2
3	A	30	C	2
4	A	30	C	2
5	A	30	C	2
6	A	30	C	2

7	A	30	C	2
8	A	0	C	2
9	A	30	C	2
10	A	30	C	1
11	A	40	C	1
12	A	40	C	1
13	A	30	C	1
14	A	30	C	2
15	A	30	C	2
16	A	30	C	2
17	A	30	C	2
18	A	30	C	2
19	A	30	C	2
20	A	30	C	2
21	B	40	C	2

While stations 8 and 17 are programmed in Controller 1, they are operated by Hunter Nodes. Hunter Nodes are each programmed separately to operate one valve. Jim Berry, Board President, stated station 8 is operated by a Hunter Node although the valve box could not be located at the time of the audit. Station 17 is programmed in Controller 1, although the controller does not operate the station. The Hunter Node operating station 17 operates on Program A for 25 minutes starting at 8:00 AM on odd days. Program A's seasonal adjust was set at 100%. Programs B, C and D in the Hunter Node were programmed to "Off".

CONTROLLER 2 IRRIGATION SCHEDULE

Stations originally operated by Controller 2 were being operated by Hunter Nodes at the time of the irrigation audit. Hunter Nodes are each programmed separately to operate one valve. There are 15 stations in this phase of the HOA, each operated by a different Hunter Node.

The Hunter Node operating Station 15 operates on Program A for 30 minutes starting at 11:15 PM on odd days. Program A's seasonal adjust was set at 100%. Programs B, C and D were programmed to "Off".

It is likely that all other stations of irrigation operated by a Hunter Node are set for similar run times. No Hunter Nodes at Orchard Meadows are operating based on weather. Therefore, when a significant rain event occurs an individual living at the HOA manually turns off the municipal supply connection so when valves are activated there is no water available to run the irrigation. If the irrigation system operated based on weather, valves would not be activated and water would be called for. This would eliminate the need for any manual shut down of the water supply.

GENERAL AUDIT OBSERVATIONS

On September 6th, 2018, WiM staff were able to operate all Controller 1 stations of irrigation with two exceptions, Stations 8 and 17. These stations are operated by Hunter Nodes. The Hunter Node operating station 17 was located although the valve was not opened to operate the station. Stations 8 valve box was not located during the irrigation audit. WiM was able to locate three valve boxes in the area of the HOA previously operated by Controller 2, Station 11, 13 and 15. However, only Stations 11 and 13 were operated. WiM did not operate Station 15 as the seal was tight in the valve and auditors were concerned about the valve closing after manual operation.

The HOA's irrigation system is comprised of a mix of rotors and spray sprinklers. The majority of sprinklers are Hunter and Rain Bird. Examples include Rain Bird T40, Rain Bird 5000, Hunter PGP, Rain Bird 1800 and Hunter Pro. Best practice isolates each sprinkler type to create stations with matched application rates. At Orchard Meadows, many stations were observed to operate both rotor and spray sprinklers. Most often sprays were placed in small turf areas between driveways in front of buildings and between buildings. Rotors irrigated the remainder of the turf at Orchard Meadows including in front of and behind most building as well as large spaces between buildings. Stations irrigating open areas are composed of rotors. Stations that have both types of sprinkler present do not have matched application rate across the station.

The arcs of various rotors are not properly adjusted to irrigate the intended landscape at Orchard Meadows. Approximately half of the stations of irrigation operated during the audit were throwing into a house, garage, window or non-maintained vegetation such as a wooded area (Figure 19). The nozzles of these rotors are often appropriate, however, it has not been adjusted during a maintenance visit. For example, a 90° nozzle has been placed in a corner next to a house. The rotor throws a portion of the irrigation water on the landscape and the remainder is sprayed on the house.

While WiM operated stations it was evident many rotors are throwing into conifers at Orchard Meadows. Damage to the conifers can be seen where the tree is hit by the stream of water.

There are also instances where the installation of the irrigation system did not follow best practices. For instance, rotors were installed to throw over the sidewalk in order to irrigate the turf strip between a sidewalk and the street (Figures 17 and 18). The water that falls on the sidewalk is not providing any benefit to the landscape it was intended to irrigate. This also creates a safety and liability issue.

Many sprinklers throughout Orchard Meadows were in need of repair. Alterations to the sprinkler included fixing the pitch and/or arc of the sprinkler to better irrigate the intended landscape (Figures 13, 14 and 15). The broken equipment varied from sprinklers disconnected from the swing joint or broken seals which currently waste a significant amount of water (Figures 11, 16 and 21).

Some sprinklers may have been installed correctly to irrigate the intended landscape, however, either landscape or hardscape changes have occurred since installation. Therefore, moving sprinklers may be necessary to protect assets such as homes as well as properly irrigate the landscape (Figure 12).

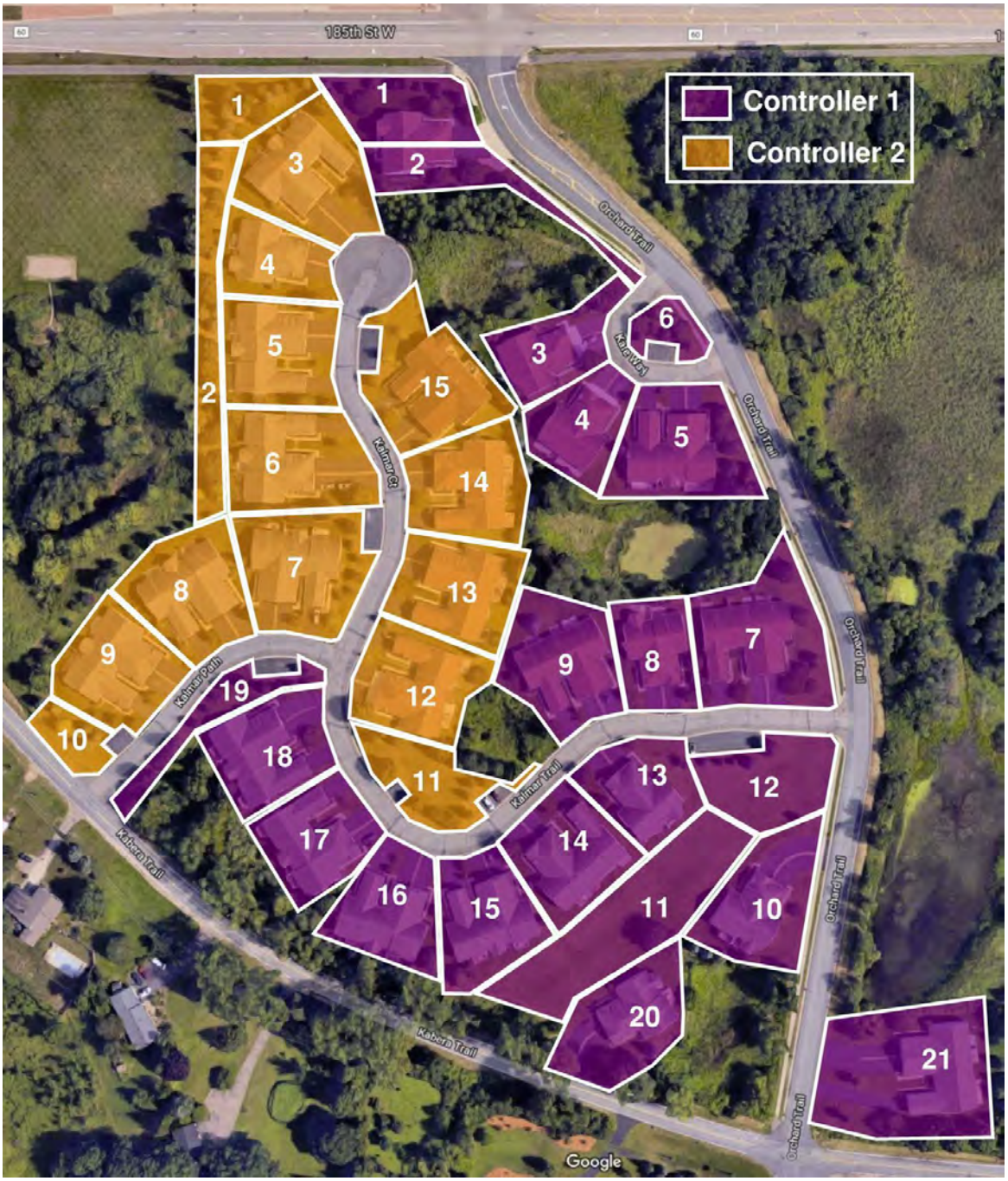
During operation of Controller 1, runoff was evident quickly after a station of irrigation began operating. Stations of irrigation operating on a slope were particularly quick to runoff (Figure 20). This is likely due to compacted soils following construction of the HOA. The same stations also had low-head drainage evident after an irrigation cycle (Figure 23). In these instances, water remaining in the lateral piping drains out of the lowest sprinkler after the valve is closed.

After operating Controller 1, WiM attempted to operate the remainder of the stations being operated by Hunter Nodes. It was difficult or impossible to locate valve boxes at Orchard Meadows. Nearly all valve boxes were sunken or overgrown with cool season turf (Figure 24). The valve boxes that were visible were oftentimes not flush with the landscape. The valve boxes that were inspected during the audit were often filled with soil or rock and were difficult to access.

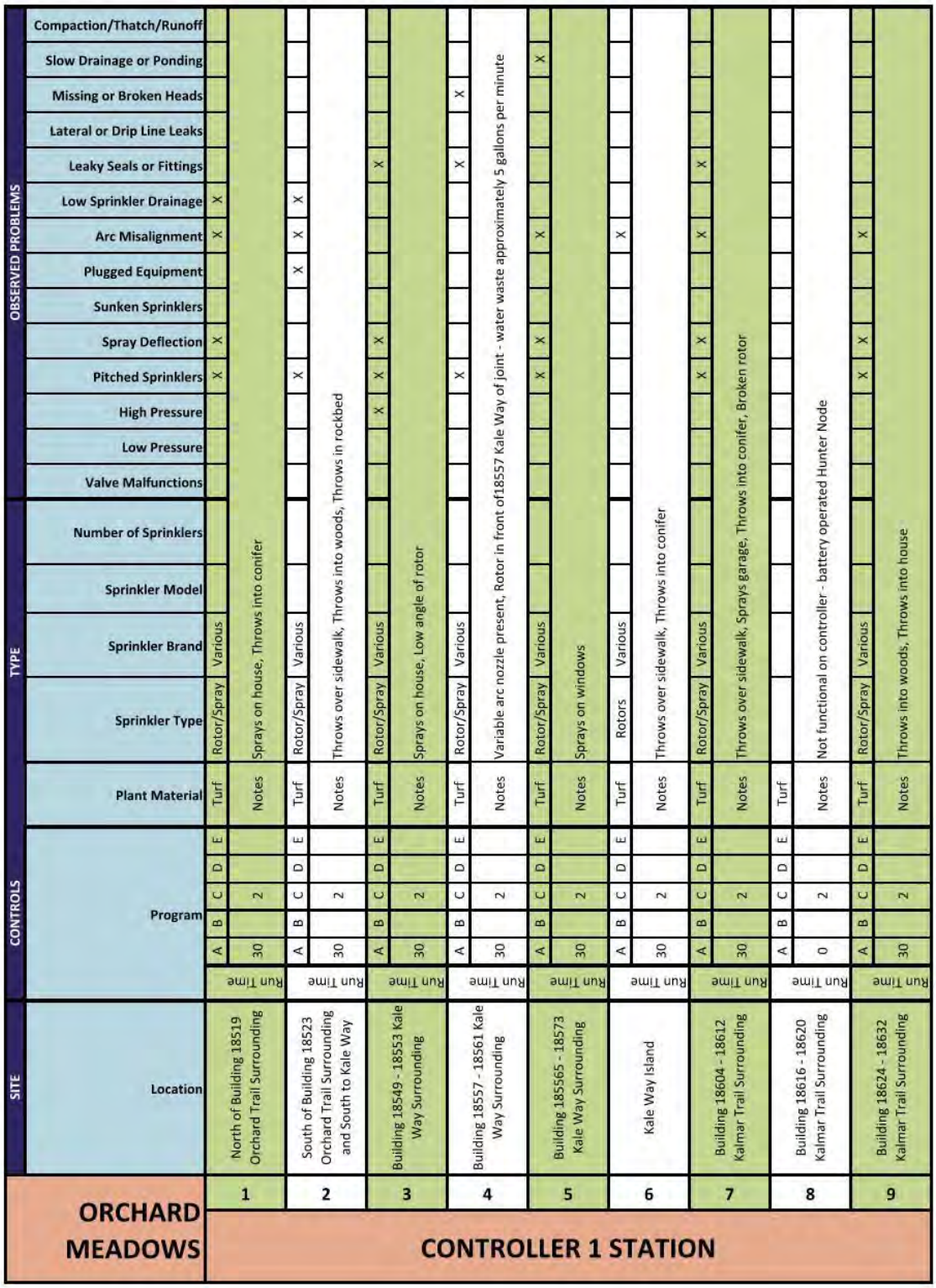
The Hunter Nodes present throughout Orchard Meadows were installed in previous years when operation of the stations from the controller failed. The solenoids in these stations were also replaced as Nodes are battery operated and function on DC power. Solenoids in valves operated by the Hunter I-CORE controller are operated on AC power. In order alter the irrigation schedule, including seasonal adjustments or rain delays, Green and White would be required to go to each Node individually and adjust the schedule manually.

STATION MAP

The station map below was created using data collected during the irrigation audit on September 6th, 2018 and from information given to WiM by Board members present during the audit. The locations of the majority of Controller 2 stations were not confirmed. Valve boxes were often impossible to locate and WiM was unsure of the integrity of the valves if valves were manually opened.



CONTROLLER 1 STATIONS 1 – 9

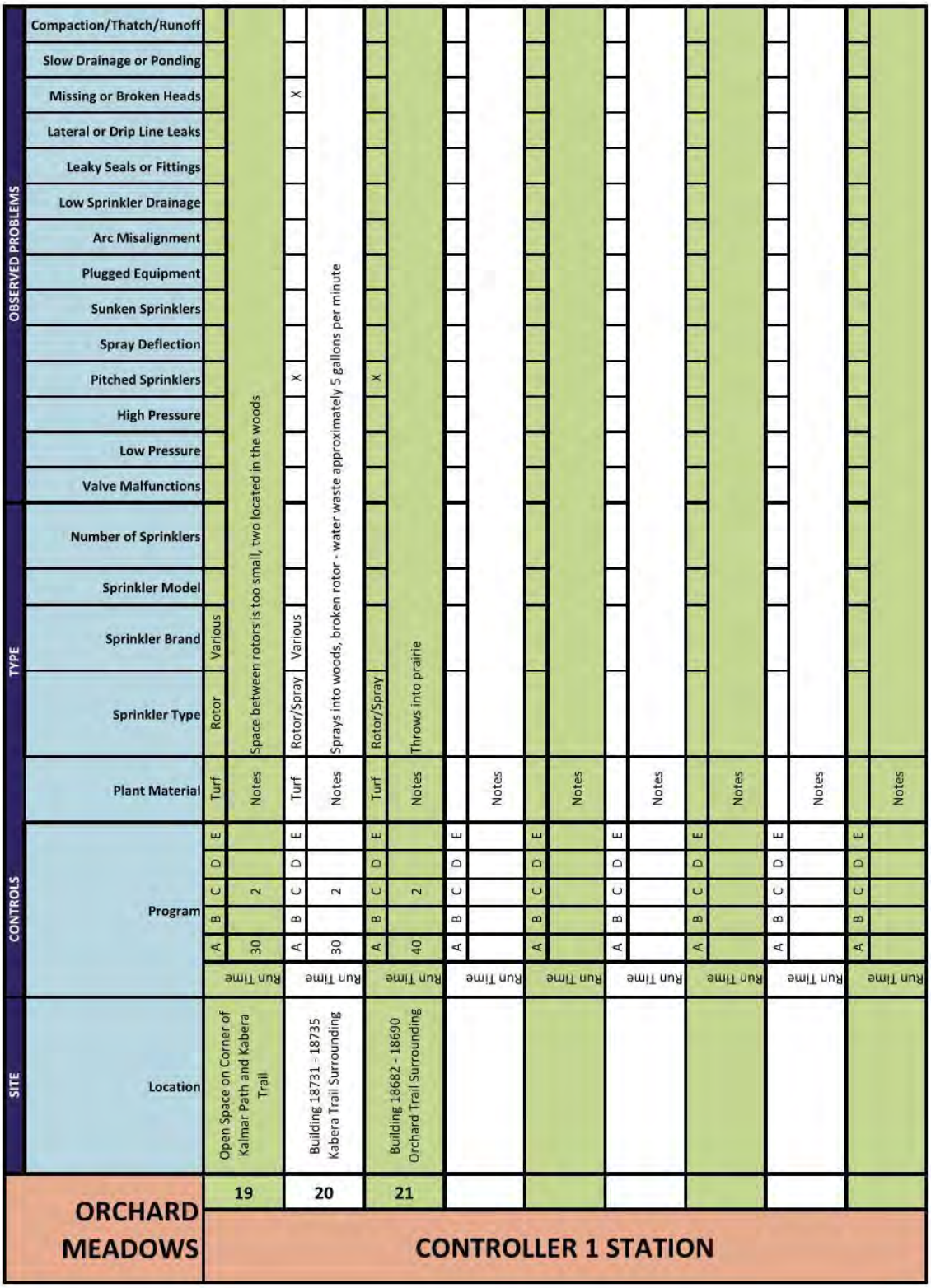


ORCHARD MEADOWS	SITE	CONTROLS							TYPE					OBSERVED PROBLEMS											
CONTROLLER 1 STATION	Location	Run Time	A	B	C	D	E	Program	Plant Material	Sprinkler Type	Sprinkler Brand	Sprinkler Model	Number of Sprinklers	Valve Malfunctions	Low Pressure	High Pressure	Pitched Sprinklers	Spray Deflection	Sunken Sprinklers	Plugged Equipment	Arc Misalignment	Low Sprinkler Drainage	Leaky Seals or Fittings	Lateral or Drip Line Leaks	Missing or Broken Heads	Slow Drainage or Ponding	Compaction/Thatch/Runoff
1	North of Building 18519 Orchard Trail Surrounding	Run Time	30		2				Turf	Rotor/Spray	Various						X	X			X	X					
									Notes	Sprays on house, Throws into conifer																	
2	South of Building 18523 Orchard Trail Surrounding and South to Kale Way	Run Time	30		2				Turf	Rotor/Spray	Various						X				X	X					
									Notes	Throws over sidewalk, Throws into woods, Throws in rockbed																	
3	Building 18549 - 18553 Kale Way Surrounding	Run Time	30		2				Turf	Rotor/Spray	Various						X	X					X				
									Notes	Sprays on house, Low angle of rotor																	
4	Building 18557 - 18561 Kale Way Surrounding	Run Time	30		2				Turf	Rotor/Spray	Various						X						X		X		
									Notes	Variable arc nozzle present, Rotor in front of18557 Kale Way of joint - water waste approximately 5 gallons per minute																	
5	Building 185565 - 18573 Kale Way Surrounding	Run Time	30		2				Turf	Rotor/Spray	Various						X	X			X						X
									Notes	Sprays on windows																	
6	Kale Way Island	Run Time	30		2				Turf	Rotors	Various										X						
									Notes	Throws over sidewalk, Throws into conifer																	
7	Building 18604 - 18612 Kalmar Trail Surrounding	Run Time	30		2				Turf	Rotor/Spray	Various						X	X			X		X				
									Notes	Throws over sidewalk, Sprays garage, Throws into conifer, Broken rotor																	
8	Building 18616 - 18620 Kalmar Trail Surrounding	Run Time	0		2				Turf																		
									Notes	Not functional on controller - battery operated Hunter Node																	
9	Building 18624 - 18632 Kalmar Trail Surrounding	Run Time	30		2				Turf	Rotor/Spray	Various						X	X			X						
									Notes	Throws into woods, Throws into house																	

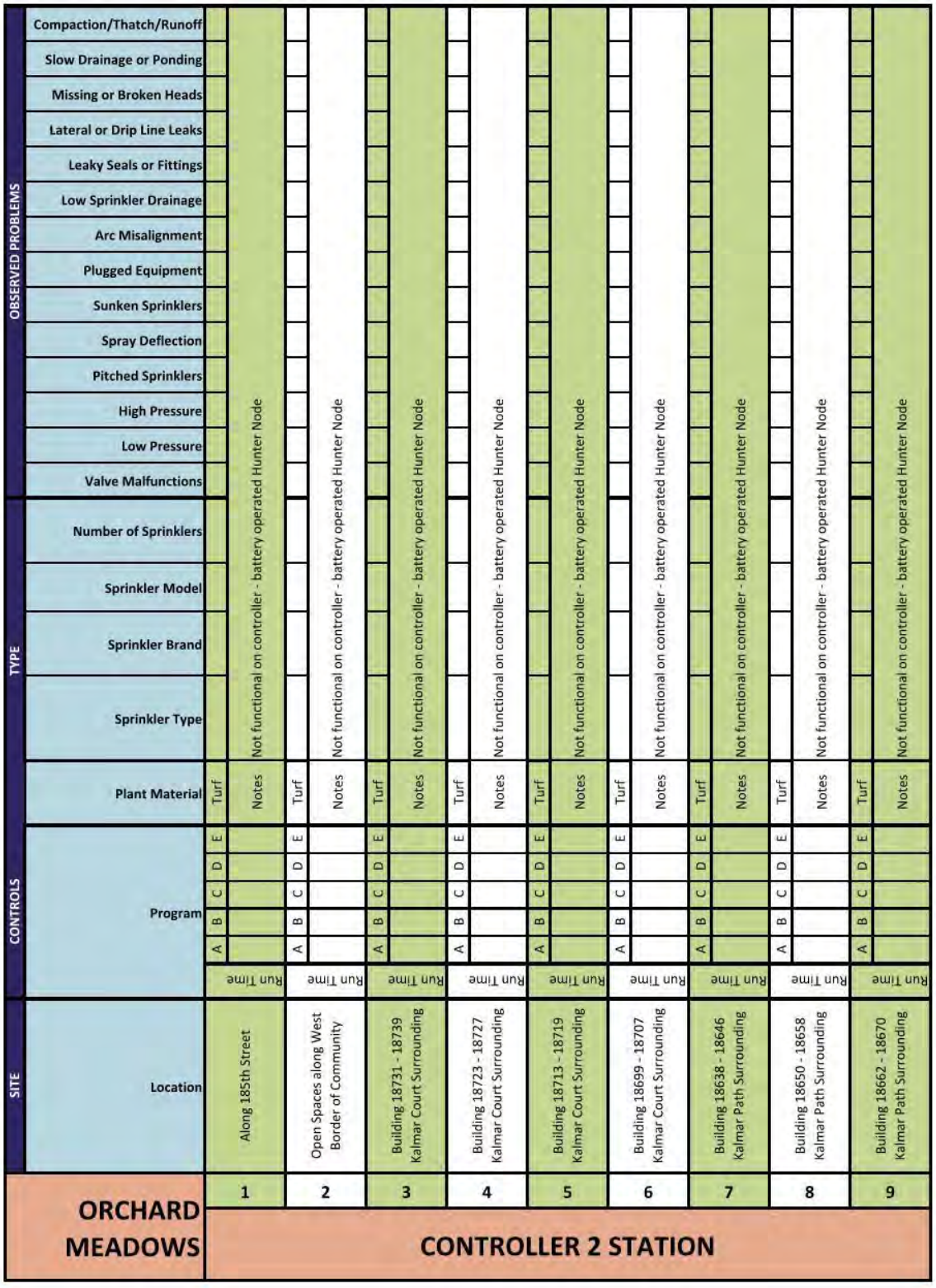
CONTROLLER 1 STATIONS 10 – 18

ORCHARD MEADOWS	SITE	CONTROLS						TYPE					OBSERVED PROBLEMS														
CONTROLLER 1 STATION	Location	Run Time	Program A	Program B	Program C	Program D	Program E	Plant Material	Sprinkler Type	Sprinkler Brand	Sprinkler Model	Number of Sprinklers	Valve Malfunctions	Low Pressure	High Pressure	Pitched Sprinklers	Spray Deflection	Sunken Sprinklers	Plugged Equipment	Arc Misalignment	Low Sprinkler Drainage	Leaky Seals or Fittings	Lateral or Drip Line Leaks	Missing or Broken Heads	Slow Drainage or Ponding	Compaction/Thatch/Runoff	Notes
10	Building 18663 - 18665 Orchard Trail Surrounding		30		1			Turf	Rotor	Various						X											Throws over sidewalk, Throws into street
11	Open Space Between Kalmar Trail, Orchard Trail and Kabera Trail		40		1			Turf	Rotor	Various																	
12	Open Space at Corner of Kalmar Trail and Orchard Trail		40		1			Turf	Rotor	Various										X							Throws over sidewalk, Throws into street, Throws into conifer
13	Building 18627 - 18631 Kalmar Trail Surrouding		30		1			Turf	Rotor	Various								X	X								
14	Building 18635 - 18643 Kalmar Trail Surrounding		30		2			Turf	Rotor/Spray	Various						X				X							Geyser - caused by broken rotor, Throws into house,
15	Building 18647 - 18655 Kalmar Trail Surrouding		30		2			Turf	Rotor/Spray	Various						X	X			X				X			Geyser - caused by broken rotor, Throws into garage
16	Building 18659 - 18667 Kalmar Trail Surrounding		30		2			Turf	Rotor/Spray	Various						X	X										Throws into house, Throws into conifer
17	Building 18669 - 18677 Kalmar Trail Surrouding		30		2			Turf																			Not functional on controller - battery operated Hunter Node
18	Building 18681 - 18689 Kalmar Trail Surrounding		30		2			Turf	Rotor/Spray							X											Throws into woods

CONTROLLER 1 STATIONS 19 – 21

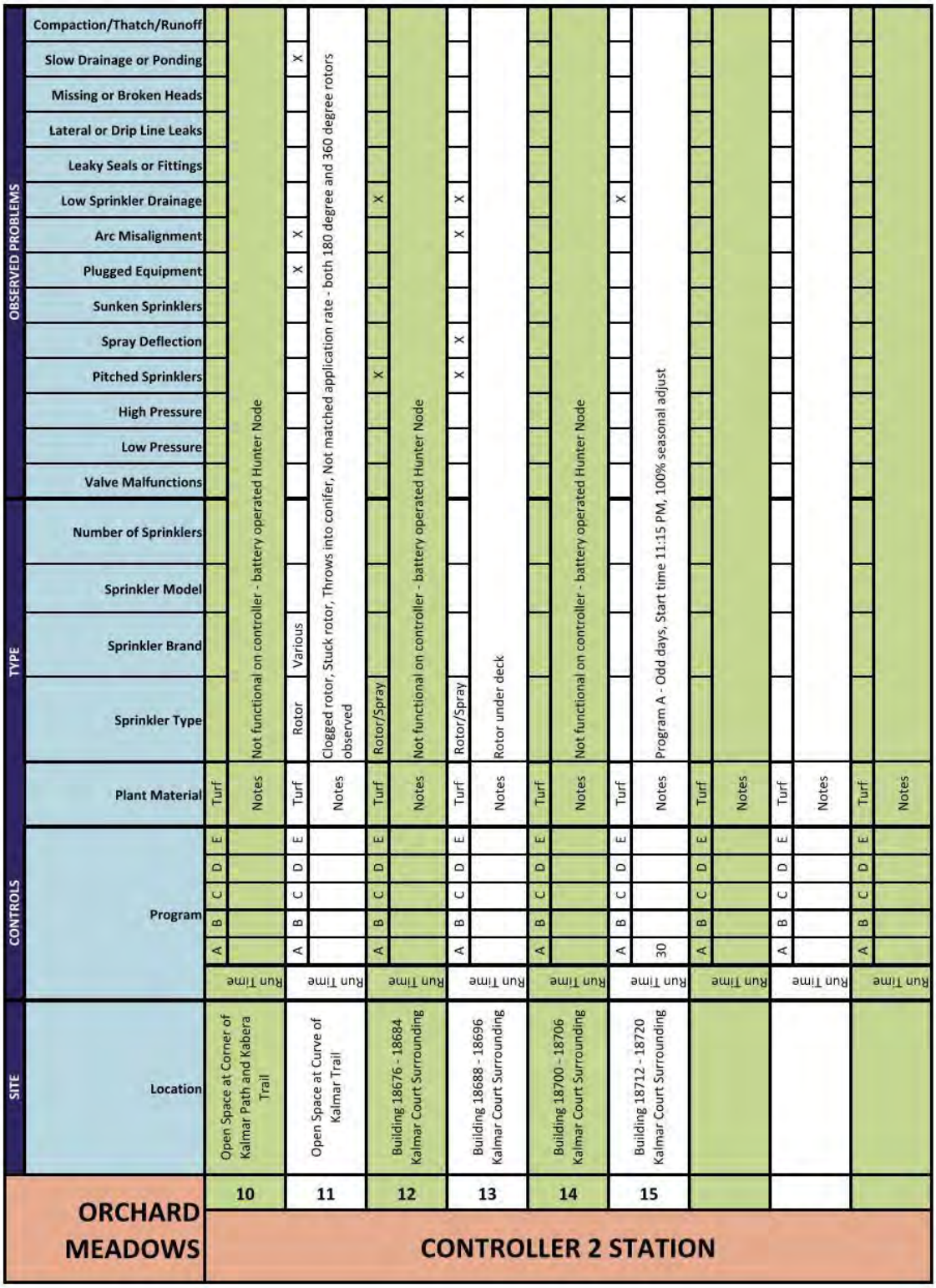


CONTROLLER 2 STATIONS 1 – 9



ORCHARD MEADOWS	CONTROLLER 2 STATION									
SITE	1	2	3	4	5	6	7	8	9
Location	Along 185th Street	Open Spaces along West Border of Community	Building 18731 - 18739 Kalmar Court Surrounding	Building 18723 - 18727 Kalmar Court Surrounding	Building 18713 - 18719 Kalmar Court Surrounding	Building 18699 - 18707 Kalmar Court Surrounding	Building 18638 - 18646 Kalmar Path Surrounding	Building 18650 - 18658 Kalmar Path Surrounding	Building 18662 - 18670 Kalmar Path Surrounding
CONTROLS									
Program	Run Time	Run Time	Run Time	Run Time	Run Time	Run Time	Run Time	Run Time	Run Time
Program	A	A	A	A	A	A	A	A	A
Program	B	B	B	B	B	B	B	B	B
Program	C	C	C	C	C	C	C	C	C
Program	D	D	D	D	D	D	D	D	D
Program	E	E	E	E	E	E	E	E	E
TYPE									
Plant Material	Turf	Turf	Turf	Turf	Turf	Turf	Turf	Turf	Turf
Plant Material	Notes	Notes	Notes	Notes	Notes	Notes	Notes	Notes	Notes
Sprinkler Type	Not functional on controller - battery operated Hunter Node	Not functional on controller - battery operated Hunter Node	Not functional on controller - battery operated Hunter Node	Not functional on controller - battery operated Hunter Node	Not functional on controller - battery operated Hunter Node	Not functional on controller - battery operated Hunter Node	Not functional on controller - battery operated Hunter Node	Not functional on controller - battery operated Hunter Node	Not functional on controller - battery operated Hunter Node
Sprinkler Brand									
Sprinkler Model									
Number of Sprinklers									
OBSERVED PROBLEMS									
Valve Malfunctions									
Low Pressure									
High Pressure									
Pitched Sprinklers									
Spray Deflection									
Sunken Sprinklers									
Plugged Equipment									
Arc Misalignment									
Low Sprinkler Drainage									
Leaky Seals or Fittings									
Lateral or Drip Line Leaks									
Missing or Broken Heads									
Slow Drainage or Ponding									
Compaction/Thatch/Runoff									

CONTROLLER 2 STATIONS 10 – 15



ORCHARD MEADOWS	SITE	CONTROLS	TYPE	OBSERVED PROBLEMS
CONTROLLER 2 STATION	Location	Program	Plant Material / Sprinkler Type / Sprinkler Brand / Sprinkler Model / Number of Sprinklers	Valve Malfunctions / Low Pressure / High Pressure / Pitched Sprinklers / Spray Deflection / Sunken Sprinklers / Plugged Equipment / Arc Misalignment / Low Sprinkler Drainage / Leaky Seals or Fittings / Lateral or Drip Line Leaks / Missing or Broken Heads / Slow Drainage or Ponding / Compaction/Thatch/Runoff
10	Open Space at Corner of Kalmar Path and Kabera Trail	Run Time: A, B, C, D, E	Turf: Notes: Not functional on controller - battery operated Hunter Node	
11	Open Space at Curve of Kalmar Trail	Run Time: A, B, C, D, E	Turf: Rotor; Various Notes: Clogged rotor, Stuck rotor, Throws into conifer, Not matched application rate - both 180 degree and 360 degree rotors observed	Plugged Equipment: X Arc Misalignment: X Slow Drainage or Ponding: X
12	Building 18676 - 18684 Kalmar Court Surrounding	Run Time: A, B, C, D, E	Turf: Rotor/Spray Notes: Not functional on controller - battery operated Hunter Node	Pitched Sprinklers: X Low Sprinkler Drainage: X
13	Building 18688 - 18696 Kalmar Court Surrounding	Run Time: A, B, C, D, E	Turf: Rotor/Spray Notes: Rotor under deck	Pitched Sprinklers: X Spray Deflection: X Arc Misalignment: X Low Sprinkler Drainage: X
14	Building 18700 - 18706 Kalmar Court Surrounding	Run Time: A, B, C, D, E	Turf: Notes: Not functional on controller - battery operated Hunter Node	
15	Building 18712 - 18720 Kalmar Court Surrounding	Run Time: A: 30; B, C, D, E	Turf: Notes: Program A - Odd days, Start time 11:15 PM, 100% seasonal adjust	Low Sprinkler Drainage: X
		Run Time: A, B, C, D, E	Turf: Notes:	
		Run Time: A, B, C, D, E	Turf: Notes:	
		Run Time: A, B, C, D, E	Turf: Notes:	

REPRESENTATIVE CATCH-CAN TEST

EXPLANATION

A catch-can test was performed on a representative station of irrigation at Orchard Meadows. Station 5 is composed of both rotor and spray sprinklers. The rotors' arc are either 90° or 180° and operate on the east side and back of the property (Figure 25). One rotor was missing in the northeast corner of Kale Way and Orchard Trail. The spray sprinklers operate in the pocket lawn in between the driveways.

Many stations of irrigation at Orchard Meadows operate both rotor and spray sprinklers. Spray sprinklers operate in the small lawn areas in front of the buildings, as represented in Station 5. Orchard Meadows stations operate various brands of rotor, as seen in Station 5. Rotors operating on Station 5 are both Hunter and Rain Bird brand.

The house, trees, or other landscaping deflected many of station 5 rotors' streams of water. The pitch of one rotor was at an angle so that the stream of water did not throw more than three feet as seen in Figure 26. Stream deflection occurs on many stations throughout the community, most of the time caused by hardscape.

SET-UP

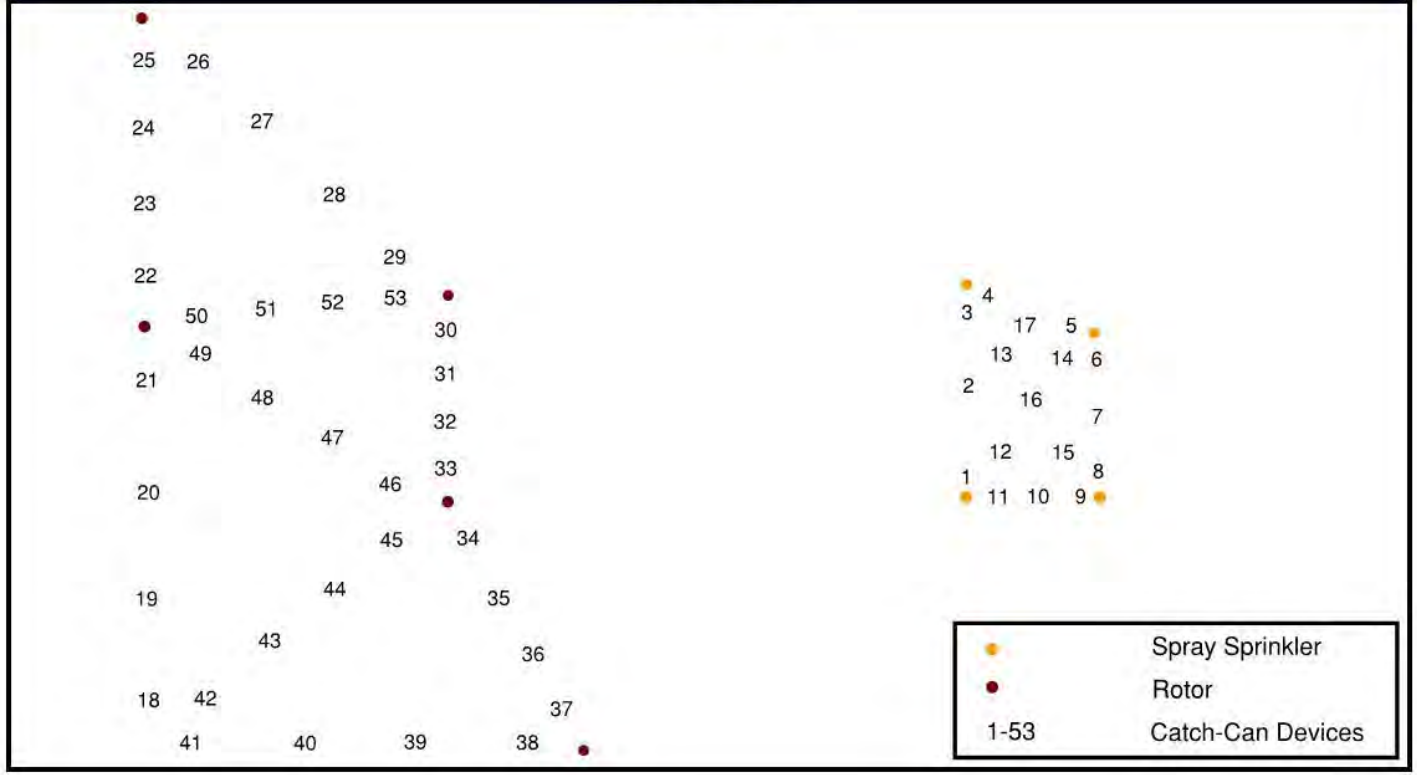
A total of 53 catch-cans were arranged between five rotors and four spray sprinklers based on the distances between the sprinklers. The catch-cans were spaced evenly between sprinklers, but at different distances to accommodate the different spacing between sprinklers. Catch-cans 1 – 17 were placed between the spray sprinklers and catch-cans 18 – 53 were placed between the rotors. The arrangement can be seen below and in Figures 25 and 26.

SITE: ORCHARD MEADOWS STATION: 5

TEST DATA

Test Run Time	30	min	Meter Start	22503520	gallons
Wind	0	mph	Meter Stop	22503305	gallons
Pressure	50	psi	Total	215	gallons

CATCH CAN MAP



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SITE: ORCHARD MEADOWS

STATION		TEST STATION		
Sprinkler Type	Rotor and Spray	Station Number	5	
Sprinkler Brand	Rainbird, Hunter	Catch Device Area	11.039063	in^2
Sprinkler Model	Rainbird T-40, 1800; Hunter Pro	Test Run Time	30	min

CATCH DEVICE VOLUMES

1	0.44	17	0.32	33	0.18	49	0.03	65	
2	0.12	18	0.12	34	0.18	50	0.4	66	
3	0.3	19	0.03	35	0.17	51	0.14	67	
4	0.18	20	0	36	0.34	52	0.18	68	
5	0.5	21	0.04	37	0.22	53	0.07	69	
6	0.45	22	0.01	38	0.13	54		70	
7	0.42	23	0	39	0.28	55		71	
8	0.36	24	0	40	0.22	56		72	
9	0.2	25	0.03	41	0.18	57		73	
10	0.06	26	0.13	42	0.18	58		74	
11	0.02	27	0.1	43	0.19	59		75	
12	0.4	28	0.1	44	0.16	60		76	
13	0.4	29	0	45	0.14	61		77	
14	0.36	30	0.08	46	0.15	62		78	
15	0.5	31	0.14	47	0.12	63		79	
16	0.16	32	0.18	48	0.06	64		80	

Number of Catch Devices	53	1/4 of Number of Catch Devices	13.25
Total Catch Volume	9.87	Total Low Quarter	0.6
Average Volume [V_{avg}]	0.186226415	Average Low Quarter [V_{avg}]	0.045283019

Calculate Distribution Uniformity	Calculate Net Precipitation Rate
$Du_{lq} = \frac{\text{Average Lower Quarter } [V_{lq}]}{\text{Average Volume } [V_{avg}]} = \frac{0.045283 \text{ mL}}{0.1862264} =$ **0.2431611**	$PR_{net} = \frac{3.66 \times V_{avg}}{t_R \times A_{CD}} = \frac{3.66 \times 0.1862264 \text{ mL}}{30 \text{ min} \times 11.039063 \text{ in}^2} =$ **0.002058112**

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The distribution uniformity of Station 5 at Orchard Meadows is 0.243, the calculations for which can be seen above. The average calculated distribution of a typical landscape irrigation system is between 0.55 and 0.75. The distribution uniformity of this representative station of irrigation is below average.

The low distribution uniformity of this station of irrigation could be caused by many factors. The station is comprised of both rotor and spray sprinklers which have different application rates. Generally, the application rate of a spray sprinkler is two to three times that of a rotor. This can be seen in the data collected above. On average the volume of water collected in catch-cans 1 – 17, which were between spray sprinklers, was three times the amount collected in the catch cans between rotors.

Various rotors needed adjustment to irrigate the intended landscape. There is a pitched rotor on Orchard Trail (Figure 26), and two rotors were throwing into the house (Figure 19). The volume of water collected in the catch-cans reflects these rotors.

A rotor was never installed on the northeast corner of the property, on the corner of Orchard Trail and Kale Way. Therefore, there is no sprinkler to sprinkler coverage in this area, therefore the distribution uniformity is low in Station 5.

Given that this station is representative of the irrigation system at Orchard Meadows, the irrigation water is likely being distributed unevenly across the landscape. It is therefore likely that the estimated distribution uniformity calculation of 0.243 is representative for the entire irrigation system at Orchard Meadows HOA.

SUMMARY

After performing the Stage II audit, WiM recommends Orchard Meadows replace the currently installed landscape irrigation system with a professionally designed and specified system that follows industry best practices, water-efficiency and contemporary technology. Vital infrastructure elements of the irrigation system are deteriorated and are non-functioning, most notably wiring. Our recommendation is based primarily in observation of system age, deficiencies of the original installation, the overall condition of the irrigation system and years of deferred maintenance contrasted against the expected resources necessary to update the irrigation system.

Should Orchard Meadows leadership choose to continue operation of the irrigation system, WiM suggests items B – S be implemented to reduce water waste and associated cost.

Recommended actions are presented individually and in bundle format. The intent of presenting actions in a bundled format is to illustrate cost savings that may be realized by authorizing similar system improvements during a single mobilization. The financial information presented below is intended for budgeting purposes only. Project electives, variables and market conditions can affect the cost of work.

RECOMMENDED OPTION 1

ITEM	PRIORITY	DESCRIPTION	ESTIMATED COST	ADDITIONAL INFORMATION
A	High	Abandon existing irrigation system. Re-design, specify and install a new, landscape irrigation system per water-efficient and industry best practices and employ modern technology.	$85,000 – $125,000	Design and specification costs are included

RECOMMENDED OPTION 2

ITEM	PRIORITY	DESCRIPTION	ESTIMATED COST	ADDITIONAL INFORMATION
B	High	Abandon existing irrigation system and replace failed system field control wiring.	$40,000 – $60,000	WiM recommends professional 3rd party project specification and installation oversight, cost of $2,000 –$2,500
C	High	Place waterproof wire nuts on all wire spices. Re-install according to industry best practices and MN electrical code.	$1,500 – $2,000	Does not assume replacement of wire, only repair to existing wire
D	High	Repair or replace sprinklers that are sunken, pitched, leaking, or clogged to improve performance. Adjust to avoid water onto hard surfaces. One broken sprinkler can waste hundreds of gallons per irrigation cycle, and up to thousands of gallons per week.	$4,000 – $7,000	Recommend pre-selection of brand and model sprinklers
E	High	Move sprinklers to accommodate maturity of or changes to landscape/hardscape; adjust to avoid water onto hard surfaces.	$3,500 – $4,500	
F	High	Install and properly adjust basic rain sensing technology onto each irrigation controller per Minnesota law.	$500 – $1,000	Cost for two rain sensors. Recommend pre-selection of brand and model. All stations must operated on a controller.
G	High	Adjust each controller programming and scheduling practice to utilize controller water-efficiency options. Document schedule.	$400 – $600	Cost for two controllers. Recommend 3rd party preparation and direction to installer, cost of $300 – $400

H	High	Immediately following comprehensive system updates or replacement, implement a program of regular, periodic, proactive system maintenance and operation.	$5,500 – $8,000	Annual cost, includes usual replacement of parts. Recommend 3rd party preparation and direction to installer, cost of $300 – $400
I	High	Move or cap sprinklers under trees, throwing into natural areas, hard surfaces and structures.	$2,000 – $2,500	Assuming 5% - 8% of sprinklers
J	High	Adjust or move sprinklers to avoid direct and repeated spray into conifers.	$2,000 – $2,500	Direct or repeated water into conifers can damage or kill the plant
K	High	On stations operating both rotor and spray sprinklers, replace spray sprinklers with multi-stream multi-trajectory (MSMT) sprinklers.	$5,000 – $8,000	Never mix rotor-type and spray type sprinklers on the same station
L	Medium	Homogenize all sprinklers to one brand and select model families from that brand and install matched application rate nozzling.	$15,000 – $20,000	Recommend 3rd party preparation and direction to installer, cost of $300 – $400
M	Medium	Sprinkler to sprinkler coverage should be maintained in all areas of the irrigated property. Align sprinklers in such a way that the end of the spray of one sprinkler reaches the next sprinkler per best practice and manufacturer recommendations. Responsible addition of sprinklers on deficient stations may be a remedy to stations lacking proper performance.	$10,000 – $15,000	Recommend 3rd party preparation and direction to installer, cost of $800 – $1,200
N	Medium	Locate, adjust and clean valve boxes. Replace or upsize as needed. Document locations to aid in maintenance and operations.	$1,500 – $1,800	Recommend 3rd party preparation and direction to installer, cost of $300-$400

O	Medium	Match application rates of each rotor nozzle within a station of irrigation to avoid over or under watering. Quarter-circle sprinklers should emit half of the amount of water as half-circle sprinklers. Likewise, a full-circle sprinkler should emit double the amount of water as a half-circle sprinkler. For instance, if the corner sprinklers in a square area deliver 2 gallons per minute, the sprinklers along the edge of the square should deliver 4 gallons of water per minute, and the full sprinklers in the center should deliver 8 gallons per minute. Application rates should be matched on all irrigation stations. This can be achieved by ensuring consistency in sprinkler selection and by installing nozzles appropriate for the arc of coverage of each sprinkler.	$8,000 – $10,000	
P	Medium	Utilize the Hunter I-CORE® technology option to convert each irrigation controller to SMART scheduling. Document to aid in maintenance and operation. Properly programmed, controllers automatically adjust irrigation schedules in response to changing weather conditions. When properly programed, the controller in SMART mode can improve moisture balance in the soil and reduce water waste.	$2,500 – $3,000	Cost for two controllers. Recommend 3rd party preparation and direction to installer, cost of $300-$400
Q	Medium	Upgrade from no or basic SMART scheduling technology, implement remote central control of the irrigation system by a trained Water Manager. A Water Manager ensures irrigation efficiency via professional weather data and proactive monitoring and reporting of system performance. The Water Manager will dispatch irrigation service personnel immediately upon real or suspected repair needs.	$7,500 – $8,500 $2,000 – $3,000	One-time installation cost for two controllers, annual water management, cellular communication and reporting. Annual cost, often paid in part from reduced cost of operation

R	Medium	Install flow sensor on water supply and integrate into two controllers. When a high flow warning is indicated, the controller can shut down the system, saving water and reducing property damage.	$2,500 – $3,500	Recommend 3rd party preparation and direction to installer, cost of $300 – $400. Typically included as a component of conversion to SMART scheduling or professional Water-Managed operation
S	Medium	Install sprinklers with check valves at the lowest areas of stations to prevent low sprinkler drainage. This will prevent excess runoff from occurring from the irrigation water being expelled from the piping after an irrigation cycle.	$800 – $1,200	

The following table combines individual recommendations of Option 2 into bundles of actions, to reduce costs of design and implementation of improvements. By completing work during a single mobilization, the installer will be more efficient, reducing the cost of work that might otherwise be engaged via separate mobilizations.

BUNDLE	ITEMS	EXPLANATION	ESTIMATED COST SAVINGS
1	C, D, E, F, G, I, J, K, N, S	Conduct deferred maintenance including but not limited to repair of known wire damage, removal of temporary control measures (ex. Hunter Node® single-station controllers), raise, straighten, adjust functional sprinklers; move sprinklers to accommodate maturity of or changes to landscape/hardscape; replace sprinklers that are leaking or broken with new devices of one manufacturer and model family; identify and expose all field service boxes; assemble and document system layout in a workmanlike fashion to aid in recordkeeping and future system maintenance and operation; install and properly adjust basic rain sensing technology per Minnesota law; clean-up all controller wiring and improve per best practices and MN electric code; assemble and document suggested seasonal scheduling for future maintenance and operation.	10% savings $25,000-$35,000 estimated total cost Recommend professional 3rd party project specification and installation oversight, cost of $2,500 – $3,000
2	F, G, P/Q, R	Conduct improvements to controls and controllers including optional SMART technology or full water management subscription.	5% savings Recommend professional 3rd party project specification and installation oversight, cost of $2,500 – $3,000

OPTION 3 (NOT RECOMMENDED)

Work in Option 3 focuses effort on investment in irrigation distribution equipment while keeping in place the Hunter I-CORE controller and the 17 Hunter Nodes until a future date. Improvements will be made to Controller 1 to increase the efficiency of that irrigation system including SMART scheduling and installation of a flow sensor.

This approach is not recommended by Water in Motion. Continuing to operate irrigation on temporary Hunter Nodes as opposed to the best practice-based centralized master controller approach, will result in higher water usage, less reliable and efficient operation and inability to embrace new water-efficient control technologies such as weather-based scheduling and practices such as cycle-and-soak. Option 3 addresses the following:

ITEM	PRIORITY	DESCRIPTION	ESTIMATED COST	ADDITIONAL INFORMATION
C	High	Place waterproof wire nuts on all wire spices. Re-install according to industry best practices and MN electrical code.	$1,500 – $2,000	Does not assume replacement of wire, only repair to existing wire
D	High	Repair or replace sprinklers that are sunken, pitched, leaking, or clogged to improve performance. Adjust to avoid water onto hard surfaces. One broken sprinkler can waste hundreds of gallons per irrigation cycle, and up to thousands of gallons per week.	$4,000 – $7,000	Recommend pre-selection of brand and model sprinklers
E	High	Move sprinklers to accommodate maturity of or changes to landscape/hardscape; adjust to avoid water onto hard surfaces.	$3,500 – $4,500	
F	High	Install and properly adjust basic rain sensing technology onto each irrigation controller per Minnesota law.	$350 – $450	Cost for one rain sensor for Controller 1. Recommend pre-selection of brand and model.
G	High	Adjust Controller 1 programming and scheduling practice to utilize controller water-efficiency options. Document schedule.	$300 – $450	Recommend 3rd party preparation and direction to installer, cost of $300 – $400

H	High	Immediately following comprehensive system updates or replacement, implement a program of regular, periodic, proactive system maintenance and operation.	$5,500 – $8,000	Annual cost, includes usual replacement of parts. Recommend 3rd party preparation and direction to installer, cost of $300 – $400
I	High	Move or cap sprinklers under trees, throwing into natural areas, hard surfaces and structures.	$2,000 – $2,500	Assuming 5% - 8% of sprinklers
J	High	Adjust or move sprinklers to avoid direct and repeated spray into conifers.	$2,000 – $2,500	Direct or repeated water into conifers can damage or kill the plant
K	High	On stations operating both rotor and spray sprinklers, replace spray sprinklers with multi-stream multi-trajectory (MSMT) sprinklers.	$5,000 – $8,000	Never mix rotor-type and spray type sprinklers on the same station
L	Medium	Homogenize all sprinklers to one brand and select model families from that brand and install matched application rate nozzling.	$15,000 – $20,000	Recommend 3rd party preparation and direction to installer, cost of $300 – $400
M	Medium	Sprinkler to sprinkler coverage should be maintained in all areas of the irrigated property. Align sprinklers in such a way that the end of the spray of one sprinkler reaches the next sprinkler per best practice and manufacturer recommendations. Responsible addition of sprinklers on deficient stations may be a remedy to stations lacking proper performance.	$10,000 – $15,000	Recommend 3rd party preparation and direction to installer, cost of $800 – $1,200
N	Medium	Locate, adjust and clean valve boxes. Replace or upsize as needed. Document locations to aid in maintenance and operations.	$1,500 – $1,800	Recommend 3rd party preparation and direction to installer, cost of $300-$400

O	Medium	Match application rates of each rotor nozzle within a station of irrigation to avoid over or under watering. Quarter-circle sprinklers should emit half of the amount of water as half-circle sprinklers. Likewise, a full-circle sprinkler should emit double the amount of water as a half-circle sprinkler. For instance, if the corner sprinklers in a square area deliver 2 gallons per minute, the sprinklers along the edge of the square should deliver 4 gallons of water per minute, and the full sprinklers in the center should deliver 8 gallons per minute. Application rates should be matched on all irrigation stations. This can be achieved by ensuring consistency in sprinkler selection and by installing nozzles appropriate for the arc of coverage of each sprinkler.	$8,000 – $10,000	
P	Medium	Utilize the Hunter I-CORE® technology option to convert each irrigation controller to SMART scheduling. Document to aid in maintenance and operation. Properly programmed, controllers automatically adjust irrigation schedules in response to changing weather conditions. When properly programed, the controller in SMART mode can improve moisture balance in the soil and reduce water waste.	$1,500 – $2,000	Cost for one controller. Recommend 3rd party preparation and direction to installer, cost of $300-$400
R	Medium	Install flow sensor on water supply and integrate into one controller. When a high flow warning is indicated, the controller can shut down the system, saving water and reducing property damage.	$1,500 – $3,000	Recommend 3rd party preparation and direction to installer, cost of $300 – $400. Typically included in conversion to SMART scheduling or professional Water-Managed operation

S	Medium	Install sprinklers with check valves at the lowest areas of stations to prevent low sprinkler drainage. This will prevent excess runoff from occurring from the irrigation water being expelled from the piping after an irrigation cycle.	$800 – $1,200	

Item F, installing a rain sensor, is feasible for the Hunter I-CORE controller. The HOA may select a wired or wireless rain sensor.

If the HOA were to install rain sensing technology for each of the 17 Hunter Nodes, only wired devices can be used. Installing hardwired rain sensors on each Hunter Node presents financial, logistical and reliability challenges. Estimated cost of wired rain sensing technology onto existing Hunter Nodes can range from $350 – $400 each.

Item G, adjusting irrigation schedules in basic form, can be accomplished when both the Hunter I-CORE and Hunter Nodes are in-place but, will be challenging to most practitioners, require additional record-keeping and will not enable implementation of water-efficient scheduling practices.

The following table combines individual Option 3 recommendations into bundles of actions to reduce costs of design and implementation of improvements. By completing work during a single mobilization, the installer will be more efficient, reducing the cost of work that might otherwise be engaged via separate mobilizations.

BUNDLE	ITEMS	EXPLANATION	ESTIMATED COST SAVINGS
1	C, D, E, F, G, I, J, K, N, S	Conduct deferred maintenance including but not limited to raise, straighten, adjust functional sprinklers; move sprinklers to accommodate maturity of or changes to landscape/hardscape; replace sprinklers that are leaking or broken with new devices of one manufacturer and model family; identify and expose all field service boxes; assemble and document system layout in a workmanlike fashion to aid in recordkeeping and future system maintenance and operation; install and properly adjust basic rain sensing technology per Minnesota law; clean-up all controller wiring and improve per best practices and MN electric code; assemble and document suggested seasonal scheduling for future maintenance and operation.	10% savings $25,000-$35,000 estimated total cost Recommend professional 3rd party project specification and installation oversight, cost of $2,500 – $3,000

2	F, G, P, R	Conduct improvements to controls and controllers including optional SMART technology or full water management subscription.	5% savings Recommend professional 3rd party project specification and installation oversight, cost of $2,500 – $3,000

OPTION 4 (NOT RECOMMENDED)

Work in Option 4 focuses effort on investment in irrigation distribution equipment while keeping in-place the Hunter I-CORE controller and 17 Hunter Nodes until a future date. The controls will not be addressed in Option 4.

This approach is not recommended by Water in Motion. Continuing to operate irrigation on temporary Hunter Nodes as opposed to the best practice-based centralized master controller approach, will result in higher water usage, less reliable and efficient operation and inability to embrace new water-efficient control technologies such as weather-based scheduling and practices such as cycle-and-soak. Option 4 addresses the following:

ITEM	PRIORITY	DESCRIPTION	ESTIMATED COST	ADDITIONAL INFORMATION
C	High	Place waterproof wire nuts on all wire spices. Re-install according to industry best practices and MN electrical code.	$1,500 – $2,000	Does not assume replacement of wire, only repair to existing wire
D	High	Repair or replace sprinklers that are sunken, pitched, leaking, or clogged to improve performance. Adjust to avoid water onto hard surfaces. One broken sprinkler can waste hundreds of gallons per irrigation cycle, and up to thousands of gallons per week.	$4,000 – $7,000	Recommend pre-selection of brand and model sprinklers
E	High	Move sprinklers to accommodate maturity of or changes to landscape/hardscape; adjust to avoid water onto hard surfaces.	$3,500 – $4,500	

F	High	Install and properly adjust basic rain sensing technology onto each irrigation controller per Minnesota law.	$350 – $450	Cost for one rain sensor for Controller 1. Recommend pre-selection of brand and model.
G	High	Adjust Controller 1 programming and scheduling practice to utilize controller water-efficiency options. Document schedule.	$300 – $450	Recommend 3rd party preparation and direction to installer, cost of $300 – $400
H	High	Immediately following comprehensive system updates or replacement, implement a program of regular, periodic, proactive system maintenance and operation.	$5,500 – $8,000	Annual cost, includes usual replacement of parts. Recommend 3rd party preparation and direction to installer, cost of $300 – $400
I	High	Move or cap sprinklers under trees, throwing into natural areas, hard surfaces and structures.	$2,000 – $2,500	Assuming 5% - 8% of sprinklers
J	High	Adjust or move sprinklers to avoid direct and repeated spray into conifers.	$2,000 – $2,500	Direct or repeated water into conifers can damage or kill the plant
K	High	On stations operating both rotor and spray sprinklers, replace spray sprinklers with multi-stream multi-trajectory (MSMT) sprinklers.	$5,000 – $8,000	Never mix rotor-type and spray type sprinklers on the same station
L	Medium	Homogenize all sprinklers to one brand and select model families from that brand and install matched application rate nozzling.	$15,000 – $20,000	Recommend 3rd party preparation and direction to installer, cost of $300 – $400

M	Medium	Sprinkler to sprinkler coverage should be maintained in all areas of the irrigated property. Align sprinklers in such a way that the end of the spray of one sprinkler reaches the next sprinkler per best practice and manufacturer recommendations. Responsible addition of sprinklers on deficient stations may be a remedy to stations lacking proper performance.	$10,000 – $15,000	Recommend 3rd party preparation and direction to installer, cost of $800 – $1,200
N	Medium	Locate, adjust and clean valve boxes. Replace or upsize as needed. Document locations to aid in maintenance and operations.	$1,500 – $1,800	Recommend 3rd party preparation and direction to installer, cost of $300-$400
O	Medium	Match application rates of each rotor nozzle within a station of irrigation to avoid over or under watering. Quarter-circle sprinklers should emit half of the amount of water as half-circle sprinklers. Likewise, a full-circle sprinkler should emit double the amount of water as a half-circle sprinkler. For instance, if the corner sprinklers in a square area deliver 2 gallons per minute, the sprinklers along the edge of the square should deliver 4 gallons of water per minute, and the full sprinklers in the center should deliver 8 gallons per minute. Application rates should be matched on all irrigation stations. This can be achieved by ensuring consistency in sprinkler selection and by installing nozzles appropriate for the arc of coverage of each sprinkler.	$8,000 – $10,000	

S	Medium	Install sprinklers with check valves at the lowest areas of stations to prevent low sprinkler drainage. This will prevent excess runoff from occurring from the irrigation water being expelled from the piping after an irrigation cycle.	$800 – $1,200	

Item F, installing a rain sensor, is feasible for the Hunter I-CORE controller. The HOA may select a wired or wireless rain sensor.

If the HOA were to install rain sensing technology for each of the 17 Hunter Nodes, only wired devices can be used. Installing hardwired rain sensors on each Hunter Node presents financial, logistical and reliability challenges. Estimated cost of wired rain sensing technology onto existing Hunter Nodes can range from $350 – $400 each.

Item G, adjusting irrigation schedules in basic form, can be accomplished when both the Hunter I-CORE and Hunter Nodes are in-place but, will be challenging to most practitioners, require additional record-keeping and will not enable implementation of water-efficient scheduling practices.

The following table combines individual Option 4 recommendations into bundles of actions to reduce costs of design and implementation of improvements. By completing work during a single mobilization, the installer will be more efficient, reducing the cost of work that might otherwise be engaged via separate mobilizations.

BUNDLE	ITEMS	EXPLANATION	ESTIMATED COST SAVINGS
1	C, D, E, F, G, I, J, K, N, S	Conduct deferred maintenance including but not limited to raise, straighten, adjust functional sprinklers; move sprinklers to accommodate maturity of or changes to landscape/hardscape; replace sprinklers that are leaking or broken with new devices of one manufacturer and model family; identify and expose all field service boxes; assemble and document system layout in a workmanlike fashion to aid in recordkeeping and future system maintenance and operation; install and properly adjust basic rain sensing technology per Minnesota law; assemble and document suggested seasonal scheduling for future maintenance and operation.	10% savings $25,000-$35,000 estimated total cost Recommend professional 3rd party project specification and installation oversight, cost of $2,500 – $3,000

CONTROLLER 1 SAMPLE IRRIGATION SCHEDULE

IRRIGATION CONTROLLER 1 PROGRAMS			
PROGRAM	START TIME	ODD/EVEN DAYS	SEASONAL ADJUST
A	9:30 PM	Odd - No Monday	Adjusted throughout the irrigation season
	12:30 AM	"	"
	4:00 AM	"	"
B	OFF	-	-
C	OFF	-	-
D	OFF	-	-

IRRIGATION STATION RUN TIMES		
STATION	PROGRAM	RUN TIME
1	A	5
2	A	5
3	A	7
4	A	7
5	A	6
6	A	8
7	A	8
8	A	5
9	A	5
10	A	7
11	A	8
12	A	8
13	A	7
14	A	6

15	A	5
16	A	5
17	A	5
18	A	5
19	A	6
20	A	7
21	B	7

CONTROLLER 2 SAMPLE IRRIGATION SCHEDULE

The sample irrigation schedule for Controller 2 is based on the surrounding landscape and information gained from operation of Controller 1. WiM recommends that the field wiring be reinstalled and the operation of this area of the community be through the controller as opposed to the Hunter Nodes that are currently in use.

IRRIGATION CONTROLLER 2 PROGRAMS			
PROGRAM	START TIME	ODD/EVEN DAYS	SEASONAL ADJUST
A	9:30 PM	Even - No Monday	Adjusted throughout the irrigation season
	12:30 AM	"	"
	4:00 AM	"	"
B	OFF	-	-
C	OFF	-	-
D	OFF	-	-

IRRIGATION STATION RUN TIMES		
STATION	PROGRAM	RUN TIME
1	A	5
2	A	5
3	A	6
4	A	7
5	A	6
6	A	7
7	A	7
8	A	6
9	A	6
10	A	7
11	A	8
12	A	6
13	A	6
14	A	5
15	A	8

PROACTIVE MAINTENANCE

MAINTENANCE

Maintenance is the regular, proactive application of a best practice-based process to preserve the integrity of a constructed system or device.

Maintenance of a landscape irrigation system includes:

- Raising, straightening and adjusting sprinklers
- Minor moving of sprinklers to accommodate growth in the landscape
- Testing and record-keeping of plumbing protection equipment, pumps and other controls
- Scheduling adjustments to accommodate a maturing landscape, realities of soil conditions and changing weather
- Interaction with the landscape maintenance provider, acting in the best interests of the client and the needs of the landscape
- Note and plan for more intensive tasks as the landscape matures or project-based changes in the landscape
- Regular reporting in clear, concise fashion of findings and outcomes to the client or client representative

REPAIR

Repair is overcoming damage or a fault, utilizing best practices or manufacturer recommendation in the application of parts and techniques to keep a device, assembly or system in working condition.

Repair of a landscape irrigation system includes:

- Replacement of failed or damaged equipment
- Overcoming deficiencies in the original installation
- Overcoming naturally-occurring damage
- Overcoming damage by others

RETROFIT

Retrofit of a system is installing a component or accessory that was not included at the time of manufacture or assembly.

Retrofit is not generally part of routine maintenance. For budgeting purposes, retrofit(s) should be separately proposed from maintenance and repair budgets and be prioritized in agreed-to between the client and the service vendor.

Some retrofits are inexpensive and bear great reward such as installation of basic rain sensing technology. Other retrofits may involve great expense and planning such as re-installation of a station of sprinklers to overcome original design deficiency or changes/growth of landscape.

OUTLINE OF A RECOMMENDED LANDSCAPE IRRIGATION MAINTENANCE PROGRAM

A properly designed and installed irrigation system requires periodic maintenance and continual scheduling adjustments to accommodate the needs of the landscape and best stewardship practices.

The frequency of maintenance interval can vary based on many factors. A practical service interval for maintenance of a landscape irrigation system at a homeowner association is once every two weeks.

A qualified service provider will specialize in landscape irrigation as a profession either exclusively or, as a properly capitalized division, adequately equipped and staffed to efficiently furnish maintenance. A landscape irrigation service technician generally has a minimum of five years' experience in the industry and may carry several credentials including Certified Irrigation Contractor or Certified Irrigation Technician. In Minnesota, a well-qualified irrigation Service Technician may also hold a Power Limited Technician License, Backflow Tester License and accreditation or degree in horticulture.

A comprehensive landscape irrigation maintenance program will be minimally based on the following approach:

- Spring system start, walk-through and repair
- Bi-weekly proactive system walk-through, adjustment and repair
- Autumn shut-down

In four-season climates, the spring system start can be the most intensive of all maintenance events including, re-setting sprinklers resultant of freeze-thaw conditions, testing of equipment and sensors and initial scheduling of irrigation.

A good maintenance provider will document repairs separately from maintenance and in a way that the client can comprehend and track in contrast to budget.

A good maintenance provider will apply maintenance to keep the original installation in tact including use of original equipment.

Whether or not a landscape irrigation controller is equipped with "SMART" weather or soil-moisture technology, regular attention paid to and adjustment of the irrigation system controller to accommodate realities of the landscape and current weather conditions is a vital function of a good landscape irrigation maintenance program.

In four-season climates, a good landscape irrigation maintenance program will include a documented approach to winterization of irrigation equipment including protected storage of backflow prevention devices, any pump equipment and other equipment.

In addition to a checklist of tasks to be performed, maintenance visits should include attendance to and documentation of items reported to vendor by the client. A list of routine tasks to illustrate the vendor's approach to maintenance should be included with the vendor's budget proposal.

A good maintenance provider will document and propose improvements and rationale. If approved, a good provider will have the capability to self-perform the improvements.

BUDGET FOR COMPREHENSIVE MAINTENANCE

Setting a budget to properly maintain a landscape irrigation system includes several assessments including:

- System condition considering best practices and manufacturer recommendations
- System complexity
- Available system records
- System age
- Condition of the landscape
- Expectations of the owner
- Consideration for use of resources

A well-communicated maintenance program will include a fixed budget for application of maintenance and a separate parts and labor budget estimate for repairs. The repair budget can only be estimated to give the client a reference for annual budgeting.

If a list of prioritized system improvements/retrofits is in place, a budget to implement improvements will be included in a comprehensive landscape irrigation maintenance program.

FIGURES

Figure 1 (above): Irrigation controller 1

Figure 2 (above right): Irrigation controller 1 traditional wiring

Figure 3 (right): Irrigation controller 1 and 2

Figure 4 (above): Irrigation water supply

Figure 5 (above right): Wireless rain sensor

Figure 6 (right): Wireless rain sensor receiver attached to Controller 2

Figure 7 (below): Hunter Node

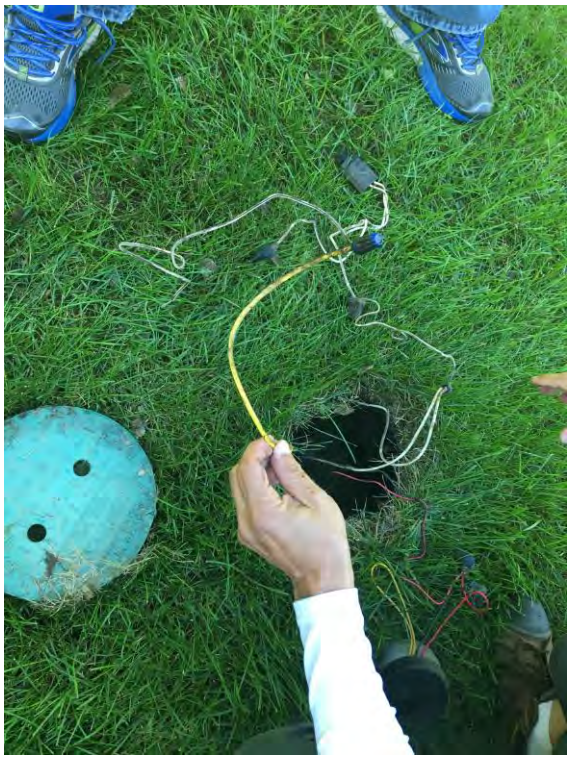

Figure 8 (above): Hunter Node

Figure 9 (above right): Abandoned Controller 2 traditional wiring in valve box; Hunter Node

Figure 10 (right): Abandoned traditional wiring for Controller 2

Figure 11 (below): Broken sprinkler

Figure 12 (above): Spray sprinkler located beneath deck

Figure 13 (above right): Pitched rotor

Figure 14 (right): Pitched rotor, significant runoff evident

Figure 15 (below): Pitched spray sprinkler

Figure 16 (above): Broken seal on rotor

Figure 17 (above right): Rotors spraying over sidewalks

Figure 18 (right): Rotors spraying over sidewalks

Figure 19 (below): Rotors throwing onto house

Figure 20 (above): Significant runoff evident

Figure 21 (above right): Rotor off of swing joint, significant runoff evident

Figure 22 (right): Rotor arc differences

Figure 23 (below): Low drainage

Figure 24 (above): Tree roots growing around an obscured valve box

Figure 25 (above right): Catch-can test

Figure 26 (right): Catch-can test

GLOSSARY

Arc – The area a part-circle sprinkler irrigates, expressed in degrees of a circle. For example, a 90-degree arc provides quarter-circle coverage, while a 180-degree arc provides half-circle coverage.

Backflow Preventer – A mechanical assembly installed to protect the potable water supply from potentially contaminated irrigation water.

Best Management Practices – An irrigation BMP is a voluntary irrigation practice that is both economical and practical and is designed to reduce water consumption and protect water quality while maintaining plant health at the desired level.

Certified Landscape Irrigation Auditor – The Certified Landscape Irrigation Auditor 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.

Controller – An automatic timing device that sends an electric signal for automatic valves to open or close according to a set irrigation schedule.

Cycle-and-Soak – Allows the user to divide a station's run time into more usable, shorter duration cycles. Cycle-and-soak is particularly applicable for slopes and tight soil (such as clay) and helps prevent excessive runoff. The cycle time is entered into the controller as a fraction of the station's watering time, and the soak time as the minimum soak required before the watering of the next portion. The total number of cycles is determined by taking the total programmed station run time and dividing it by the cycle time.

Distribution Uniformity – (Also referred as "Performance") Measure of the uniformity of irrigation water over an area.

EPA WaterSense Partner – WaterSense is a voluntary, public-private partnership program sponsored by the U.S. Environmental Protection Agency. WaterSense works to protect the future of national water supplies by promoting water-efficient products, practices and professionals. EPA WaterSense Partners are committed to bringing water-efficient products and practices to the market.

Fixed Arc Nozzles – Rotor style sprinkler where the arc stays static and is non-adjustable.

Hydrozone – Grouping of plants with similar water requirements so that they can be irrigated with a common zone.

Maintenance – The work of keeping something in operating condition.

Matched Application Rates – Refers to sprinklers that apply water at the same rate per hour no matter the arc of coverage or part of a circle they cover.

Microclimate – The unique environmental conditions in a particular area of the landscape. Factors include amount of sunlight or shade, soil type, slope and wind.

MSMT – A "multi-stream, multi-trajectory" sprinkler that uses individual, rotating streams of water to distribute irrigation water.

Municipal Water – Domestic or drinking water. 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.

Nozzle – The final opening through which water passes from the sprinkler or emitter. Nozzle shape, size, and placement has a direct effect on the distance, watering pattern, and distribution efficiency.

Pitched Sprinkler Head – A sprinkler that is slanted or tilted.

Point of Connection – Location where irrigation system is connected to a (potable) water supply.

Rain Sensor – A device that automatically interrupts irrigation events during periods of sufficient moisture.

Rotor Sprinkler – A type of sprinkler where a primary stream of water is distributed back and forth across the area being watered.

Runoff – Portion of precipitation, snow melt or irrigation, that flows over the soil, eventually making its way to surface water supplies.

Spray Sprinkler – A sprinkler that does not rotate.

Sprinkler to Sprinkler Coverage – Single sprinklers generally do not provide even distribution of water throughout their range of throw. When overlapping coverage is provided, the weak areas from one sprinkler are supplemented by the strong areas from another sprinkler. Overlapping coverage also reduces time necessary to complete an irrigation cycle from the perspective of total water required.

Station/Zone/Circuit – Section of an irrigation system served by a single point of control. Also known as a Hydrozone, optimally comprised of similar sprinkler types and plant material types and applying water onto a consistent topography or microclimate.

Topography – The arrangement of the natural and artificial physical features of an area.

Valve Box – A protective container installed around an underground valve to allow operation or maintenance access to underground pipeline valves.

Variable Arc Nozzles – Rotor style sprinkler where the arc can be adjusted to more accurately apply irrigation to nonconvention landscape areas.

Water in Motion was pleased to compose this report. Our company specializes not only in system audits, but also design, consultations, and education. Should Orchard Meadows choose to implement some or all of our recommendations, we will be pleased to support with suggested processes, prioritization and measures of success.

Please contact Cara Donovan or Rich Koechlein at 763-559-1010.