Dominion Water & Sanitation District
9250 E. Costilla Avenue, Suite 210
Greenwood Village, CO 80112

July 1, 2020

Mr. Kevin Reidy
Colorado Water Conservation Board
1313 Sherman Street, Suite 721
Denver, Colorado 80203

Ms. Tracy Kosloff
Colorado Division of Water Resources
1313 Sherman Street, Suite 818
Denver, Colorado 80203

Re: 2020 Sterling Ranch Precipitation Harvesting Pilot Study Annual Report

Dear Ms. Kosloff and Mr. Reidy:

Enclosed is the tenth annual report for the Precipitation Harvesting Pilot Study submitted by LRE Water, Inc. on behalf of Dominion Water and Sanitation District serving the Sterling Ranch Development. The annual report documents progress that was made in the 2019/2020 pilot study year, data that was collected, and plans for the 2020/2021 study year.

The 2019/2020 data collection included:

- Climate and precipitation data have continued to be collected, extending the record for the site-specific data from March 2010 to May 2020.

The 2019/2020 pilot year precipitation was below average (16.78 inches is average (04/2010-05/2019)), with a total of 16.13 inches of recorded precipitation at the Sterling Ranch climate station. The largest precipitation event recorded at the Sterling Ranch climate station this project year occurred on July 4th, totaling 1.24 inches over ~1.25 hours. If this same storm occurred in Providence Village (Filing 1 ~417 acres/~65% impervious) the estimated precipitation harvested from this one event may have been as much as 25-30 acre-feet. This continues to demonstrate the potential of precipitation harvesting as a physical and legal supply.

Approximately 630 homes are now occupied by residents (primarily in Providence Village) and an estimated 800 homes are to be occupied by the end of the year. It is not anticipated that the development at Sterling Ranch will slow down anytime soon. The planning and integration of raw water supply, stormwater management, non-potable irrigation systems, and precipitation

harvesting continues to be an important focus of the past year. With the non-potable and drainage master plans for the entire site being complete, Dominion can now move forward with its plan to develop a precipitation harvesting master plan for evaluation of all precipitation harvesting opportunities throughout the site. This key document will allow targeted and regional precipitation harvesting to be developed holistically and cost-effectively using a phased approach. The precipitation harvesting master plan will provide the detailed information required for determining the physical and legal supply of each facility required for an SWSP and augmentation plan as well as key operational information.

Dominion is also excited about the existing and near-term precipitation harvesting opportunities on Sterling Ranch. Including Sterling Gulch Interim Pond, an existing 37.3 af facility located in Providence Village and two ponds currently being developed in Prospect Village. These facilities provide the first opportunity to harvest precipitation on a regional scale to meet community non-potable irrigation demands.

The 2019-2020 project year also marks the third year of metered water used data collection for over 600 homes at Sterling Ranch, and the first year that indoor and outdoor residential historical water use has been evaluated. A recent study of Sterling Ranch 2018 through 2019 water use completed by Element Water Consulting reports the current average residential outdoor water use for ranges between 0.086 afy/account to 0.141 afy/account. The outdoor water use trends will continue to be monitored providing a baseline of existing outdoor water use before precipitation harvesting.

Lastly, Dominion continues to work towards an augmentation plan and SWSP application. Utilizing much of the site-specific data compiled, methods, findings, and legal framework that resulted from the 2018 CWP grant and subsequent work completed by the state.

We appreciate the opportunity to continue the investigation of harvested precipitation as a viable water supply and look forward to continuing our work with the Colorado Water Conservation Board and Colorado Division of Water Resources. Thank you for your support.

Dominion Water and Sanitation District

Mary Kay Provaznik

By: Mary Kay Provaznik
General Manager

cc: DWSD Board of Directors
Encl: 2020 Sterling Ranch Precipitation Harvesting Pilot Study Annual Report

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RE: 2020 Sterling Ranch Precipitation Harvesting Pilot Study Annual Report

Dear Mr. Reidy and Ms. Kosloff,

This is the tenth annual report addressing the Sterling Ranch Precipitation Harvesting Pilot Study to be submitted by LRE Water (LRE) on behalf of Dominion Water and Sanitation District (Dominion).

Introduction

Dominion's participation in the Colorado Water Conservation Board's (CWCB) Rainwater Harvesting Pilot Project Program (Program) reflects their commitment to establishing sustainable, defensible, non-potable water supplies for Northwest Douglas County including the Sterling Ranch development. Dominion's participation is in coordination with the Sterling Ranch Community Authority Board and the developers of Sterling Ranch (Sterling Ranch). Sterling Ranch continues to work passionately towards a vision for the land that is in harmony with the area, the community, and the State, and that meets a significant need for housing and infrastructure in Douglas County, including developing a positive example of conservation and efficient resource management. The project continues to transition from planning and data collection to implementation of precipitation harvesting as a viable physical and legal supply. During the 2019-2020 project year, the primary focus has been on: 1) planning and evaluating opportunities to actively harvest precipitation onsite; 2) refining processes and evaluating data to support an SWSP and augmentation plan; 3) quantify current metered water use and water demands without precipitation harvesting.

Current Sterling Ranch Development Activity

The development of Sterling Ranch is continuing on the fast track. In the past year, construction of water and wastewater infrastructure for Sterling Ranch's second neighborhood (Accent Village) has continued into its second year, and construction has commenced in Sterling Ranch's third neighborhood (Prospect Village). Temporary and permanent stormwater facilities used to accommodate construction activity for Providence, Accent and Prospect Villages have also been completed or are under construction. Approximately 630 homes are now occupied by residents, with an estimated 800 homes to be occupied by the end of the year. The commercial office building known as the Sterling Center is complete with tenants occupying much of the office space. With development fully underway the focus of the next year will be the continued planning and implementation of precipitation harvesting systems for

commercial sites and regional stormwater facilities. This may include a draft application for a temporary Substitute Water Supply Plan (SWSP).

Summary of Pilot Project Progress

Generally, the Sterling Ranch Precipitation Harvesting Pilot Study (Pilot Project) has proceeded on schedule. The variances to the Pilot Project, including the proposed schedule, are described herein. The following tasks were accomplished during the 2019-2020 monitoring season:

- Climate and precipitation data were collected from the Sterling Ranch Climate Station;
- Dominion is planning to complete a Rainwater Master Plan evaluating the planning and evaluation of precipitation harvesting opportunities holistically for the entire development;
- Construction on the East and West stormwater ponds is currently under way in Prospect Village based upon the stormwater design standards defined by Dominion in 2017;
- Sterling Ranch has completed an initial review of indoor and outdoor residential metered water use (2018-2019) to be used as a baseline for determining current average water use without precipitation harvesting;
- Continue to work towards processes and requirements to support an SWSP and augmentation plan

CWCB Program and Reporting Requirements

On March 1, 2010, Sterling Ranch provided the "Sterling Ranch Precipitation Harvesting Pilot Study Application" (Application) based on the criteria and guidelines outlined by the CWCB that were established under House Bill 09-1129. The aim of the Program is to use natural conditions data to evaluate precipitation harvesting in Colorado as a legally obtainable water supply and as a water conservation enhancement when paired with advanced outdoor water demand management.

The Application described Dominion's conceptual planning policies and requirements, including Sterling Ranch's current water conservation plan and the Pilot Project strategies to be implemented that assist in the overall precipitation harvesting design.

The Pilot Project is split into three phases; 1) Natural Conditions, 2) Experimental Precipitation Harvest Designs, and 3) New Precipitation Harvest Designs.

Annual Reporting Requirements

One of the requirements of the Program is to submit an annual progress report (Annual Report) by July 1st of every year that the Pilot Project is in operation. In accordance with Section 37-60-115(6)(a), C.R.S., the Report summarizes each component of the Pilot Project and indicates how the data and findings address Program goals. The CWCB Annual Report Requirements serve as an outline for this report and are included in Attachment A. The information required includes:

1. A description of variances from the Application including information on any data quality issues that may magnify if results are extrapolated to a larger scale project.
2. Precipitation harvesting performance metrics.

3. Pilot Project **implementation plan and estimated water conservation** achieved through pairing precipitation harvesting with advanced outdoor water management.
4. A **description of the climate and hydrologic data collected** to characterize the pre-existing, natural vegetation conditions.

Sterling Ranch Precipitation Harvesting Pilot Project – Progress and Variances

Four objectives were established in the Application that were designed to meet the guidelines and criteria provided by CWCB. They are:

1. Evaluate natural conditions (climate, hydrology, and ET) to quantify the amount of precipitation physically and legally available as a water supply;
2. Evaluate a variety of precipitation collection designs;
3. Evaluate precipitation harvesting paired with advanced outdoor water demand management as a water conservation practice; and
4. Create a baseline set of data to support:
    a) An engineering report in support of a water court application for an augmentation plan to use harvested precipitation, and define a defensible water supply.
    b) Develop sound, transferable, and scalable methodologies for use at other locations in the State of Colorado.

Phase 1 of the Pilot Project began with the installation of the measuring devices in 2010 and have been collecting natural conditions data ever since. Now with Sterling Ranch development under way, Dominion is focused on the final planning and implementation of Phase 2 and 3 of the Pilot Project and the development of a regional precipitation harvesting system. These efforts are further discussed in the sections below.

Phase 1: Natural Conditions

The Sterling Gulch watershed is the study basin selected to evaluate natural conditions at Sterling Ranch. A comprehensive monitoring plan has been implemented in Sterling Gulch to collect climate, precipitation, surface runoff, native ET, deep percolation, and ground water data providing the foundation for defining physical yield characteristics and return flow obligations under natural conditions.

Figure 1 shows the location of the Sterling Gulch watershed and the location of the implemented monitoring stations within the Sterling Ranch boundary to date. Sterling Gulch is being used to quantify the site-specific amount of precipitation that, under pre-existing natural vegetation conditions, accrues to the natural stream system via surface and ground water return flows. The sections below summarize the progress, variation, and data collected to date for each of the monitoring programs designed to characterize the natural hydrology at the site.

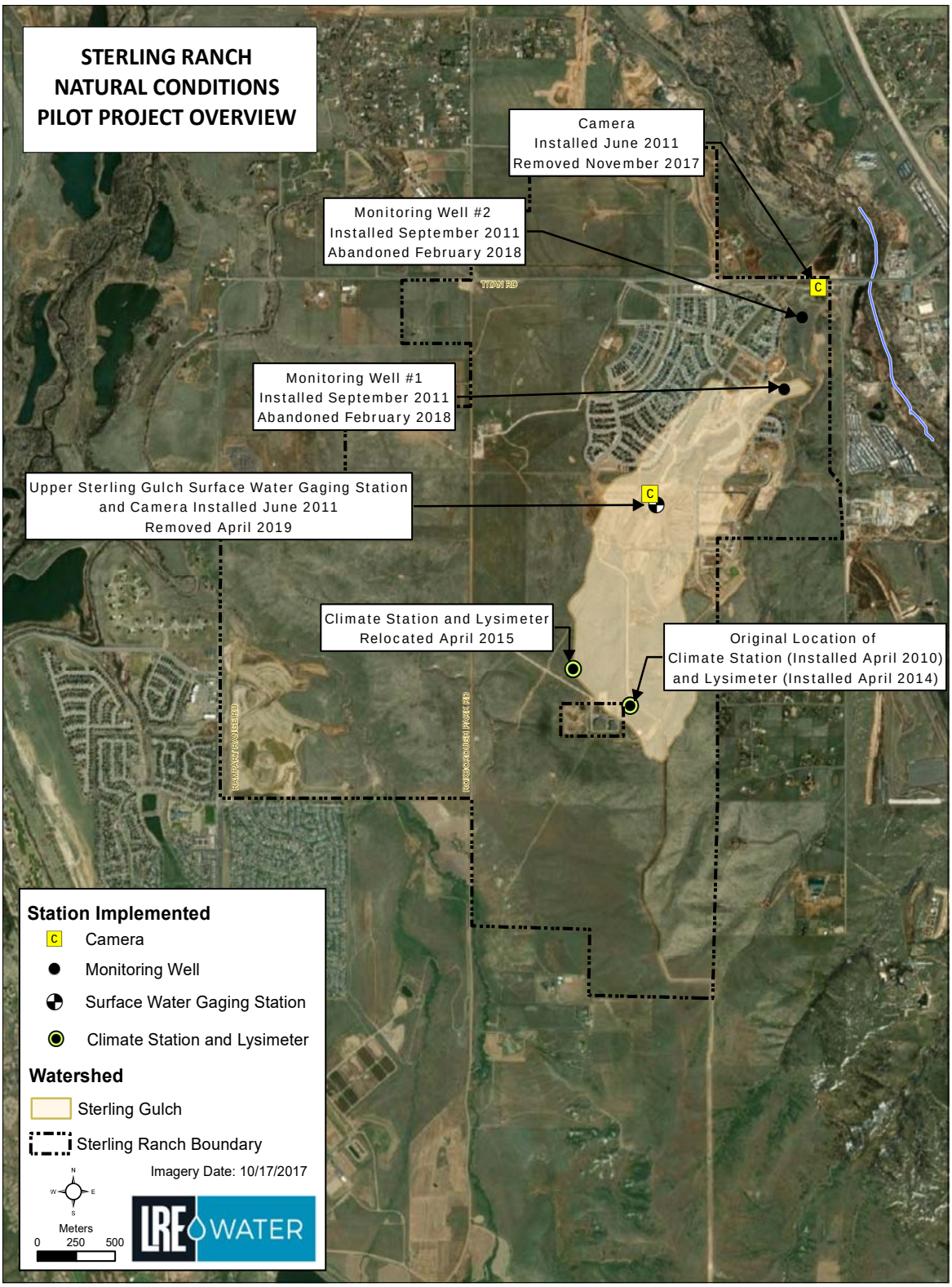


Figure 1 – Sterling Ranch Natural Conditions Monitoring Program

Climate Monitoring Program

2019-2020 Variance from Application: None

The Sterling Ranch Climate Station was installed on March 29, 2010 and moved to new location in April 2015 to avoid construction activity in the area (see Figure 1 & Figure 2). The station continues to collect data that is used to characterize local weather patterns, and will be used for the future estimates of native ET. The data collected at the Sterling Ranch site includes net solar radiation, air temperature, wind velocity and direction, relative humidity, and barometric pressure, and soil temperature at varying depths. Most parameters are recorded in 15-minute intervals, transmitted to the Sterling Ranch website, and archived in a centralized database. Table 1 is a monthly summary of the data collected to date from the Sterling Ranch Climate Station. The original soil temperature sensors at the climate station have been discontinued. All sensors were operational during the 2019-2020 season and data is found to be consistent, with no major outliers that would cause measurement or averaging errors.

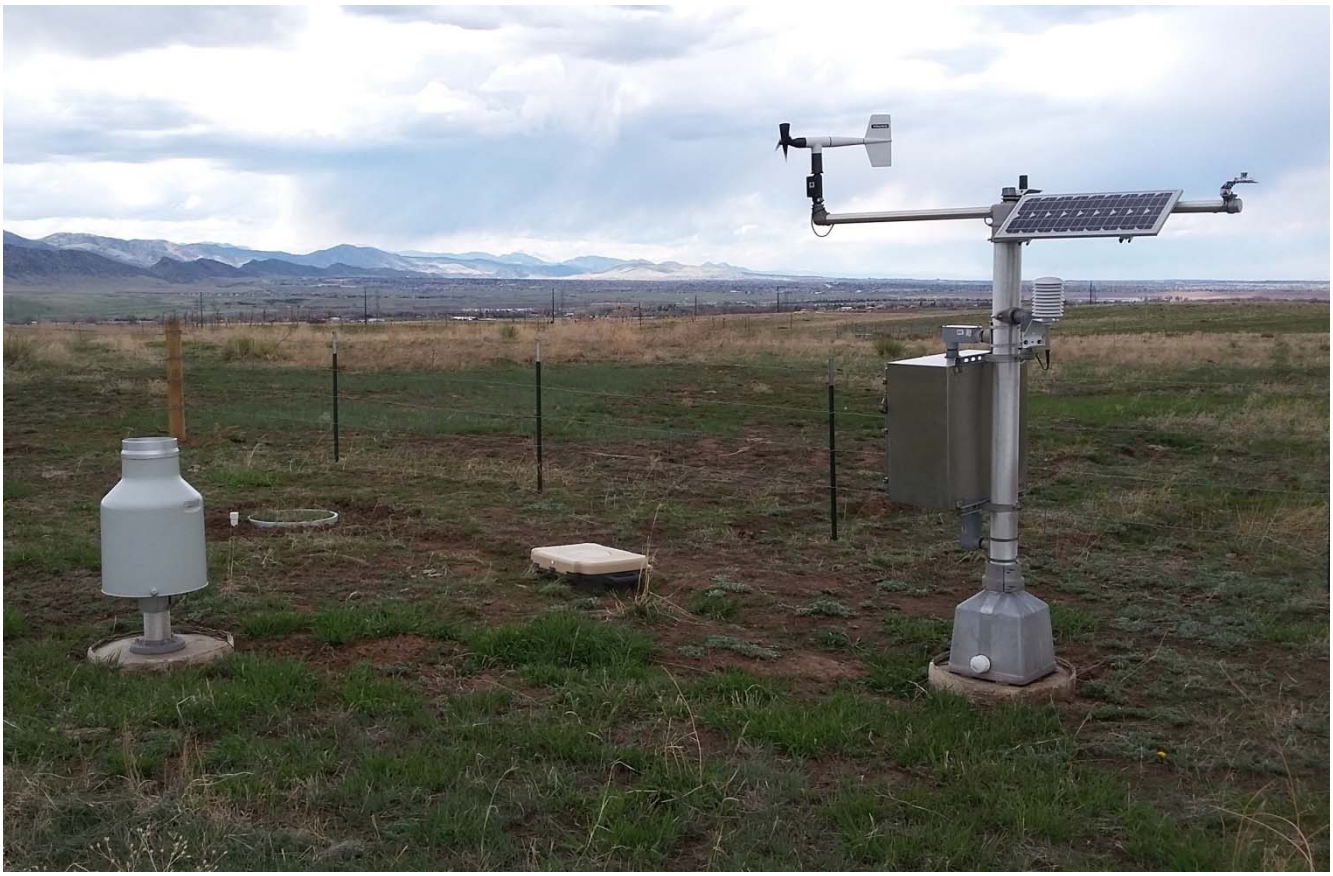


Figure 2 – Sterling Ranch Climate Station (April 2016)

Table 1 – Sterling Ranch Climate Station Monthly Summary

Year	2019							2020				
Month	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Temperature (F)												
Average Temperature	65.3	74.4	73.9	68.6	44.4	38.5	35.3	35.7	29.7	42.7	46.6	59.5
Max Temperature	94.8	97.9	95.4	96.1	81.6	75.9	65.7	59.8	70.5	69.1	81.9	89.2
Min Temperature	43.1	53.4	53.9	42.6	4.7	5.0	9.4	10.8	1.1	17.5	11.5	34.3
Temp Range	51.7	44.5	41.5	53.5	76.9	70.9	56.3	49.0	69.4	51.6	70.4	54.9
Wind (mph)												
Average Velocity	6.2	6.8	6.0	6.8	6.1	6.2	7.3	6.5	6.9	6.9	6.6	6.8
Max Velocity	43.9	30.6	26.5	39.0	30.4	37.7	28.8	40.8	39.6	31.1	30.8	35.7
Solar Radiation (MJ/m²/h)												
Average Radiation	0.97	1.00	0.88	0.79	0.59	0.41	0.36	0.40	0.52	0.75	0.88	1.02
Max Radiation	4.41	4.05	3.81	3.67	2.96	2.75	2.36	2.41	3.01	3.72	4.16	4.44
Barometric Pressure (mbar)												
Average BP	823.60	825.80	825.21	823.02	822.09	821.63	820.38	820.47	820.88	819.91	820.44	822.61
Max BP	835.78	833.26	831.18	831.79	833.55	835.40	828.93	834.02	835.28	832.33	831.60	833.17
Min BP	814.01	817.58	817.94	810.61	806.88	801.85	808.54	806.03	806.82	809.42	807.58	811.74
Humidity (%)												
Average Humidity	46.5	41.8	41.0	37.4	46.5	54.4	46.0	41.1	57.4	52.9	48.2	47.3
Max Humidity	96.0	93.7	96.6	95.5	99.4	99.4	99.4	98.5	99.4	99.5	99.4	99.4
Min Humidity	8.5	8.1	5.8	6.2	2.9	5.8	4.8	9.1	4.7	7.6	6.1	4.1

Precipitation Monitoring Program

2019-2020 Variance from Application: None

An OTT Pluvio² weighing precipitation gage was installed on the climate station site and began collecting data on March 29, 2010 (see Figure 3). The precipitation gage is located at the Sterling Ranch Climate Station and reports data in 15-minute intervals. The data collected at the site includes total accumulation and maximum rainfall intensity. The physical measurement of precipitation is important in characterizing the native water supply, native water demand, and other hydrologic processes. Table 2 is a summary of the data collected from the Sterling Ranch precipitation station. During the 2019-2020 monitoring season the rain gage measured a total 16.30 inches of precipitation and max intensity rate of 15.13 in/hr, which occurred on October 24, 2019 caused by an accumulation of snow.

Figure 3 – OTT Pluvio²

Table 2 – Sterling Ranch Precipitation Station Summary

Year	2019							2020				
Month	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May
Precipitation (in)												
Monthly Total (in)	1.37	2.99	1.29	1.12	1.38	1.21	0.71	0.22	1.63	2.14	0.86	1.38
Max Intensity (in/hr)	1.07	10.86	5.2	2.45	15.13	0.36	0.26	0.32	0.39	6.38	0.42	0.77

Surface Water Monitoring Program

2019-2020 Variance from Application: None – Inactive

The Upper Sterling Gulch flume was removed in April 2019 to accommodate the regrading and drainage improvements required for new development. With over seven years of natural condition data collected by the surface water monitoring program and no active sensors currently onsite the surface water monitoring program was discontinued. Historical surface water data collected (6/23/2011 to 5/31/2018) has been compiled and will be reported as a part of the Colorado Water Plan Grant project. There was no surface water monitoring data collection for the 2019-2020 project year.

Native Vegetation (ET) Monitoring Program

2019-2020 Variance from Application: None – Inactive

The design and construction of a single weighing lysimeter began in January 2014. A representative single intact soil core was collected on April 8, 2014 in an area of Providence Village where future precipitation harvesting is planned. The lysimeter was completed and began transmitting data on April 11, 2014. The lysimeter is 24 inches in diameter, 42 inches tall and is equipped with three 500 lb load cells, 4 soil moisture sensors, and a tensiometer controlled vacuum

system and tipping bucket. The lysimeter was constructed next to the climate station to take advantage of the existing sensors and telemetry infrastructure at the site. In April 2015 the lysimeter was moved along with the climate station to a new location. At that time the lysimeter load cells were recalibrated and the soil moisture sensors and vacuum system were tested.

The data collected at the lysimeter is being used to address two important aspects of the pilot study; the actual native vegetation ET and the amount of precipitation that percolates through the soil root zone to the ground water table known as ground water recharge or deep percolation. The lysimeter also provides some insight into site-specific soil moisture storage and surface runoff.

Historical lysimeter data collected (04/12/2014 to 5/31/2018) has been compiled and will be reported as a part of the Colorado Water Plan Grant project. The lysimeter was not operational during the 2019-2020 project year and no data was collected.

Groundwater Monitoring Program

2019-2020 Variance from Application: None – Inactive

As a result of drainage improvements and grading occurring in this area of Sterling Gulch the groundwater monitoring wells were required to be abandoned. On February 21, 2018 both MW-1 and MW-2 were abandoned and plugged based on Colorado Division of Water Resources protocols. Historically, the monitoring wells were operational within Sterling Gulch between September 2011 and February 2018 (see Figure 1).

Monitoring Program Maintenance Plan

Since March 2010, OneRain has been the contractor assisting in the monitoring and maintenance of the Sterling Ranch climate station. The design of the monitoring plan is modular, and the maintenance requirement of each monitoring program element is different. Once installed, routine physical inspections of all instrumentation have been conducted. Real-time sensors were remotely monitored to verify that they are operating correctly. The data-logging sensors were checked and maintained every time that the data was retrieved. During the 2019-2020 project year, all sensors were found to be operational and reporting accurately.

Beginning in July 2011, LRE Water has been responsible for the data collection and maintenance of the Upper Sterling Gulch flume, trail cameras, and monitoring wells. During the 2019-2020 project year, no site visits were made and no data were collected.

Natural Consumptive Use, Return Flows to the River, Water Budgets, and Models

As a result of the Colorado Water Plan (CWP) grant funding, significant progress has been made in the development of water budgets and supporting models used to quantify the natural surface and groundwater return flows, and consumptive use. Below is a list of hydrologic models incorporated into the process:

- Site-Specific Water Balance (Hydrus 1-D)
- Soil Moisture Reservoir Accounting Model (Excel)
- Continuous Runoff Simulation Model (WQ-COSM)
- Alluvial Water Accounting System (AWAS)

These models and methods are the basis for the development of both site specific factors representative of Sterling Ranch and the Dominion service area as well as regional factors benefiting the community. Use of the water budget models and methods listed above are described more thoroughly in the CWP grant task memorandums and final report.

Phase 2: Experimental Precipitation Harvesting Designs

Experimental precipitation harvesting designs is an ongoing planning and implementation effort that evaluates the feasibility of residential, commercial, and regional harvesting designs at the development. Dominion and Sterling Ranch continue to evaluate and collect information about different types of precipitation harvesting designs, equipment, and materials. The information collected under this phase of the project will be applied to new designs.

The best example of the experimental precipitation harvesting occurring on the site is the precipitation harvesting park shelter (see Figure 4) competed in July 2018 as a part of the new Sterling Center located in the northwest corner of Providence Village near Titan road. Rainwater is used directly to irrigate the immediate landscape and serves as a demonstration of rainwater harvesting and Sterling Ranch's commitment to sustainable water resources. An initial

Figure 4 – Precipitation Harvesting Park Shelter

investigation has been completed to retrofit the structure with water level sensors for collecting data at the site, but was not implemented during the 2019-2020 project year. Information gathered from the shelter may include total precipitation harvested and capture efficiencies for different storm types. Currently, this is the only structure of its kind planned for the site.

With development under way there have been no new experimental precipitation harvesting information collected or designs evaluated during the 2019-2020 project year.

Phase 3: New Precipitation Harvesting Designs

Targeted and regional precipitation harvesting opportunities continue to be the focus as the most cost-effective solutions. Figure 5 is a map of the Sterling Ranch planned community and villages. At this time the primary opportunities where new precipitation harvesting designs are being evaluated are located in Providence and Prospect Villages. The planning and integration of raw water supply, stormwater management, non-potable irrigation systems, and precipitation harvesting has been an important focus of the past year and has resulted in a non-potable and stormwater master plans for the entire site. These masterplan's provide the information required to evaluate precipitation harvesting on a regional scale.

Providence Village

The first opportunity to evaluate new precipitation harvesting designs on a regional scale is Providence Village. Providence Village, located in the northeast corner of the development adjacent to Titan Road and Sterling Gulch, is the location where the most significant development has taken place. Construction in Providence Village was nearly 70% builtout during the 2019-2020 project year with over 550 homes and 6 acres of parks/open space completed. As well as major utility and transportation corridors and infrastructure, and multiple stormwater facilities used to collect and regulate precipitation events. Providence Village is the first location where regional collection to centralized storage will be utilized to monitor and harvest precipitation for non-potable use.

The primary location being evaluated for precipitation harvesting is the Sterling Gulch Interim Pond. This facility is a regional stormwater facility has a capacity of 37.3 AF (100-yr detention volume) and located on the main channel of Sterling Gulch. The final design and construction for this facility was completed during the 2018-2019 project year. A plan view (grading plan) detailing the facility completed by Matrix Design Group is included as Attachment B. To actively use the facility for precipitation harvesting the facility would need to be partially lined and potentially deepened to regulate stormwater flows. The major consideration being evaluated during the 2019-2020 project year is how to operate the facility to optimize yield but maintain stormwater capacities. The system could be operated by gravity or by pump to 1) meet demands directly; 2) move to terminal storage; or 3) store for later use. With many of the irrigation uses online or coming on-line the facility is being evaluated to determine the operational strategies, infrastructure requirements, and costs for retrofitting the facility. Also, due to its capacity and location the Sterling Gulch Interim Pond is a key regional facility required for the storage and distribution of collected precipitation regionally.

Prospect Village

The second opportunity to evaluate new precipitation harvesting designs on a regional scale is Prospect Village. Prospect Village is located in the southwest corner of the development adjacent to Rampart Range Road and Willow Creek and is the next location where development is planned to take place.

Prospect Village is currently in the planning phase with the development of the site to begin over the next year. Two stormwater facilities (East and West Ponds) adjacent to Willow Creek have been identified as potential precipitation harvesting locations. The preliminary drainage plan submitted to the County showing the location of these facilities is included in Attachment B. The design considerations included in the preliminary drainage plan are based upon the stormwater standards defined by Dominion in 2017, which include: sizing of facilities and pumps, monitoring requirements, connections to the non-potable system, and easement/access for maintenance of these facilities. Currently the East and West Ponds are being constructed to Dominions design standards including easements, infrastructure requirements, and the addition of a non-potable distribution pipeline with connections near both facilities. Over the next year Dominion will be working with stormwater engineers to evaluate these stormwater facilities, connection to the non-potable system, and their potential operation to meet non-potable irrigation demands of the park located in Prospect Village.

Sterling Ranch Master Drainage and Non-potable Plans

To support the holistic planning required for the Sterling Ranch development. There were two key documents completed during the 2019-2020 project year: 1) Sterling Ranch Master Drainage Plan (Matrix Design Group) and; 2) Sterling Ranch Non-potable Master Plan (Black & Veatch). Over the next year Dominion will be working with stormwater engineers, Sterling Ranch CAB, and planners to evaluate the potential yield and operation of each planned stormwater facilities onsite to meet non-potable irrigation demands. As well as the best way to integrate these supplies into Dominion's system. Dominion will rely on the stormwater standards developed in 2017 to determine which facilities provide the most benefit. With these documents Dominion can develop its Rainwater Capture Master Plan for Sterling Ranch. Allowing future phases of development the design standards and information required to build a robust regional rainwater harvesting system.

Although several opportunities have been identified there is no data to report on New Precipitation Harvesting Designs for the 2019-2020 project year.

Figure 5 – Sterling Ranch Village Map

LRE WATER

Overall Pilot Project Schedule

With construction and home building under way the pilot program is on schedule and continues to progress. Below is a summary of the variances from the original application:

2019-2020 Variance from Application:

- Climate and precipitation monitoring site was installed in March of 2010 and is collecting data. *On Schedule*
- The lysimeter was installed in April 2014 and ET and deep percolation monitoring has begun. *Delay = approx. 3 years (Same as last year) - Inactive program (07/2019)*
- The first surface water monitoring site was installed in June 2011 and is collecting data. *Ahead of schedule = 6 months (Same as last year) – Inactive program (04/2019)*
- Ground water monitoring started in September 2011. *Ahead of schedule = 1 year (same as last year) – Inactive program (02/2018)*
- All planning and implementation of Experimental Harvesting Designs continues to progress as the project progresses. *(Same as last year)*
    - Residential Experimental Site - *Delay = approx. 6.0 years*
    - Commercial Experimental Monitoring Site - *Delay = approx. 6.0 years*
    - Regional Observation Site - *Delay = approx. 6.0 years*
- All New Precipitation Harvesting Designs are planned to begin within the next year. *(Same as last year)*
    - Residential System - Delay = approx. 5 years
    - Commercial System – Delay = approx. 4.5 years
    - Regional System – Delay = approx. 4 years
- We are in our fourth year developing a plan for administering precipitation harvesting, which continues to evolve to incorporate the new information from the Regional Factors CWP grant and updated Precipitation Harvesting Criteria and Guidelines into the plan. Datasets and models supporting an SWSP and augmentation plan have been completed with an application planned to be submitted within the next year - *Delay = approx. 5.5 years (Same as last year)*

Figure 6 below shows the proposed timeline with the adjustments made due to the extended schedule as described above.

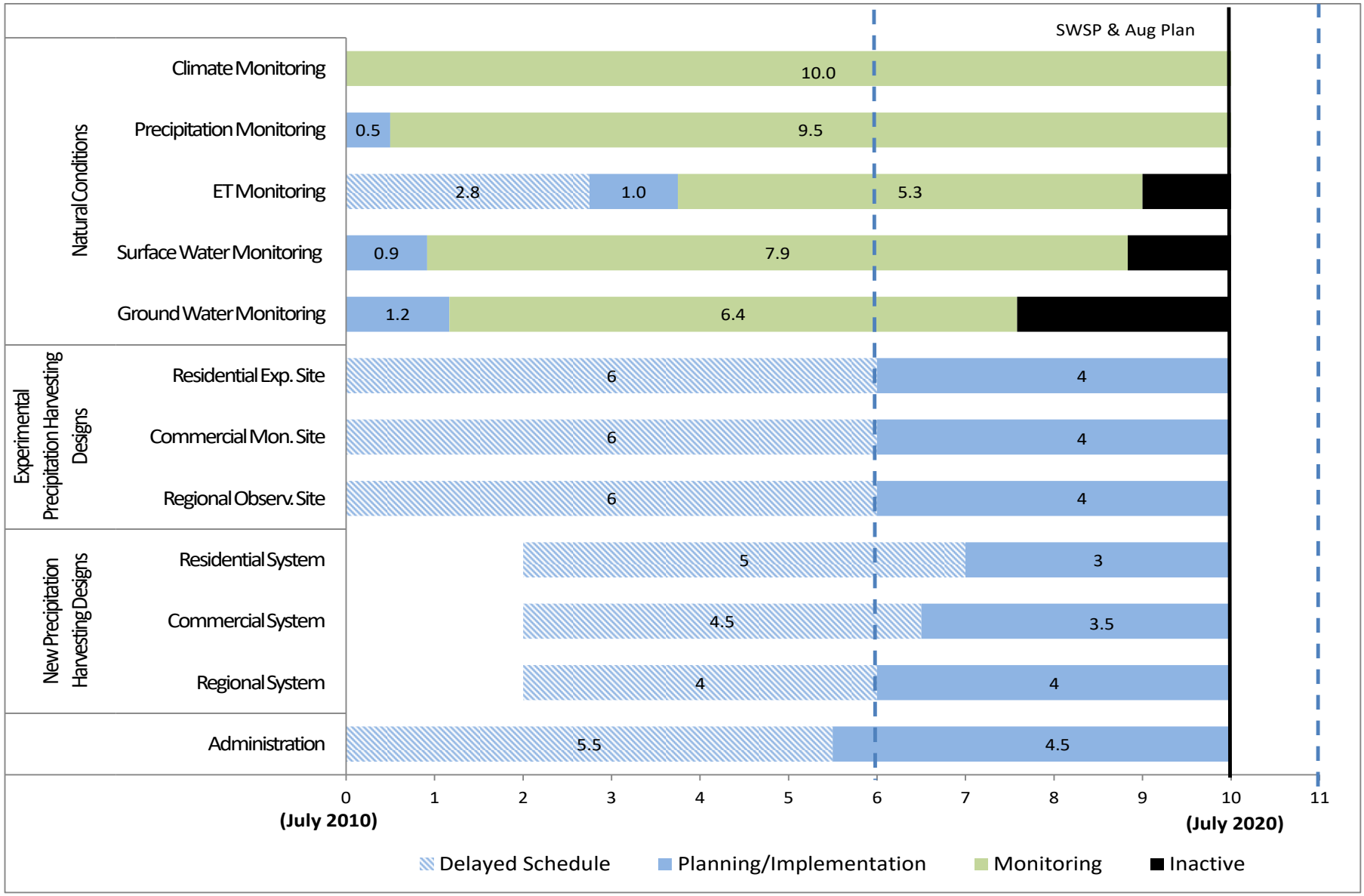


Figure 6 – Pilot Project Schedule

Augmentation Requirements

Currently, there is no precipitation harvesting on Sterling Ranch requiring augmentation at this time. Over the next year, Dominion will be working toward an augmentation plan and SWSP application utilizing the legal framework, methods, and data sets resulting from the CWP grant.

Implementation

As described in the New Precipitation Harvesting Designs section above, several precipitation harvesting opportunities have been identified. However, data is not yet available for describing operation and maintenance of regional or targeted precipitation harvesting facilities.

Estimated Water Savings, Landscape Plans, Metered Water Use, Consumptive Use and Estimated Water Conservation, and Estimated Unit Cost for Rainwater

Daily indoor and outdoor metered water use continues to be collected for over 630 homes, the 2019-2020 project year was the third year in which metered water use data was collected at Sterling Ranch. Each home is equipped with a dual-water metering system that provides real-time data on how much water is used at individual lots for outdoor use, and how much is used for indoor use. The 2019-2020 project year marks the first year that indoor and outdoor residential historical water use has been evaluated. A recent study of Sterling Ranch 2018 through 2019 water use completed by Element Water Consulting reports the current average residential outdoor water use for 2018 (68 accounts) ranges between 0.106 afy/account (with trees) to 0.141 afy/account (without trees) and 2019 (362 accounts) ranges between 0.086 afy/account (with trees) to 0.096 afy/account (without trees). The current residential outdoor water budgets are based upon lot sizes (0.05 afy/account to 0.08 afy/account). The water use is currently higher than budgeted for most accounts, which is expected as the majority of landscapes are still being established. Providence Village has also some of the largest lots in the development. It is anticipated that the average outdoor water use will decrease with smaller lot sizes in the future. Non-residential outdoor water use data is being collected but was not compiled for this report. Outdoor water use trends will continue to be monitored providing a baseline of existing outdoor water use before precipitation harvesting. The baseline outdoor water trends will be used to monitor and quantify water conservation practices and unit water/costs savings with precipitation harvesting.

Annual Costs

Below is a summary of the annual costs associated with the Pilot Project for the 2019-2020 project year including: climate monitoring, natural conditions monitoring/maintenance, data management an analysis/reporting, rainwater SWSP and water court application, and rainwater implementation.

- Climate Station Monitoring – $3,516
- Natural Conditions Monitoring and Maintenance – $2,320
- Data Management/Analysis/Reporting – $10,321
- Rainwater SWSP and Water Court Application - $1,570
- Rainwater Implementation - $2,200

Partnerships and the Sharing of Information

Sterling Ranch and Dominion continue to look for opportunities to engage the water community and to educate them about the Sterling Ranch Pilot Program as well as the importance of pairing precipitation harvesting with water conservation practices. However, during the 2019-2020 project year, public outreach was minimal and there is nothing new to report.

Closing

This letter report describes the tenth year of the Sterling Ranch Precipitation Harvesting Pilot Study. If you have any questions, please feel free to call at 303-455-9589.

Sincerely,

LRE Water

Mark Mitisek, P.H.
Project Manager

Greg Roush, P.E.
Senior Project Manager

Sterling Ranch, Attachment A - CWCB Requirements for Annual Report

1. A description of variances from the Pilot Project application including information on any data quality issues that may magnify if results are extrapolated to a larger scale project.

2. Precipitation harvesting performance metrics, including:
    a) Description of final collection system design with plans and specifications of all system components.
    b) Operation and maintenance plans and any issues encountered.
    c) Meter data of water flowing into the precipitation collection device and estimated capture efficiency.

3. Pilot project implementation plan and estimated water conservation achieved through pairing precipitation harvesting with advanced outdoor water management, including:
    a) A description of the applied method used to capture precipitation and any potable water supply with plans and specifications for all system components including any technology utilized (system programmers, ET controllers, etc.).
    b) Landscaping plans including measured irrigated acres, plan descriptions, theoretical irrigation water requirement methods, results, and water budgets reflecting application efficiencies.
    c) Metered water use from precipitation collection system. Water use will be categorized by use if application varies.
    d) Metered water use from other potable water supplies if the precipitation collection is supplemented. Water use will be categorized by use if application varies.
    e) Comparison of actual consumptive use by category of use to estimated water budgets. Estimate amount of water conserved as a result of the precipitation harvesting.
    f) A landscape maintenance assessment of quality of the landscapes, maintenance issues encountered, and any necessary replacement of plantings. The results of the irrigation system audit and corresponding actions.
    g) Cost to date including design, infrastructure, operations, and maintenance costs. Estimated costs to implement precipitation harvesting system per acre-foot of water saved; and comparison of original projected and actual costs from implementing the precipitation harvesting systems. The cost comparison will include institutional, legal, technical/design, infrastructure, and augmentation water supplies.

4. A description of the climate and hydrologic data collected to characterize the preexisting, natural vegetation conditions including:
    a) A description of the methodology and analysis results toward providing information about the technical ability to reasonably quantify the site-specific amount of precipitation that, under preexisting natural conditions, accrues to the natural stream system via surface and ground water return flows.
    b) A description of the baseline set of data and sound, transferrable methodologies used for measuring local weather and precipitation patterns that account for variations in hydrology and precipitation event intensity, frequency, and duration.
    c) Descriptions of the methodology and analysis results quantifying preexisting natural vegetation consumption; measuring precipitation return flow amounts; identifying surface versus ground water return flow splits; and identifying delayed ground water return flow timing to receiving streams.

d) Quantification of the amount of precipitation that must be augmented to prevent injury to decreed water rights.
e) Description of the location and methods used to collect climate data measurements, with a summary of data including, at a minimum, temperature and precipitation

Attachment B – Stormwater Planning Documents

811 Know what's below. Call before you dig.

STERLING GULCH INTERIM POND		
STAGE-STORAGE-DISCHARGE		
STAGE	STORAGE	DISCHARGE
ELEV (FT.)	*AC-FT*	*CFS*
5573.5	0.00	0.00
5574.0	0.04	0.47
5575.0	0.18	0.82
5576.0	0.77	1.59
5577.0	2.68	2.17
5578.0	6.67	3.14
5579.0	12.66	3.90
5580.0	20.03	159.73
5581.0	28.04	379.91
5582.0	36.31	421.88
5582.5	40.53	439.52

STERLING RANCH INTERIM POND
100-YEAR DETENTION VOLUME = 37.30 AC-FT
100-YEAR WATER SURFACE ELEVATION = 5582.12
100-YEAR RELEASE RATE = 434 CFS
EURV VOLUME = 11.90 AC-FT
EURV WATER SURFACE ELEVATION = 5579.84

BLUE RIVER AVE.
PINEY RIVER AVE.
STERLING RANCH FILING NO. 1
EAGLE RIVER ST.
STERLING GULCH
FUTURE STERLING RANCH FILING NO. 2
STERLING GULCH INTERIM POND

PROP. MAINTENANCE TRAIL MAX SLOPE 10:1 SEE SHEET TR01 AND DT02
PROP. REGIONAL TRAIL SEE SHEETS TR02 AND DT02
EX. FIS FLOODWAY
18" THICK TYPE L RIPRAP
PROP. 3X 54" RCP
PROP. SPILLWAY SEE SHEET DT14
PROP. OUTLET STRUCTURE SEE SHEETS DT10-DT13
PROP. MAINTENANCE TRAIL
PROP. MICROPOOL SEE SHEET DT14
PROP. TRICKLE CHANNEL SEE SHEET DT14
GRADE BOTTOM OF POND TO 4% WITHIN 25-FT OF THE TRICKLE CHANNEL
PROP. DROP STRUCTURE SEE SHEET DPDT02
100 YEAR WSE = 5582.12
EURV WSE = 5579.84
REMOVE EXIST. STORM OUTLET STRUCTURE AND PIPE.
EXISTING TRICKLE CHANNEL TO BE REMOVED
EXISTING MAINTENANCE TRAIL TO BE REMOVED
EXISTING RIPRAP TO BE ABANDONED
EXISTING FOREBAY AND RIP-RAP TO BE REMOVED
PROP. STORM SEE SHEET SD01
EX. FIS FLOODWAY BOUNDARY
TRACT J

N. 1608203.34 E. 3132446.14
N. 1608097.35 E. 3132602.73
N. 1608058.39 E. 3132291.53
N. 1608032.97 E. 3132683.28
N. 1607983.98 E. 3132740.04
N. 1607916.35 E. 3132928.04
N. 1607865.85 E. 3132953.62
N. 1607866.22 E. 3132306.37
N. 1607761.21 E. 3132239.53
N. 1607736.37 E. 3132253.80
N. 1607724.29 E. 3132314.35
N. 1607675.94 E. 3132345.37
N. 1607557.49 E. 3132758.71
N. 1607499.54 E. 3132420.89
N. 1607463.07 E. 3132629.99

MATCHLINE SEE SHEET GR03
MATCHLINE SEE SHEET GR02

KEY MAP
SCALE: 1" = 2000'

N

60 0 60 120
SCALE IN FEET
ORIGINAL SCALE

ASSISTANT DIRECTOR OF DEVELOPMENT REVIEW

DATE

THESE CONSTRUCTION PLANS HAVE BEEN REVIEWED BY DOUGLAS COUNTY FOR DRAINAGE IMPROVEMENTS ONLY.

ENGINEERING DIVISION ACCEPTANCE BLOCK

Matrix DESIGN GROUP
1601 BLAKE ST, SUITE 200
DENVER, CO 80202
PH: 303-572-0200
www.MATRIXDESIGNGROUP.COM

STERLING RANCH
COLORADO

STERLING RANCH COMMUNITY AUTHORITY BOARD
8390 E. CRESCENT PKWY, #500
GREENWOOD VILLAGE, CO 80111
PH: 303-779-5710

COLORADO REGISTERED 48153 PROFESSIONAL ENGINEER

DRAWN	FRD
DESIGNED	FRD
REVIEWED	PC
PROJECT NO.	14.718.001
HORZ. SCALE	1"=60'
VERT. SCALE	NA
SUBMITTAL DATE	SEPT 2017

NOTES

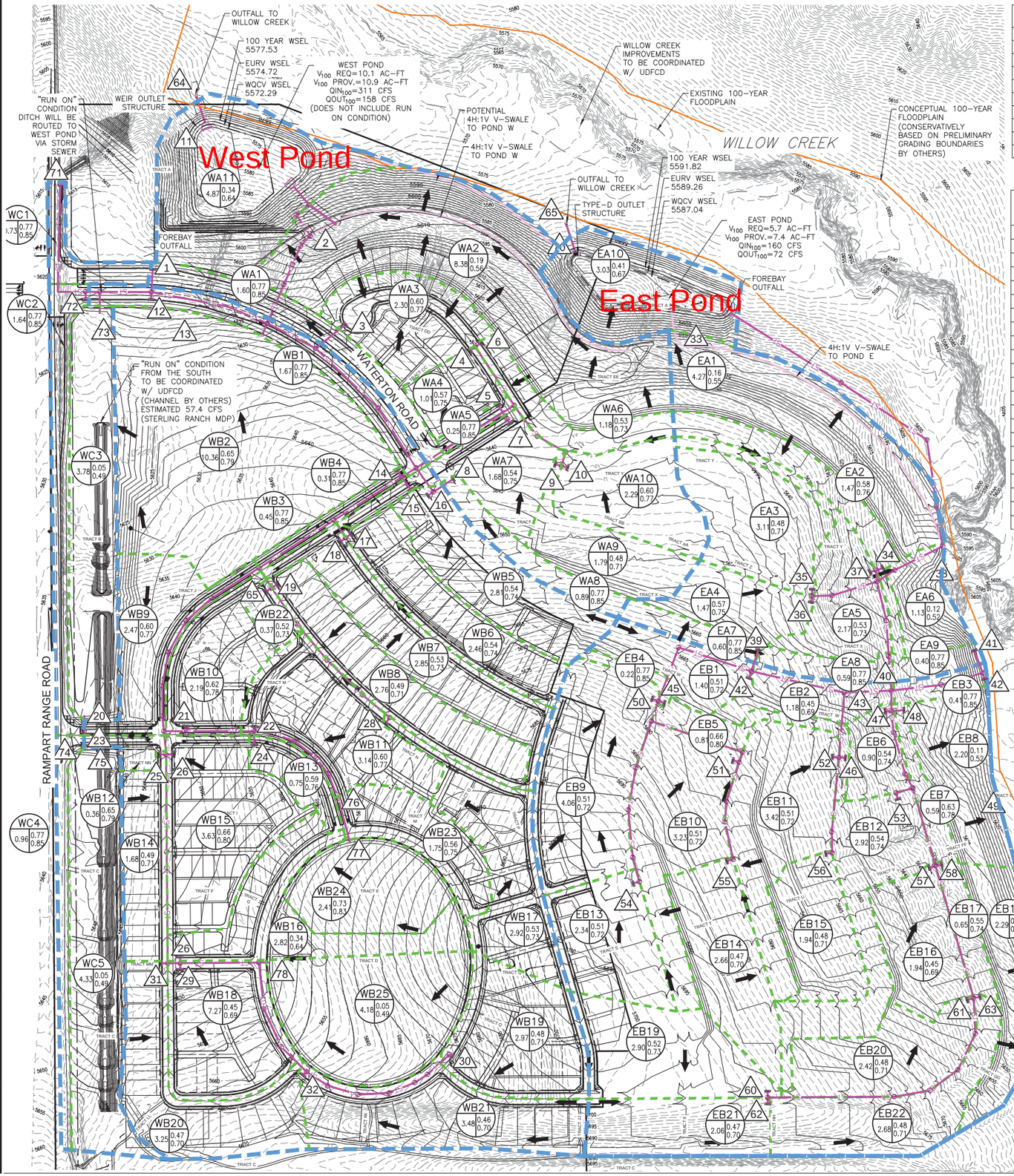
NO.	DATE
1	09/21/16
2	01/17/17
3	05/19/17
4	06/30/17
5	09/11/17

FIRST SUBMITTAL
SECOND SUBMITTAL
THIRD SUBMITTAL
FOURTH SUBMITTAL
FIFTH SUBMITTAL

STERLING RANCH
STERLING GULCH - INTERIM POND
GRADING
INTERIM POND

SHEET
GR01
SHEET 11 OF 89

FILENAME: R:\14.718.001 (Sterling Ranch)\Dwg\Construction Plans\Sterling Gulch Interim Pond\C-11-GR01.dwg PLOT DATE: 9/11/2017 4:42 PM



EA BASINS

BASIN	DESIGN POINT	AREA (ACRES)	% IMP.	C5	C100	Q5 (CFS)	Q100 (CFS)
EA1	33	4.3	16%	0.16	0.55	3.1	18.6
EA2	34	1.5	67%	0.58	0.76	3.0	7.0
EA3	35	2.7	55%	0.48	0.71	5.1	13.7
EA4	36	1.5	66%	0.57	0.75	3.2	7.5
EA5	37	2.2	60%	0.53	0.73	3.8	9.6
EA6	38	1.1	10%	0.12	0.52	0.6	4.6
EA7	39	0.6	90%	0.77	0.85	2.1	4.2
EA8	40	0.6	90%	0.77	0.85	2.2	4.4
EA9	41	0.4	90%	0.77	0.85	1.5	3.0
EA10	70	3.0	41%	0.37	0.65	3.6	11.5

EB BASINS

BASIN	DESIGN POINT	AREA (ACRES)	% IMP.	C5	C100	Q5 (CFS)	Q100 (CFS)
EB1	42	1.4	59%	0.51	0.72	3.3	8.6
EB2	43	1.2	51%	0.45	0.69	2.2	6.1
EB3	44	0.4	90%	0.77	0.85	1.5	3.1
EB4	45	0.2	90%	0.77	0.85	0.8	1.7
EB5	46	0.8	77%	0.66	0.80	2.4	5.3
EB6	47	0.9	62%	0.54	0.74	1.7	4.3
EB7	48	0.6	73%	0.63	0.78	1.8	4.1
EB8	49	2.2	9%	0.11	0.52	0.8	6.9
EB9	50	4.1	58%	0.51	0.72	6.9	17.8
EB10	51	3.2	59%	0.51	0.72	6.0	15.4
EB11	52	3.4	58%	0.51	0.72	6.2	16.1
EB12	53	2.9	61%	0.54	0.74	5.7	14.3
EB13	54	2.3	58%	0.51	0.72	4.9	12.8
EB14	55	2.7	53%	0.47	0.70	4.2	11.4
EB15	56	1.9	55%	0.48	0.71	3.5	9.4
EB16	57	1.9	51%	0.45	0.69	3.1	8.5
EB17	58	0.7	64%	0.55	0.74	1.5	3.7
EB18	59	2.3	25%	0.24	0.59	2.4	11.0
EB19	60	2.9	59%	0.52	0.73	5.5	14.1
EB20	61	2.4	54%	0.48	0.71	4.1	11.0
EB21	62	2.1	53%	0.47	0.70	3.2	8.7
EB22	63	2.7	55%	0.48	0.71	4.5	12.1

WA BASINS

BASIN	DESIGN POINT	AREA (ACRES)	% IMP.	C5	C100	Q5 (CFS)	Q100 (CFS)
WA1	1	1.6	90%	0.77	0.85	4.8	9.7
WA2	2	8.4	19%	0.19	0.56	6.4	34.9
WA3	3	2.3	69%	0.60	0.77	4.4	10.3
WA4	4	1.0	65%	0.57	0.75	2.0	4.8
WA5	5	0.3	90%	0.77	0.85	0.9	1.9
WA6	6	1.2	61%	0.53	0.73	2.0	5.0
WA7	7	1.7	62%	0.54	0.74	2.9	7.3
WA8	8	0.9	90%	0.77	0.85	3.1	6.2
WA9	9	1.8	55%	0.48	0.71	2.5	6.8
WA10	10	2.3	70%	0.60	0.77	4.1	9.5
WA11	11	4.9	37%	0.34	0.64	5.8	19.9

WB BASINS

BASIN	DESIGN POINT	AREA (ACRES)	% IMP.	C5	C100	Q5 (CFS)	Q100 (CFS)
WB1	12	1.6	90%	0.77	0.85	4.9	9.8
WB2	13	10.4	75%	0.65	0.79	25.2	56.0
WB3	14	0.5	90%	0.77	0.85	1.6	3.1
WB4	15	0.3	90%	0.77	0.85	1.2	2.3
WB5	16	2.8	54%	0.54	0.74	4.4	11.8
WB6	17	2.5	62%	0.54	0.74	4.5	11.3
WB7	18	2.9	60%	0.53	0.73	4.9	12.4
WB8	19	2.8	55%	0.49	0.71	4.3	11.4
WB9	20	2.5	80%	0.68	0.81	5.5	11.8
WB10	21	2.2	72%	0.62	0.78	4.7	10.7
WB11	22	3.1	69%	0.60	0.77	7.6	17.7
WB12	23	0.5	76%	0.65	0.79	1.5	3.4
WB13	24	0.8	68%	0.59	0.76	1.7	4.0
WB14	25	1.7	56%	0.49	0.71	2.9	7.6
WB15	26	3.6	70%	0.61	0.77	8.0	18.4
WB16	27	2.8	37%	0.34	0.64	2.6	9.1
WB17	28	2.9	60%	0.53	0.73	5.1	12.7
WB18	29	3.1	58%	0.51	0.72	5.3	13.6
WB19	30	3.0	54%	0.48	0.71	4.7	12.5
WB20	31	3.3	53%	0.47	0.70	4.8	13.1
WB21	32	3.5	53%	0.46	0.70	5.0	13.8
WB22	71	0.4	60%	0.52	0.73	0.9	2.4
WB23	76	1.8	64%	0.56	0.75	3.1	7.7
WB24	77	2.4	85%	0.73	0.83	7.1	14.8
WB25	78	4.2	2%	0.05	0.49	0.5	8.6

WC BASINS

BASIN	DESIGN POINT	AREA (ACRES)	% IMP.	C5	C100	Q5 (CFS)	Q100 (CFS)
WC1	71	0.7	90%	0.77	0.85	2.3	4.6
WC2	72	1.6	90%	0.77	0.85	4.3	8.8
WC3	73	3.8	2%	0.05	0.49	0.6	10.4
WC4	74	1.0	90%	0.77	0.85	2.6	5.3
WC5	75	4.3	2%	0.05	0.49	0.7	11.8

NOTES:

1. EXISTING WILLOW CREEK AND EXISTING WILLOW CREEK FLOODPLAIN ARE SHOWN FRO INFORMATION ONLY. PROPOSED IMPROVEMENTS TO WILLOW CREEK ARE BEING COORDINATED WITH URBAN DRAINAGE AND FLOOD CONTROL DISTRICT AND WILL BE SHOWN IN FUTURE SUBMITTALS.
2. STORM SEWERS, INLETS, AND DRAINAGE FACILITIES ARE CONCEPTUAL AND SHOWN FOR INFORMATION ONLY. DETAILED DESIGN OF THE STORM SEWER SYSTEM WILL BE COMPLETED WITH THE FINAL DRAINAGE REPORT.
3. MANHOLES AND DRAINAGE FEATURES ARE SHOWN AT A LARGER SCALE FOR AESTHETIC PURPOSES.
4. EXISTING CONTOURS SHOWN AT 1' INTERVAL. PROPOSED CONTOURS SHOWN AT 2' INTERVAL.

POND SUMMARY TABLE

POND	IMP	TRIB. AREA	100-YEAR REQ. VOLUME
	%	ACRES	AC-FT
WEST	54%	102.9	10.1
EAST	51%	61.1	5.8

LEGEND

BASIN BOUNDARY
SUB-BASIN BOUNDARY
CONCEPTUAL 100-YEAR FLOODPLAIN
1' DEPTH 4H:1V OPEN CHANNEL V-SWALE
PROPOSED STORM SEWER SYSTEM
PROPOSED TYPE-R INLET
DIRECTION OF FLOW
DESIGN POINT
1
BASIN B 1.25 .85 .95 C5 C100
AREA IN ACRES

N

150 75 0 150 300
SCALE: 1"=150'
ALL DIMENSIONS SHOWN ARE U.S. SURVEY FEET

MARTIN/MARTIN
CONSULTING ENGINEERS
12499 WEST COLFAX AVENUE, LAKEWOOD, COLORADO 80215
303.431.6100 MARTINMARTIN.COM

NOT FOR CONSTRUCTION

STERLING RANCH
PRELIMINARY PLAN NO. 3
PRELIMINARY DRAINAGE PLAN
PROPOSED DRAINAGE PLAN

No.	Issue / Revision	Date	Name
1	ISSUED FOR CONCEPTUAL REVIEW	05/03/18	M/M
2	ISSUED FOR CONCEPTUAL REVIEW	08/27/18	M/M
3	ISSUED FOR 2ND SUBMITTAL	09/13/18	M/M
4	ISSUED FOR 3RD SUBMITTAL	10/24/18	M/M

Job Number 18.0158
Project Manager D. KUNTZ
Design By J.DICKERSON
Drawn By J. DICKERSON
Principal In Charge D. LOVATO

Sheet Number:
D1

PLOT DATE: Wednesday, December 05, 2018 9:38 AM LAST SAVED BY: JDICKERSON
DRAWING LOCATION: G:\LOVATO\18.0158-Sterling Ranch Filing 3\ENG\DRAINAGE\PRELIMINARY DRAINAGE REPORT\DWG\D1.dwg