Santa Fe Paired Watersheds

Stream Flow and Precipitation Monitoring and Water Budget Estimates Update

January 2009 through September 2019

Prepared for the New Mexico Interstate Stream Commission

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Acknowledgements

The many individuals who volunteered assistance in the field were integral in making this a successful project. The City of Santa Fe Water Treatment Plant staff has been very patient and helpful in providing access to the Santa Fe Watershed.

Executive Summary

A paired basin study in the Upper Santa Fe River watershed following forest restoration has successfully measured water budget components in a treated and an untreated (control) basin. The paired basin study was established to investigate questions that have arisen with regards to changes in water yield from forest treatments. If forest treatments, for instance, increase the water yield or increase the sustained flow in streams, this could have implications for sensitive ecosystems or downstream water users that require sustained flow. Precipitation, stream flow, soil moisture, and chloride concentrations in precipitation and stream flow were measured to quantify the water budget components. The results from eleven years of data collection and analysis show a high degree of confidence with respect to measuring the water budget components based on the mass balance of water and chloride.

The cycle of chloride entering and exiting each basin is examined over six integration periods. The total inflow of chloride from precipitation is assumed to be equal to the outflow of chloride in stream flow and recharge over each integration period. Volume-weighted chloride concentration in precipitation ranges from 0.18 to 0.24 mg/L for the six integration periods. The volume-weighted chloride concentration in stream flow for the same periods ranges from 2.2 to 3.2 mg/L in the treated basin and 0.9 to 1.4 mg/L in the control basin. The difference in chloride concentrations between the two basins was observed prior to forest treatments. Based on the ratio of chloride concentration in precipitation to the chloride concentration in stream flow, outflow of water due to evapotranspiration (ET) is estimated to be about 90 to 94% of precipitation in the treated basin and 77 to 86% in the control basin, within the same range as observed prior to forest treatments. The higher ET in the treated basin both before and after forest treatments may be due to the much greater area of western slope in the treated basin that receives warm afternoon sun and the greater area of rock cover in the control basin. Changes in the ratio of water budget components in the control as compared to the treated were the focus of this investigation. While the pre-

treatment data before 2004 is limited, treatments will continue to occur in order to achieve a forest structure that is more resilient to wildfire.

Estimates of recharge, based on the chloride mass balance, range from 1.7 to 7.2% of precipitation in the treated basin and 1.1 to 13% in the control basin. While ET appears to decrease over time following forest treatments in the treated stream relative to the control basin (based on the chloride ratio), changes in stream flow and recharge are only observable during periods when winter precipitation represents a greater proportion of the annual precipitation. The relatively dry period of this eleven-year investigation may have contributed to the lack of overall discernable differences in stream flow and recharge.

1. Introduction

This report is a summary of data collected in the Santa Fe Paired Basins that was not included in the publication of "*Monitoring Effects of Wildfire Mitigation Treatments on Water Budget Components: A Paired Basin Study in the Santa Fe Watershed, New Mexico. summary of data collected in the paired basins for the New Mexico" New Mexico Bureau of Geology and Mineral Resources Bulletin 163 (Lewis, 2018).*

The Interstate Stream Commission began funding the paired basin project in 2008 and had intended to transfer the project to New Mexico Tech Hydrology Program in the fall of 2017. However, due to lack of funding, New Mexico Tech was not able to continue the monitoring. In the May of 2019 following a significant snowpack, HydroAnalytics was retained to download the data that was collected by the data loggers and determine if any new insights could be gleaned. Thus, the data collection efforts over the period from October 2017 through May 2019 were not as rigorous as the previous 9 years when the project was actively maintained. However, the dataloggers continued to perform in the stream gages and the tipping buckets, but the chloride samples were collected less frequently during this latest period of investigation.

2. Modification of Monitoring Equipment

Modifications to the monitoring equipment as previously described (Lewis, 2018) include the addition of a new snow collector (identified as Upper 2) located east of the Upper Precipitation station. Dan Cadol and Zach Sheppard of New Mexico Tech were assisted by Amy and Greg Lewis on January 19, 2018 in the installation of the precipitation collector. No tipping bucket was installed, but the site was protected with an electric fence using an older energizer. The new precipitation collector was installed to address questions regarding the higher chloride concentrations observed in samples from the Upper Precipitation station. Table 1 provides a description of the monitoring equipment deployed in the basins, and Figure 1 shows the monitoring locations. Monitoring of precipitation and stream flow in the vicinity of the paired basins is conducted by the USGS, NRCS, USFS and City of Santa Fe and is used for comparison to check on the data collected in the paired basins (Figure 2). The two precipitation stations installed for the City of Santa Fe in 2011, one above McClure Reservoir and one below Nichols Reservoir, are no longer working.

Table 1. Descriptions of monitoring stations.

Station Name	Coordinates (NAD 83)		Elevation (feet)	Drainage Area (acres)	Issues/Problems	Recommendations
	UTM X	UTM Y				
Measurements	**Stream flow**		*Equipment*: 9-inch and 30-inch Parshall flumes *Measurement interval:* 15 minutes			
	Stream temperature		INW AquiStar PT2X transducer			
	Stream chloride concentration		INW AquiStar TempHion chloride sensor			
Control basin stream	13S 425486	3949663	7932	377		
Treated basin stream	13S 425228	3949550	7922	443		
Measurements:	**Precipitation recorder**		*Equipment*: Campbell Scientific TE-525 tipping bucket rain gage with snowfall adapter *Measurement interval:* 1 hour			
	Precipitation collector		5-foot precipitation collector, 12-inch diameter			
Lower	13S 425434	3949630	8063	NA	Bear damaged collector in July 2019	Need stronger energizer
Middle	13S 425691	394850	9077	NA		
Upper	13S 426253	3947826	9910	NA	Bear damaged collector in July 2019, funnel clogged 9/19/2019	
	Precipitation collector only		5-foot precipitation collector, 12-inch diameter			
Upper 2	13S 426548	3947849	10,210	NA	Bear damage to collector	
Measurements:	**Soil moisture content**		*Equipment*: 12 cm Water Content Reflectometer (CS655-L50DS) *Measurement interval:* 1 hour			
Lower	13S 425434	3949630	8063	NA		

Figure 1. Location of Monitoring Stations in the Paired Watersheds.

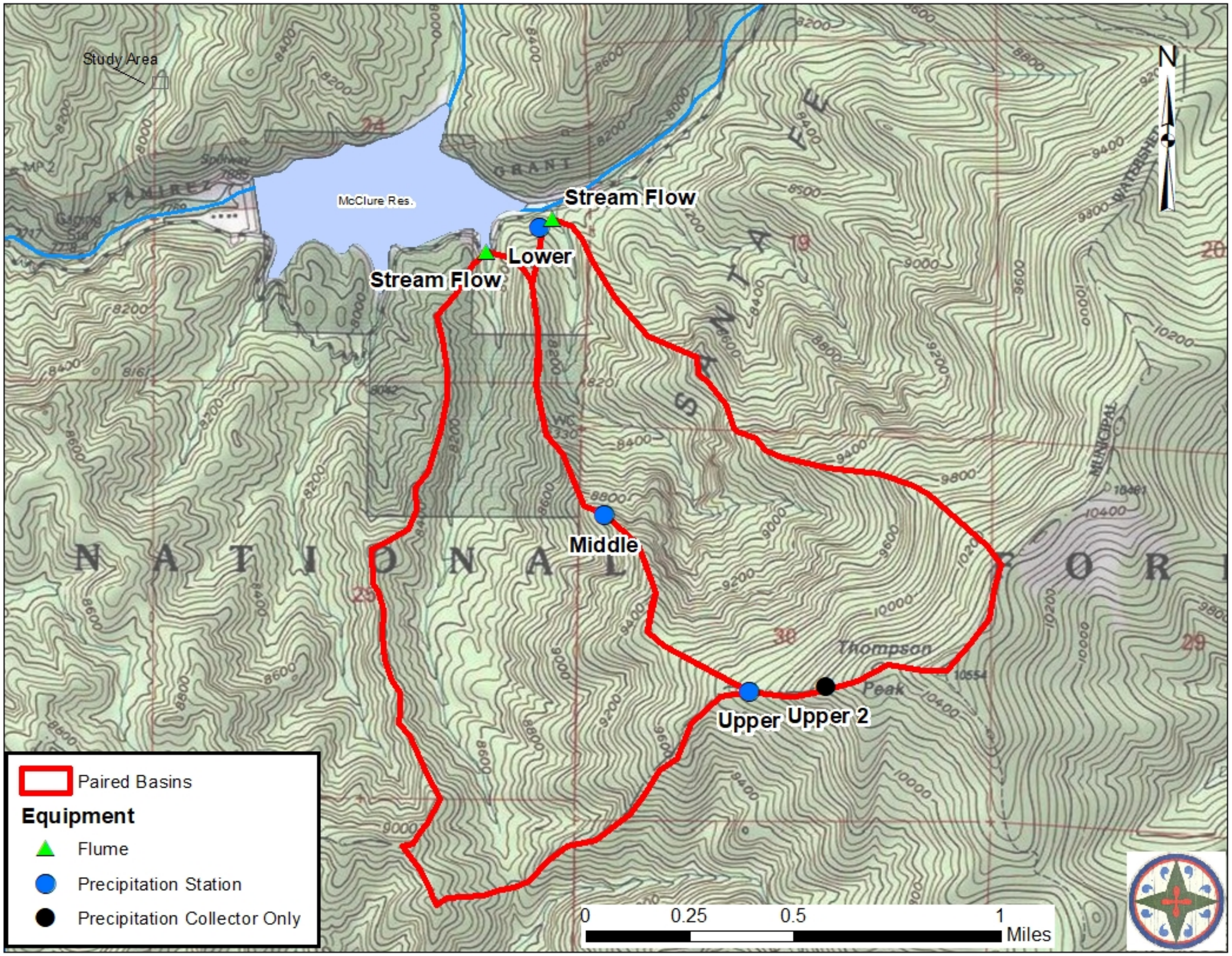
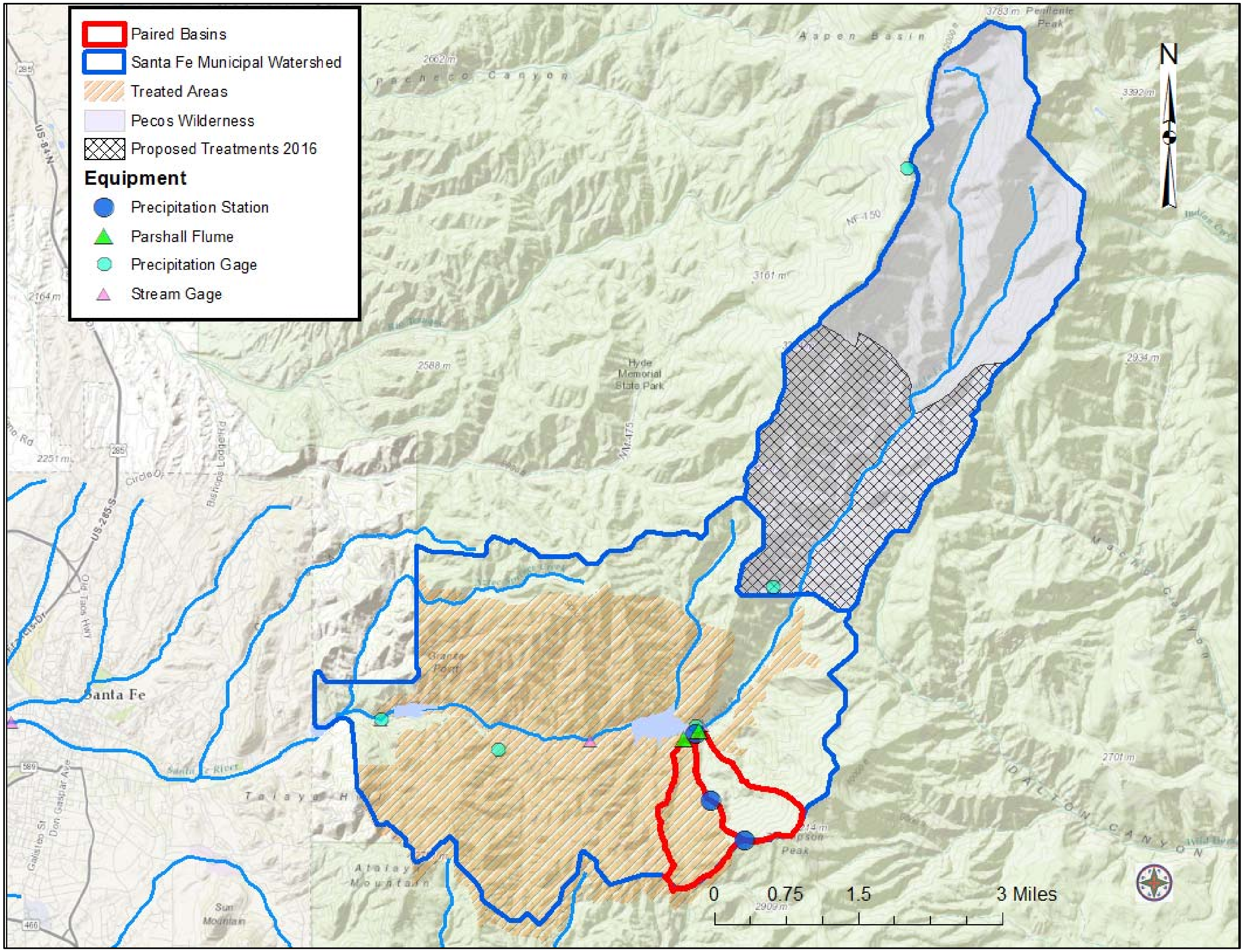


Figure 2. Location of Monitoring Stations in the Santa Fe Watershed.



2.1 Surface Water Monitoring Equipment

Surface water monitoring continued with the pressure transducers installed in the nine-inch flumes in each of the basins year-round and in the 30-inch flumes during monsoon season. The pressure transducers measure depth of the water in the flume which is converted to cubic feet per second (cfs) using a rating table. Chloride concentrations in stream flow were estimated from samples analyzed by Hall Environmental Analysis Laboratory. The pressure transducer in the control flume was sent back to the manufacturer for repairs in the spring of 2019 because communication with the datalogger was not working. The manufacturer was able to retrieve the data and repair the unit. Due to the high run-off, and lack of the usual bi-monthly visits, the control flume was clogged with rocks in March of 2019 (Figure 3).

Figure 3. Gravel in the control flume.

2.2 Precipitation Monitoring Equipment

The three precipitation stations monitored precipitation using Campbell Scientific TE-525WS tipping bucket gages with the snow adapter. Each station also includes a 12-inch diameter precipitation collector for sampling precipitation for chloride concentration. A new site (Upper 2) was established in January of 2018 located above the Upper station (Figure 4). The precipitation collector holds two nested 5-foot long 6-mil polyethylene bags that are constricted in the lower third to reduce evaporation. Precipitation samples were collected 8 times over the 2-year period (October 2017 through September 2019) from the precipitation collectors and submitted for laboratory analyses of the chloride concentration. All samples were analyzed by Hall Environmental Laboratory in Albuquerque, NM using EPA Method 300.0.

Monitoring precipitation throughout the course of this investigation has been challenged by damage from wildlife, particularly bears. Figure 5 shows the damage to the Lower and Upper precipitation stations observed on July 19, 2019, indicating that the strength of energizer for the electric fence is insufficient to deter bears.

Figure 4. Installation of the Upper 2 precipitation collector.

Figure 5. Bear Damage to Lower Precipitation Station observed July 2019.

2.3 Soil Moisture Monitoring Equipment

NOAA's NWS Climate Prediction Center data was used to estimate soil moisture changes for the beginning and end of the integration periods. The NWS estimates soil moisture using a one-layer hydrological model based on observed precipitation and temperature (NWS, 2017). The NCDC data for the northern mountains was compared to onsite soil moisture data using the 12-cm soil moisture probe (CS655 Time Domain Reflectometry (TDR)) installed near the lower precipitation station in July 2013.

2.4 Vegetation Monitoring

Vegetation monitoring was conducted by the USFS in 2003, 2005 and 2010 in the treated basin, but no additional monitoring is planned by the USFS (Hurlocker, 2015). Characterization of vegetation in both basins was conducted in 2010 and described in Lewis (2011). Portions of the treated basin were burned in 2011 and 2018 and continue to be treated with prescribed fire to maintain the desired forest structure and reduce the regrowth of ponderosa trees.

3. Monitoring Results

A monthly and annual summary of the data collected to date in the paired basins is provided in Appendices A through I. The following sections describe the results of the data collected, and calculations performed with the data, such as annual flow and precipitation in each basin. All the data is stored in an Access database (SantaFeWatershedData.mdb).

3.1 Vegetation Surveys

The vegetation surveys are described in Lewis (2011). Prior to treatment (thinning in the spring of 2004 and prescribed burns in fall of 2004, 2010 and 2011 and 2018), tree density was estimated to be about 412 trees/acre in the treated basin in 2003 (Bagne & Finch, 2008). In 2005, tree density was reduced to about 164 trees/acre through thinning, representing a reduction of 60 percent. Tree density sampled in 2010 was 273 trees/acre in the control basin, compared to 98 trees/acre in the treated basin, reflecting 64 percent fewer trees per acre from the control to the treated basins. The canopy cover in the control basin was about 65 percent in 2010, similar to the treated basin estimated canopy cover (73 percent) prior to treatment. Savage (2010) estimated tree canopy cover to be about 32 percent in the treated basin in 2010.

The density of grass and forbs increased in the treated basin after treatments, from 20 percent of ground cover in 2003 to 28 percent in 2005. In 2010, the grass and forb cover was measured at 35 percent in the treated basin, indicating continued increase in ground cover, a desired and expected change following thinning. The measured grass and forb cover in the control basin was 18 percent in 2010, very similar to the pre-treated condition of the treated basin. Similarities between the percent cover in the treated basin prior to treatment and the control basin provide confidence that the control basin is representative of pre-treatment conditions.

3.2 Surface Water Monitoring Results

Mean daily stream flow for the period of record is shown in two graphs (Figure 6 and Figure 7) in linear and logarithmic scales, respectively. The zero values cannot be plotted on the logarithmic scale, thus no data is shown when the stream is dry. Annual stream flow in 2010 (Figure 8) exceeds stream flow in all other years although the highest instantaneous peak flow occurred in September 2013. Appendix A summarizes the mean monthly flow from January 2009 and through September 2019, mean daily flow, and the maximum and minimum instantaneous flow measured each month are in Appendix B and C for 2017 through September 2019. The total yield from the control basin continues to be greater than the treated basin for all calendar years 2009 through 2019 (Figure 8).

Figure 9 shows the cross plot of mean monthly flow before and after forest treatments. The data collected from 2001-2006 by Watershed West is discussed in Lewis (2013). While the r^2 value for the post-treatment data is not very high, the shift in the monthly flow between the two basins is toward more flow in the control basin. If stream flow yield is increasing in the treated basin relative to the control basin, the shift would be towards the 1:1 line or even above the line. Instead, the stream flow appears to be decreasing slightly with respect to the control stream before and after forest treatment.

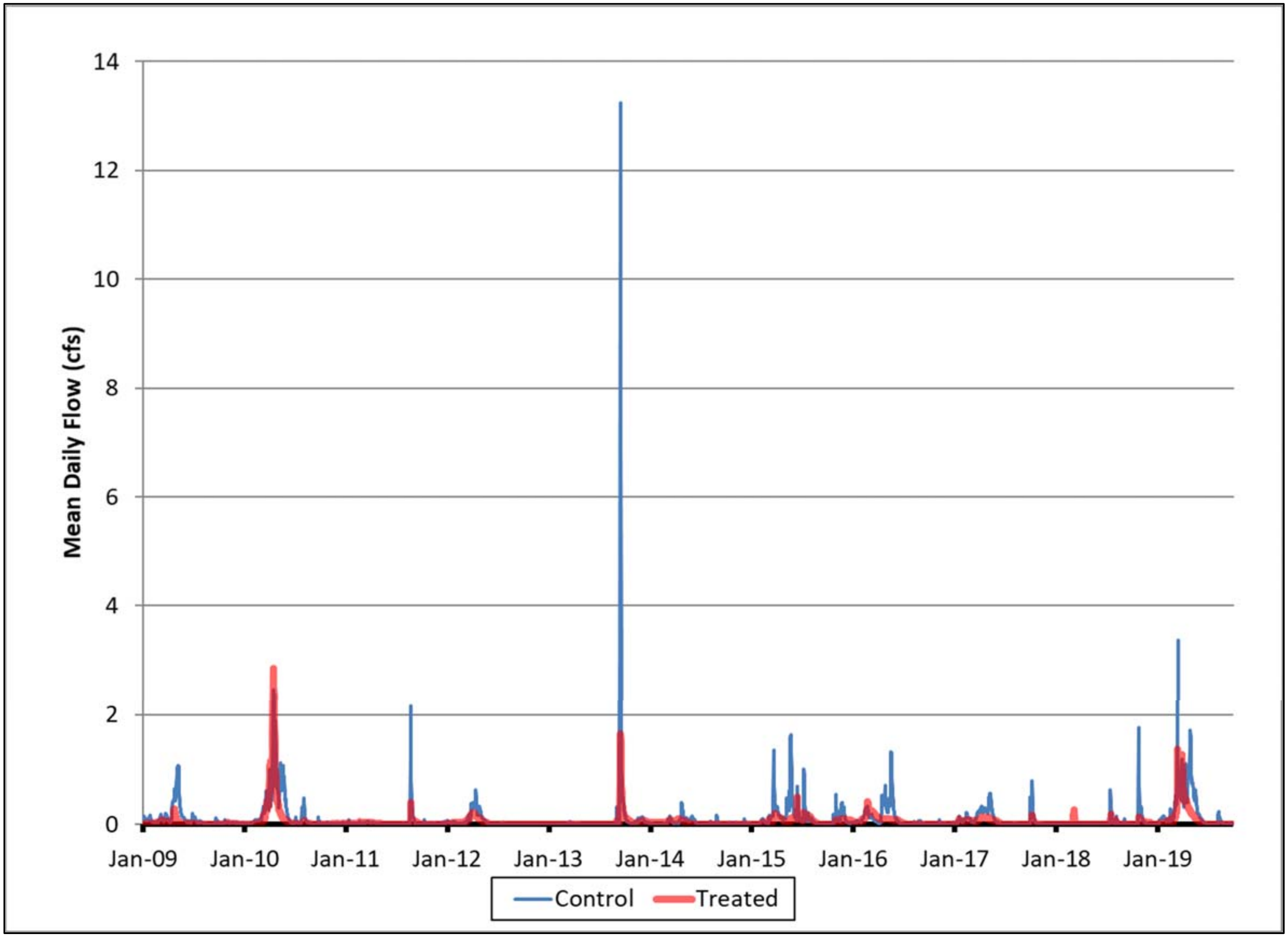
Chloride concentrations in stream flow and precipitation are shown in Figure 10 (Appendix D and Appendix E). Surface water chloride concentrations in the treated basin ranged from 1.9 to 5.0 milligrams per liter (mg/L) and were about three times the concentration in the control basin, which ranged from 0.3 to 1.9 mg/L (Appendix D) over the course of this investigation; however the decrease in this ratio is discussed later. Surface water samples in the treated basin were collected in a small pool upstream about 160 feet when no flow was present at the small flume. Figure 11 shows the chloride concentrations from this study and samples collected prior to this investigation by White (2007). Only one sample set was collected (in 1996) before the treatments began and the concentrations are within the range observed from this investigation (2009-2019).

The chloride concentrations and mean daily flow from January 2009 through September 2019, are shown in Figure 12 and Figure 13. Chloride concentrations had been lowest in the treated basin (down to 2 mg/L) when the stream flow is highest (2.8 cfs) during spring run-off and chloride in the control stream has been more consistent and generally less impacted by stream flow. However, concentrations in the control stream were high (1.6 mg/L) in March of 2013 after a dry winter and minimal snowmelt and the highest (1.7 mg/L) was observed during the peak flows (47 cfs) on September 13, 2013 (Figure 12 and Figure 13).

The total mass of chloride discharged from each basin through surface water was calculated by multiplying the daily chloride concentration by the mean daily flow. The daily chloride concentration was based on water quality samples collected approximately twice a month. If concentrations changed significantly (more than 0.3 mg/L) between sampling events, then the daily concentration was averaged between the two samples for the intervening period.

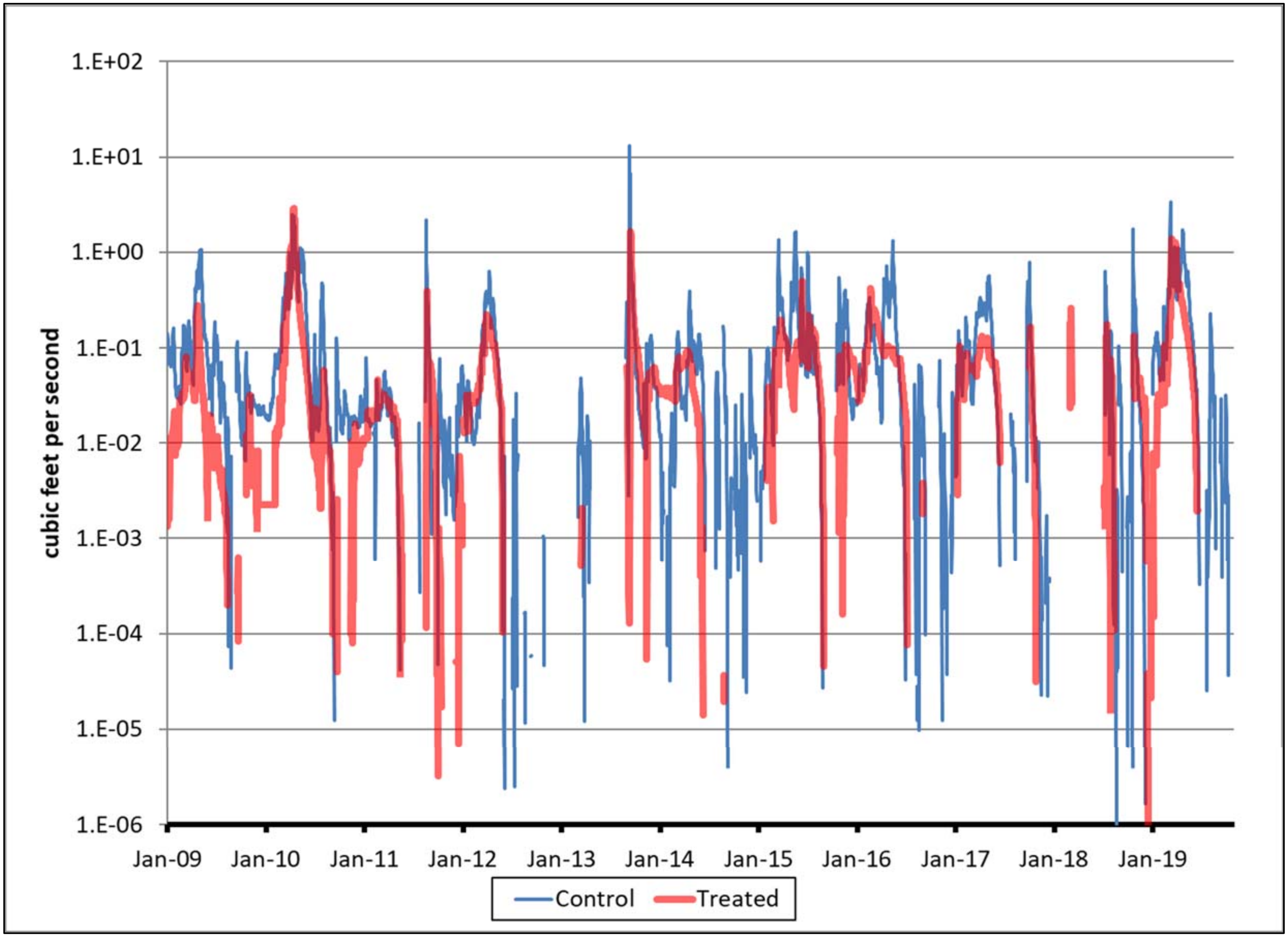
The ratio of chloride concentration in the treated stream to the control stream should remain constant if no change in evapotranspiration occurs. Figure 14 shows a downward trend in this ratio with time, which would suggest decreasing ET in the treated basin relative to the control basin. The r^2 value is low (0.51 for the period 2009 to 2019), thus we cannot conclude that ET is decreasing in the treated basin. However, ET does not appear to be increasing due to forest treatments.

Figure 6. Mean Daily Stream Flow in the Treated and Control Basins 2009 to October 2019.



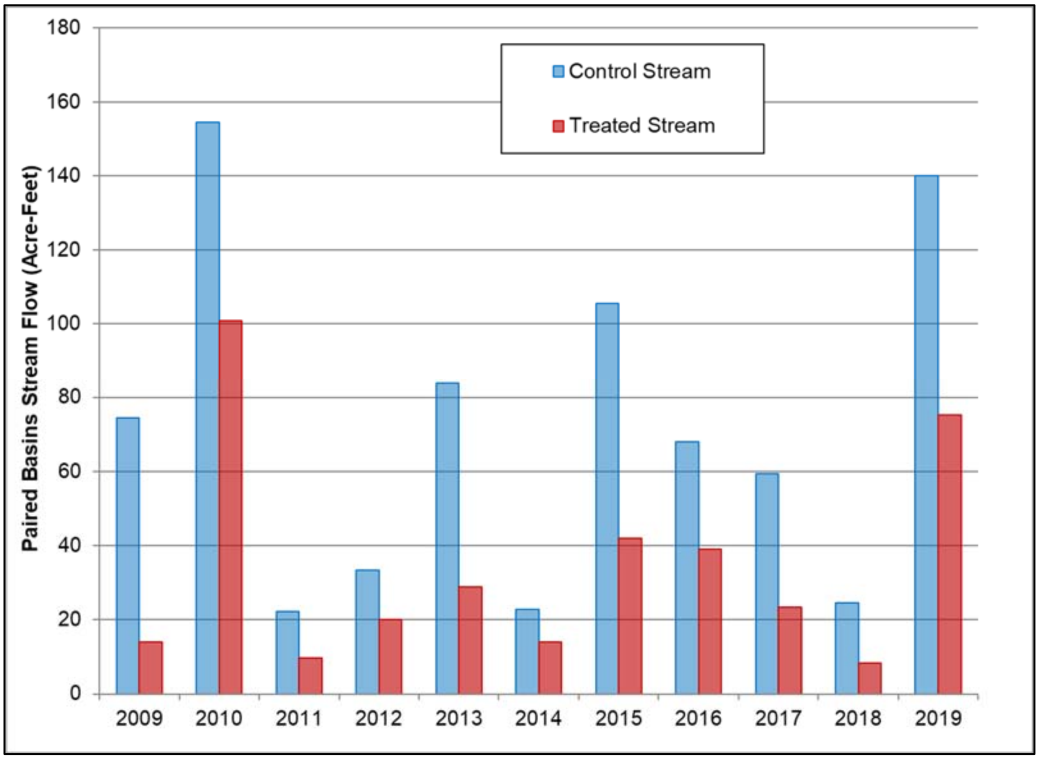
DailySummary/MDF-Fig5

Figure 7. Mean Daily Flow in the Treated and Control Basins with Logarithmic Scale.



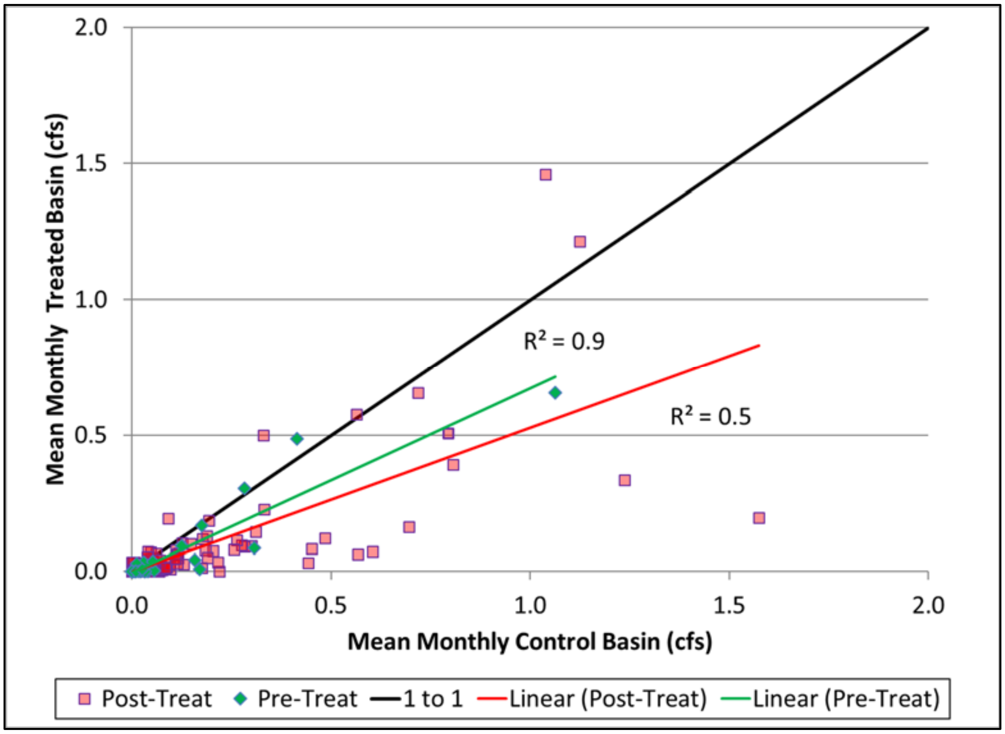
DailySummary/MDF-Fig6

Figure 8. Annual Stream Flow in the Paired Basins.



Partial record for 2019 AnnualPrecipitation/FlowBars

Figure 9. Cross Plot of Mean Daily Flow in Each Basin, before and after Treatment.



Treat_V_ControlFlow2019.xls/F8_TvCMonth

Figure 10. Chloride Concentration from Laboratory Analysis in the Control and Treated Basins and the Average Adjusted Concentration in Precipitation from the three Precipitation Gages.

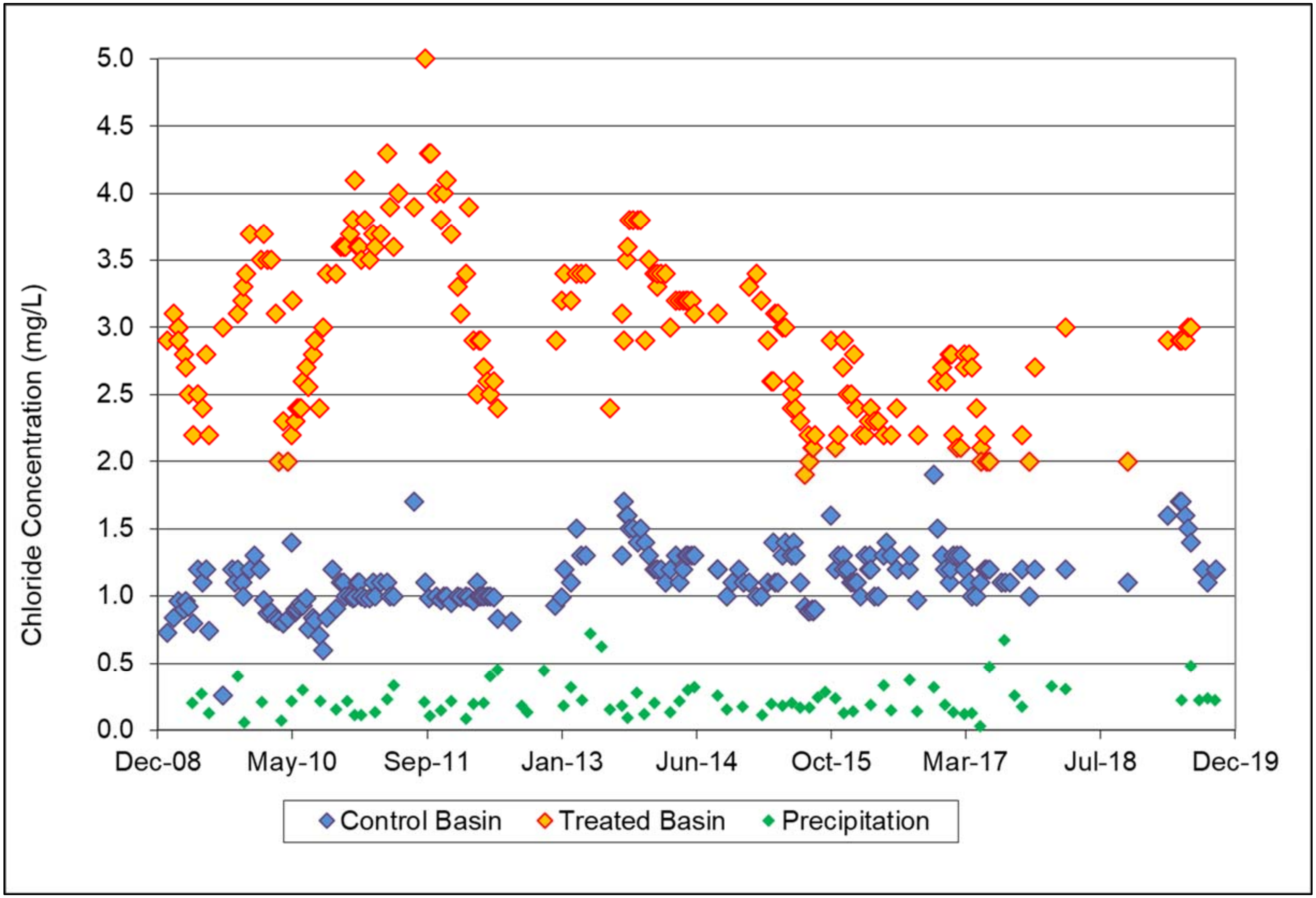


Figure9 Chloride 2019.xls

Figure 11. Chloride Concentrations in the Control and Treated Streams from 1996 through 2019.

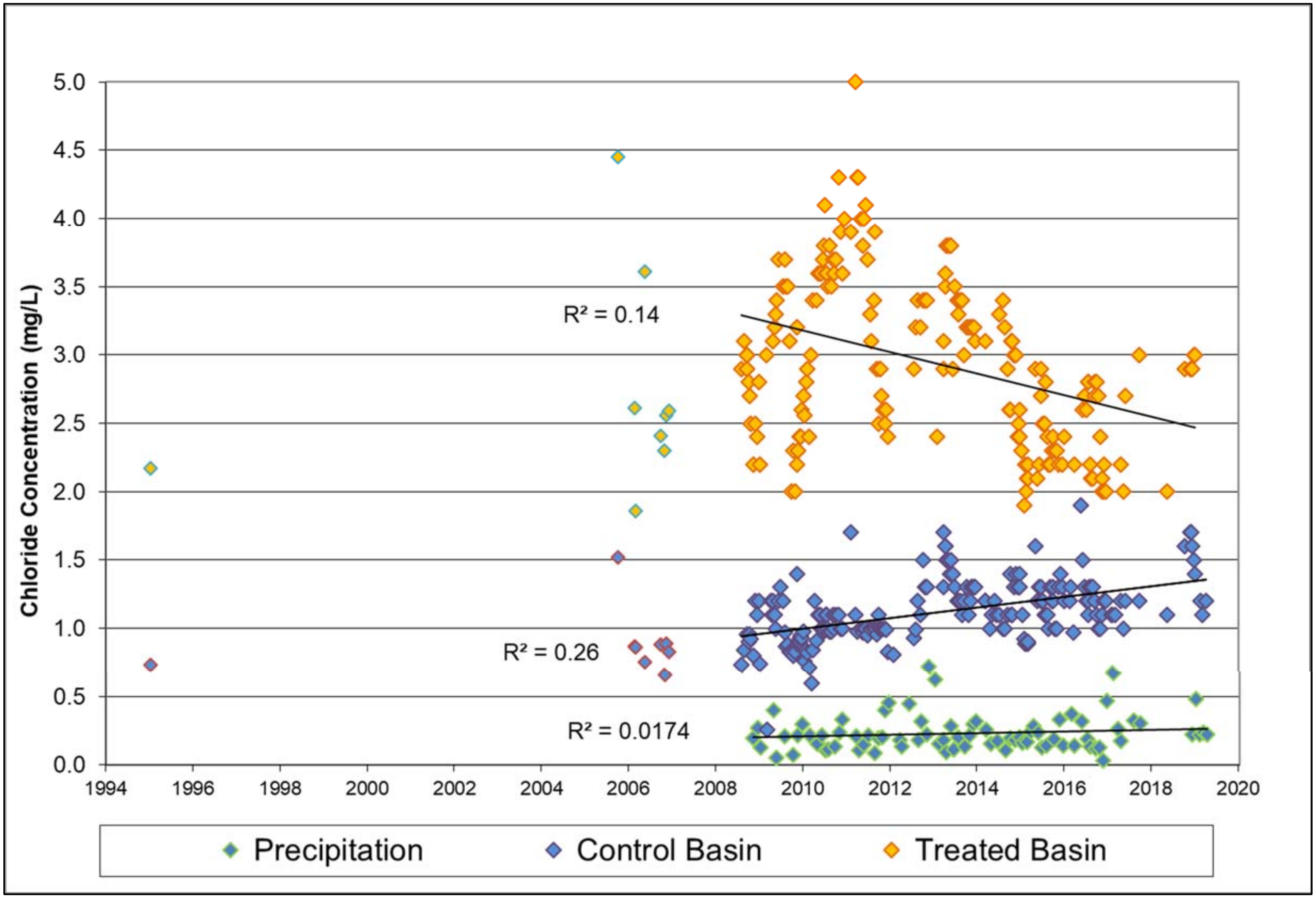
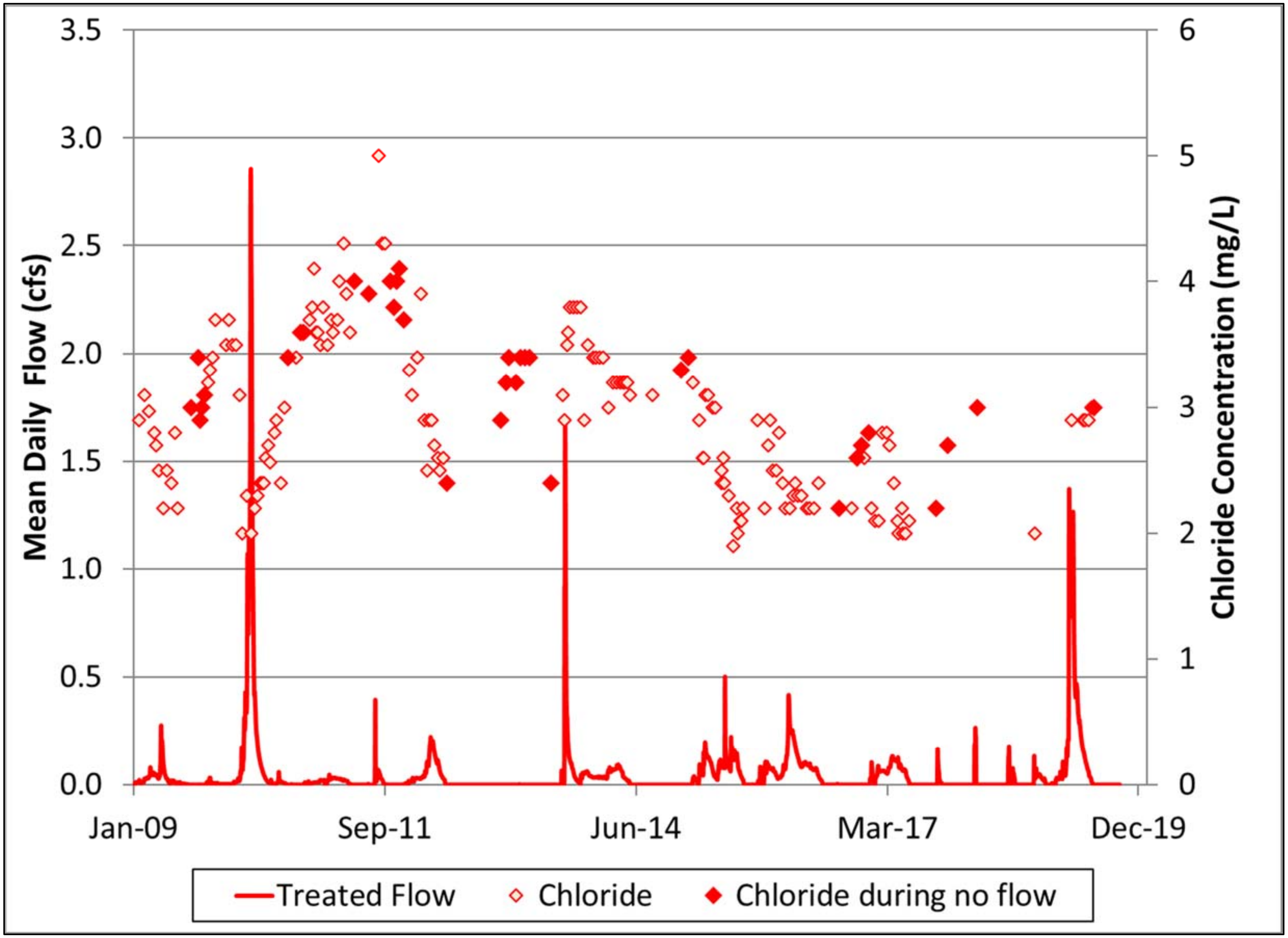


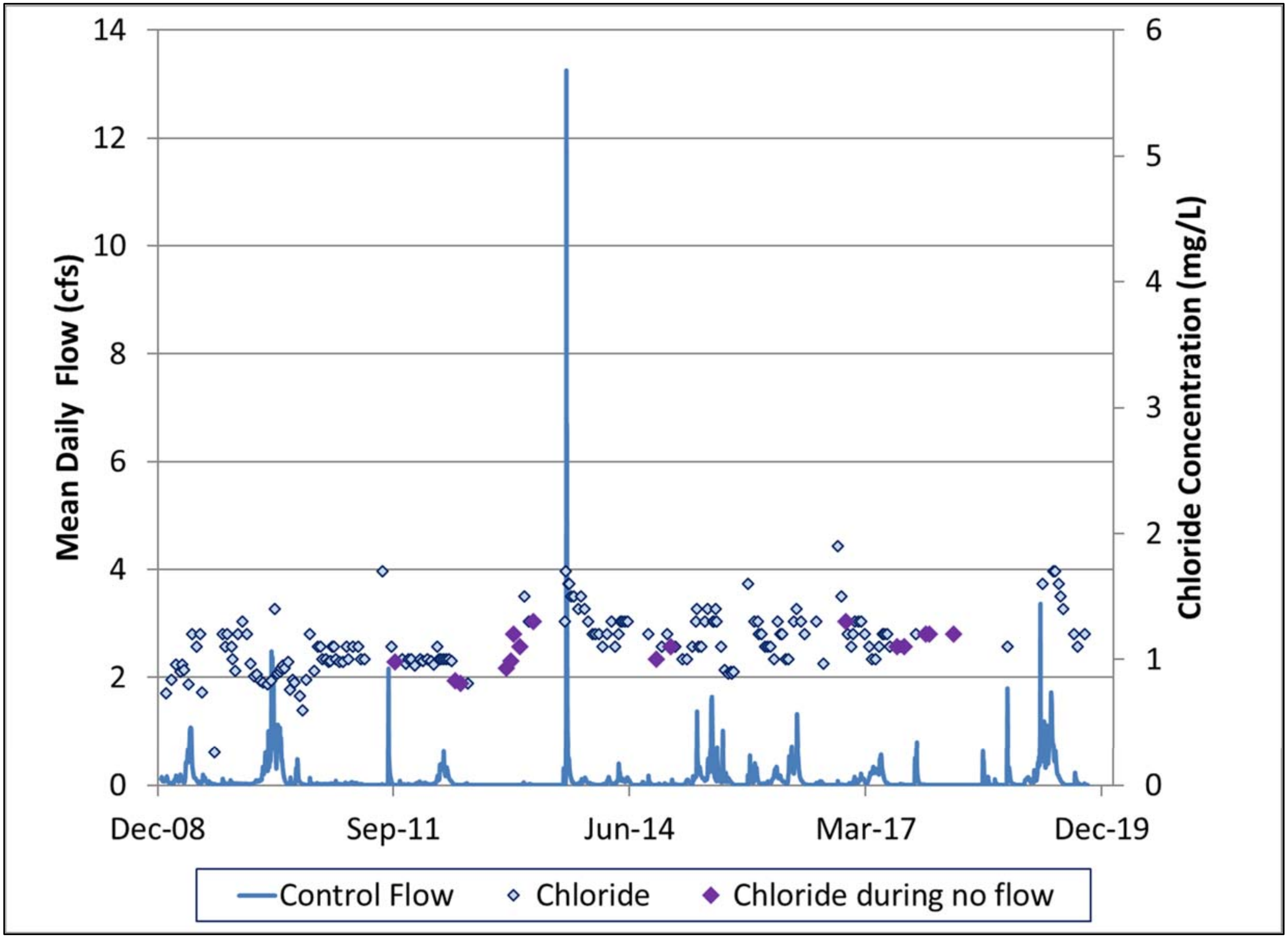
Figure_9 Chloride2019.xls/F10_CL All

Figure 12. Mean Daily Stream Flow and Chloride Concentrations from Laboratory Analysis in the Treated Basin 2009 to October 2019.



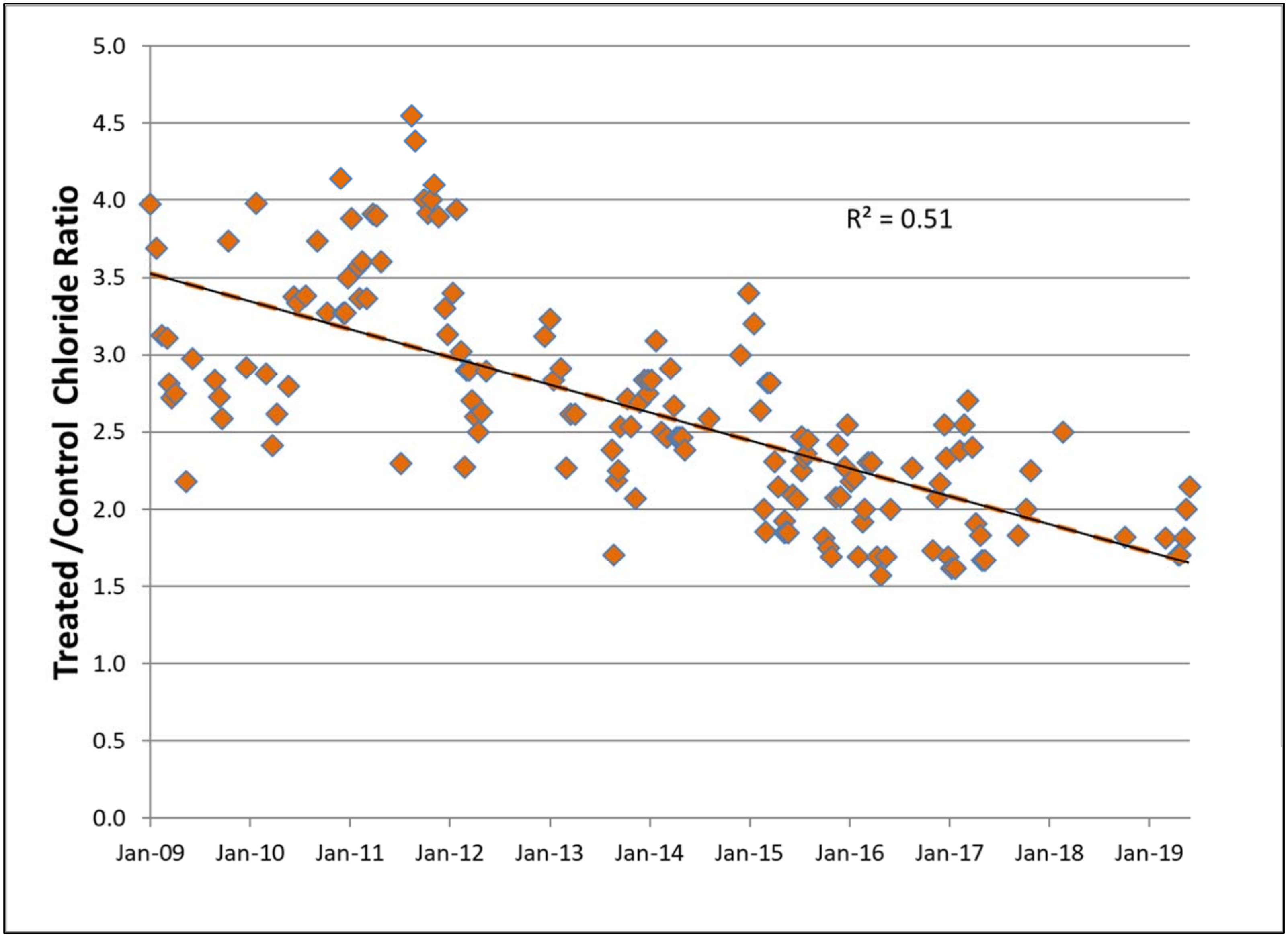
Daily Summary.xls/TreatQ&C_Fig11

Figure 13. Mean Daily Stream Flow and Chloride Concentrations from Laboratory Analysis in the Control Basin 2009 to October 2019.



Daily Summary.xls/ControlQ&CL_Fig12

Figure 14. Ratio of Chloride Concentration in the Treated versus Control Streams.



FiguresChlorideRatio2019.xls

3.3 Precipitation Monitoring Results

Precipitation rates have been monitored at the lower rain gage since December 19, 2008, and at the middle and upper gages since January 24, 2009 (Appendix F, Appendix G, and Appendix H). Because periodic problems have resulted in some lost data at each station throughout this investigation (such as a clogged tipping bucket or damage from wildlife) the daily precipitation from each station is averaged to calculate the monthly and annual precipitation. Figure 15 shows the annual precipitation for each water year since this investigation began (2009 to 2019).

Precipitation samples collected from the precipitation collectors for laboratory analyses of the chloride concentration are shown in Appendix E. The monthly precipitations measured at the three stations and other precipitation stations in the Santa Fe area are shown in Appendix I.

The chloride concentration was adjusted to account for evaporation of the sample. Evaporation of the sample can occur during light rainfall events when the precipitation evaporates prior to entering the lower part of the collection bag. Sublimation can also occur from snow fall that sits in the upper two thirds of the polyethylene bag before melting into the lower constricted area. Only a small amount of evaporation occurs once the precipitation enters the lower part of the bag. Claassen and Halm (1994) found that only at most 3 percent of water was lost to evaporation within the collector over 1 to 3 months for a sample placed in the collector (with a cap to reduce introduction of precipitation). However, in this study, when rain is falling on the collector, particularly in light rainfall events, raindrops may evaporate on the surface of the bag, leaving behind chloride residue. Collection of the samples was generally performed within a day or two after a significant precipitation event that could effectively “rinse” the chloride residue from the surface of the bags.

During review of the chloride data and adjustments to the concentration, an error was found in the calculation for August 30, 2012 at the Middle Precipitation station included in the most recent publication (Lewis 2018). While the appendices showing the lab and adjusted chloride concentrations were correct, the value used in the calculation of water budgets was incorrect. Correction of this error resulted in a reduction in the estimated recharge for the second integration period.

When precipitation amounts from the precipitation collector were less than rain-gauge measurements at the same site, a correction factor was used to adjust the Cl concentration for the evaporative concentration of the sample. The correction factor was based on the ratio of tipping bucket precipitation to the volume measured in the precipitation collector. The reported concentration, the percent in the collector and the adjusted concentration are shown in Appendix E. The average daily precipitation from the three gages was multiplied by the average adjusted chloride for the time period over which the precipitation sample was collected. The average volume-weighted chloride concentration deposited (both wet and dry) on the basins was estimated using the total mass of chloride divided by the total volume of precipitation (Appendices J, K, L, M, N and O). Average chloride concentrations by integration period range from 0.18 to 0.24 mg/L as shown in Table 2.

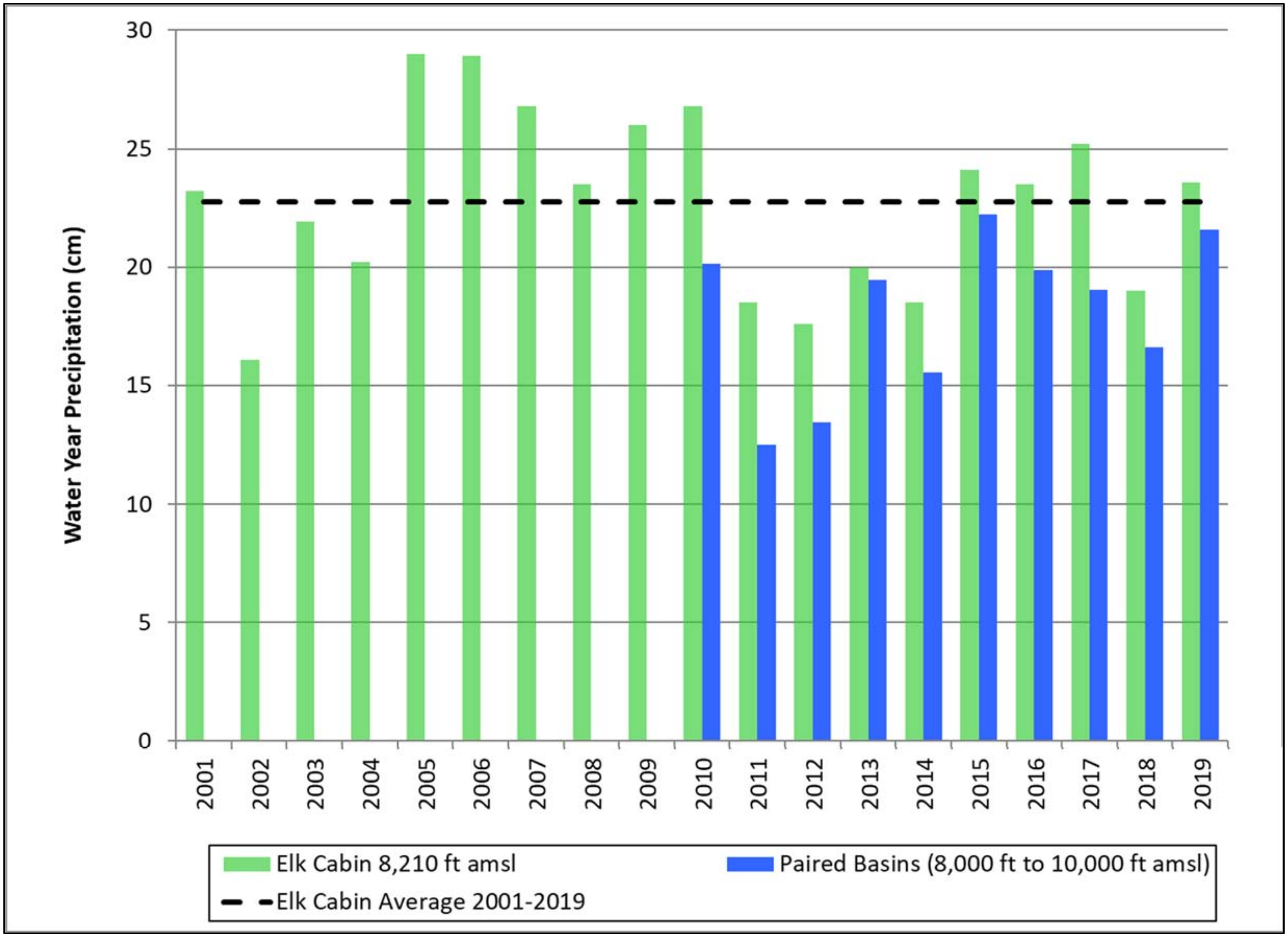
Assuming that each basin received the same rate of precipitation (because no orographic effect has been observed) and same concentration of chloride, the estimated total chloride deposited through precipitation (and dry deposition) onto the 377-acre control basin and the 443-acre treated basin was calculated for each integration period (Appendices J through O). The chloride concentrations and deposition rates shown in Table 2 are within the national observed values (NADP, 2015).

Table 2. Summary of chloride concentrations in precipitation and deposition rate by integration period.

Integration Period	Average Volume Weighted Chloride Concentration in Precipitation	Chloride Annual Deposition Rate
	mg/L	kg/ha/yr
10/2008-9/2010	0.21	1.1
10/2010-9/2014	0.19	0.8
10/2014-9/2015	0.18	1.0
10/2015-9/2016	0.23	1.1
10/2016-9/2017	0.24	1.2
10/2017-9/2019	0.24	1.2

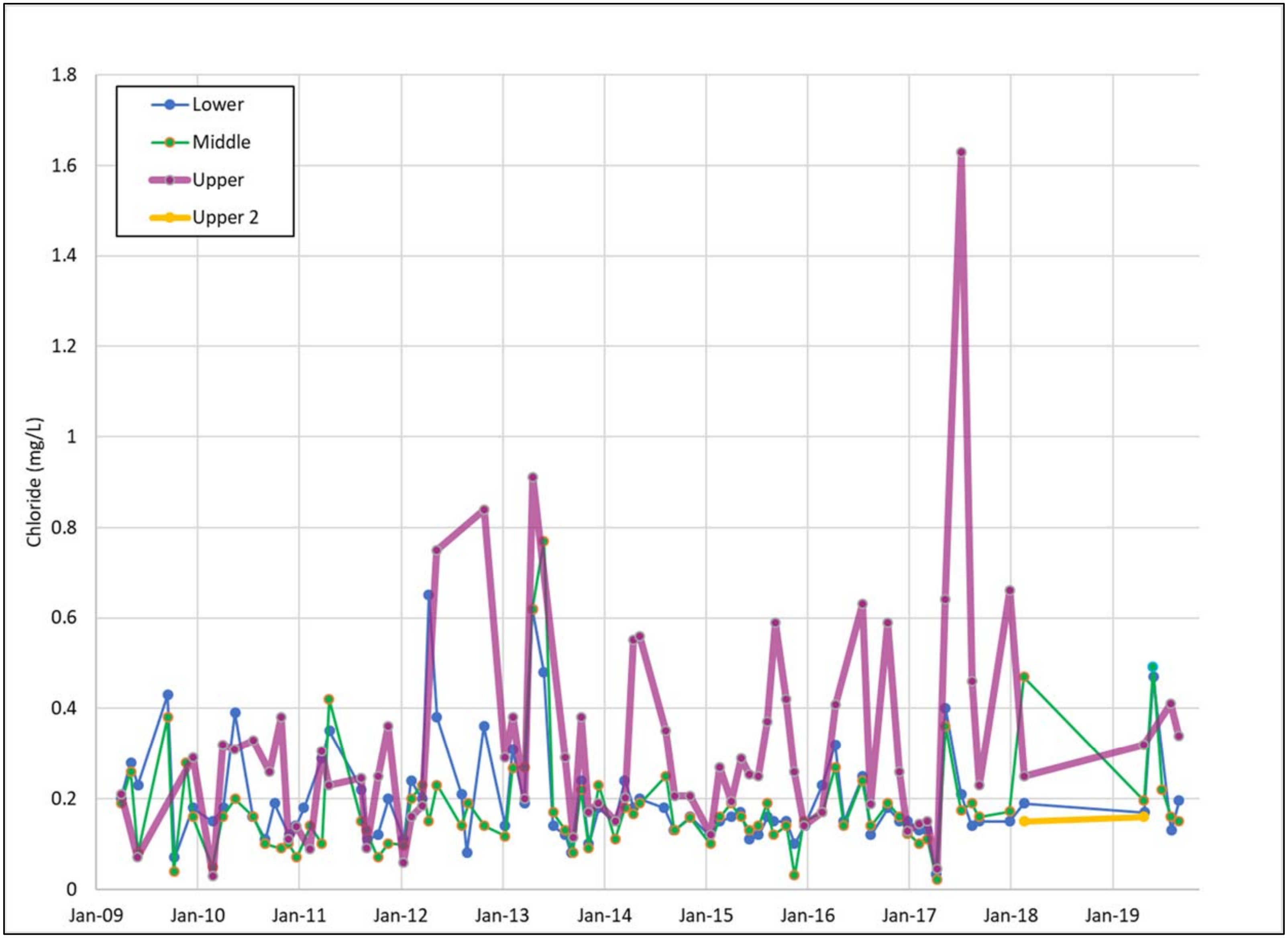
The chloride concentrations from the Lower and Middle precipitation stations track relatively closely compared to the concentrations from the Upper precipitation station (Figure 16). The Upper site generally has much higher chloride concentrations than the other two stations. The overstory at the Upper site is much greater than the Middle station, but similar to the Lower station. In order to investigate the cause of the higher chloride concentrations at the Upper Station, a new site was located near the Upper Station in the closest open area.

Figure 15. Water year precipitation in the Paired Basins and Elk Cabin SNOTEL gage.



Annual Precipitation.xls/Fig 16 Precipitation (in) (WY)

Figure 16. Time series of adjusted chloride concentrations at precipitation stations.



Adjusted Chloride2019.xls/4 Stations

Two samples were collected from the Upper 2 station (March 13, 2018 and May 17, 2019). No other samples were collected due to damage from bears. On July 20, 2019 both the Upper and Upper 2 sites were damaged by bears. The Upper 2 site was destroyed, which would have required replacement of the electric fence and energizer and the collector. Results of the two samples shows that the chloride concentration at the Upper site was 1.7 to 2 times the concentration of chloride at the Upper 2 site. However, the concentration at the Middle Precipitation station is even higher than the Upper station

Table 3. Chloride concentrations from four precipitation collectors.

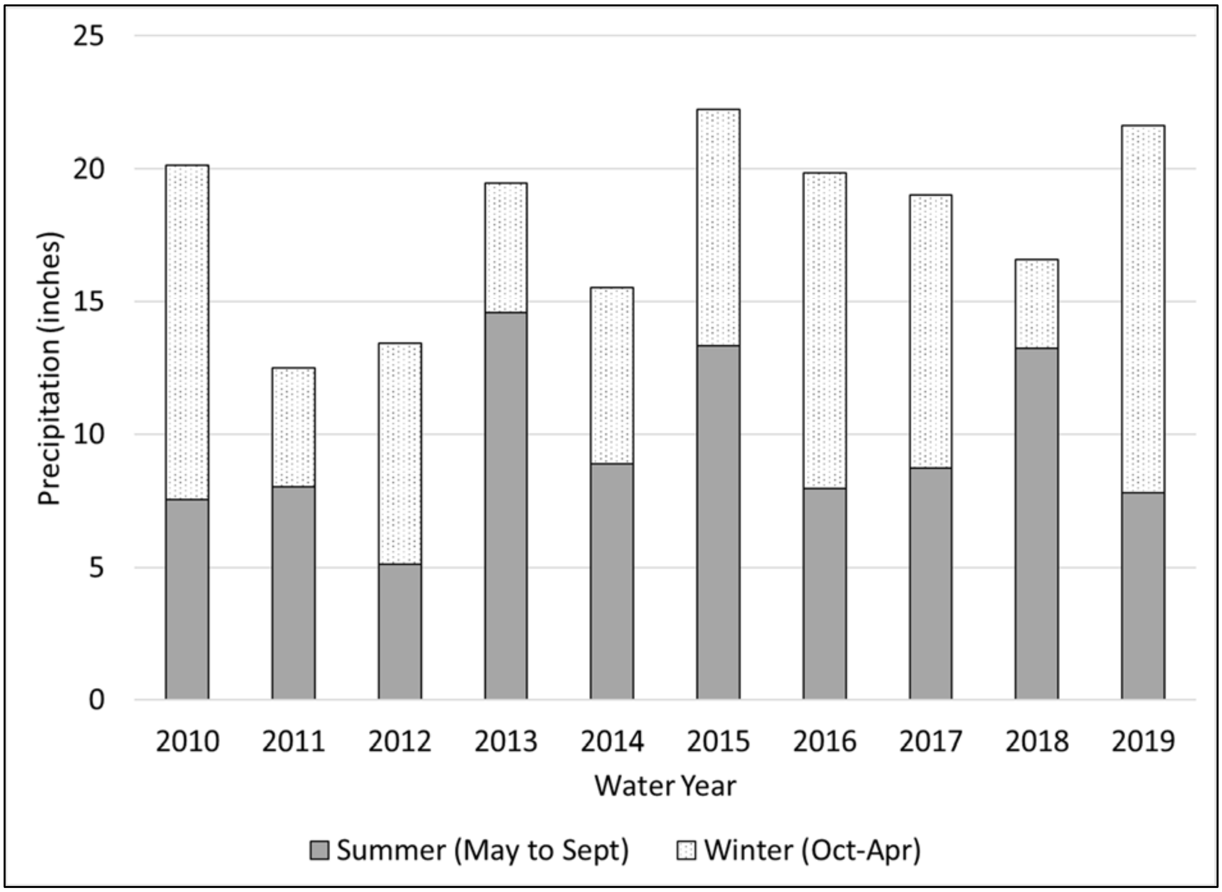
Date Sample Collected	Lower	Middle	Upper	Upper 2	Precipitation Collection Period
	mg/L				Days
3/13/2018	0.3	0.56	0.34	0.2	53
5/17/2019*	0.22	0.22	0.39	0.2	*430*

**Average concentration for samples collected from the Lower and Middle Gages form the period from March 14, 2018 through May 17, 2019. All samples reflect lab results and not adjusted for evaporation within the collector.*

The seasonal influence of precipitation on runoff was discussed in Lewis 2018 and updated here to include the two additional years of data collection. This update also includes a revision to the periods considered as winter or summer. The month of April is now included as winter precipitation instead of summer. (Both paired basins have an estimated frost-free period of 51 to 100 days (USDA NRCS, Esri. 2019), which is about 3 months). Figure 17. Percent of precipitation that falls during winter and summery months by water year. Figure 17 shows the percent of seasonal precipitation for each water year. Comparing the percentage of precipitation that occurs in the winter (primarily as snow fall) to the ratio of streamflow in the treated basins to the control basin (Figure 18) shows a strong correlation with an R^2 of 0.75. WY 2014 was an outlier due to the high precipitation that fell in September 2013 and produced above average flows in the next water year and not included in this cross-plot. Figure 19 shows the relative increase in the stream flow in the treated basin when a greater percent of precipitation falls in the winter months.

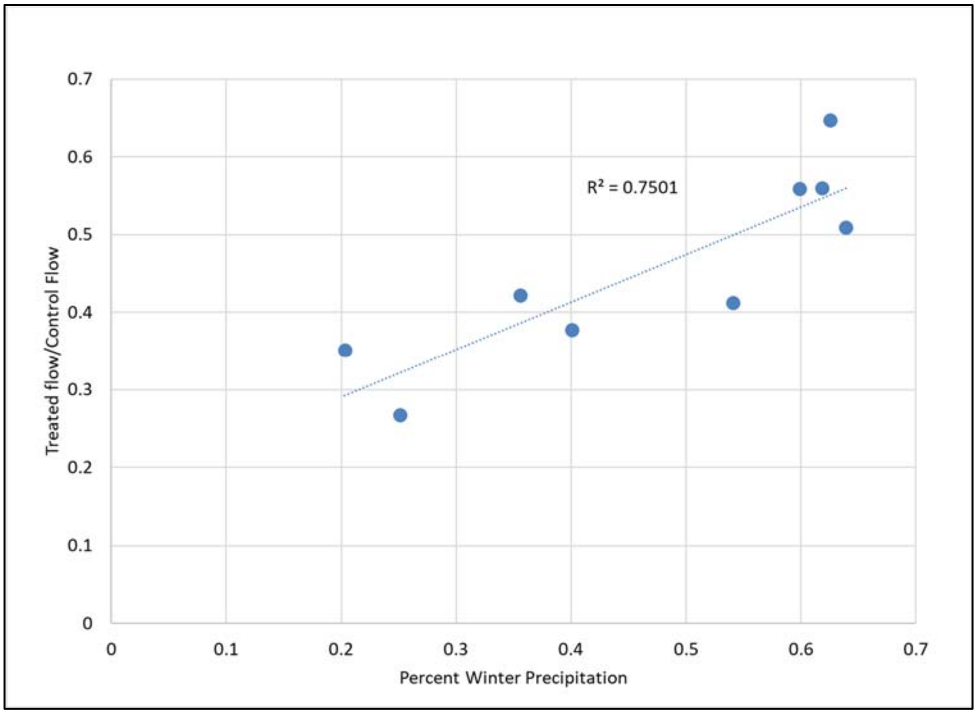
While this study did not measure the form of precipitation (as snow or rain), most of the precipitation occurring from October through April at elevations of 8,000 to 10,000 feet is in the form of snow. Another important aspect of these winter months is not only the cooler temperatures as compared to the summer months, but the angle of the sun and the differences in aspect between the two watersheds.

Figure 17. Percent of precipitation that falls during winter and summery months by water year.



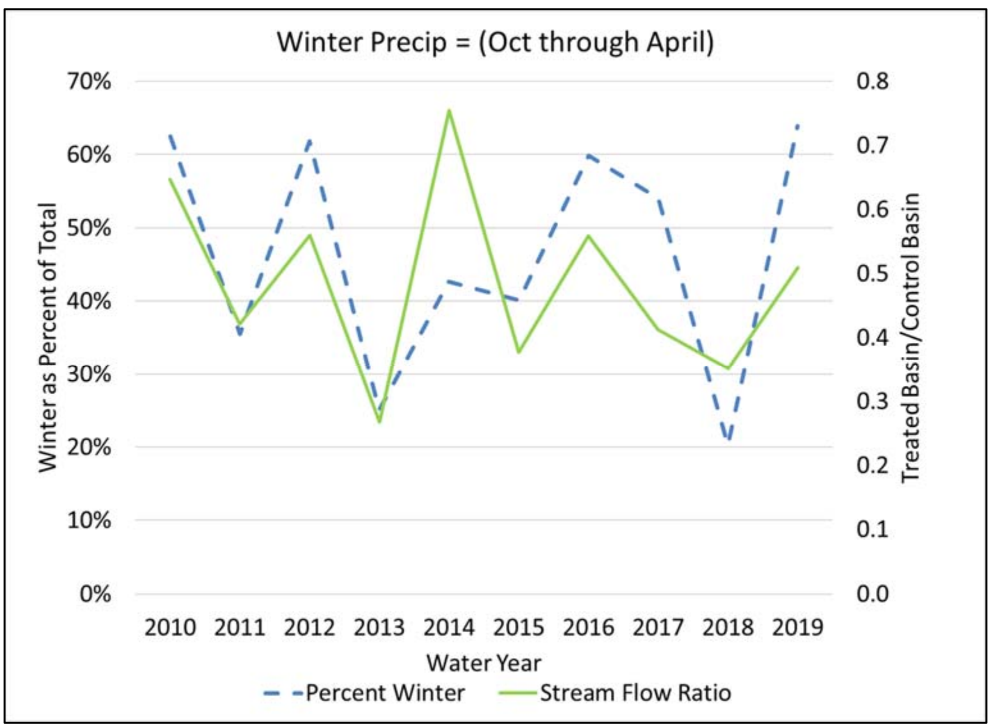
Report Tables Precipitation.xls/Fig17 SummerWinter

Figure 18. Cross-plot of percent winter precipitation (Oct-April) to ratio of Treated to Control Basin flow by water year (excluding WY 2014).



Report Tables Precipitation.xls/xy plot of flow vs winter (3)

Figure 19. Percent winter precipitation and ratio of Treated to Control Basin flow by water year.

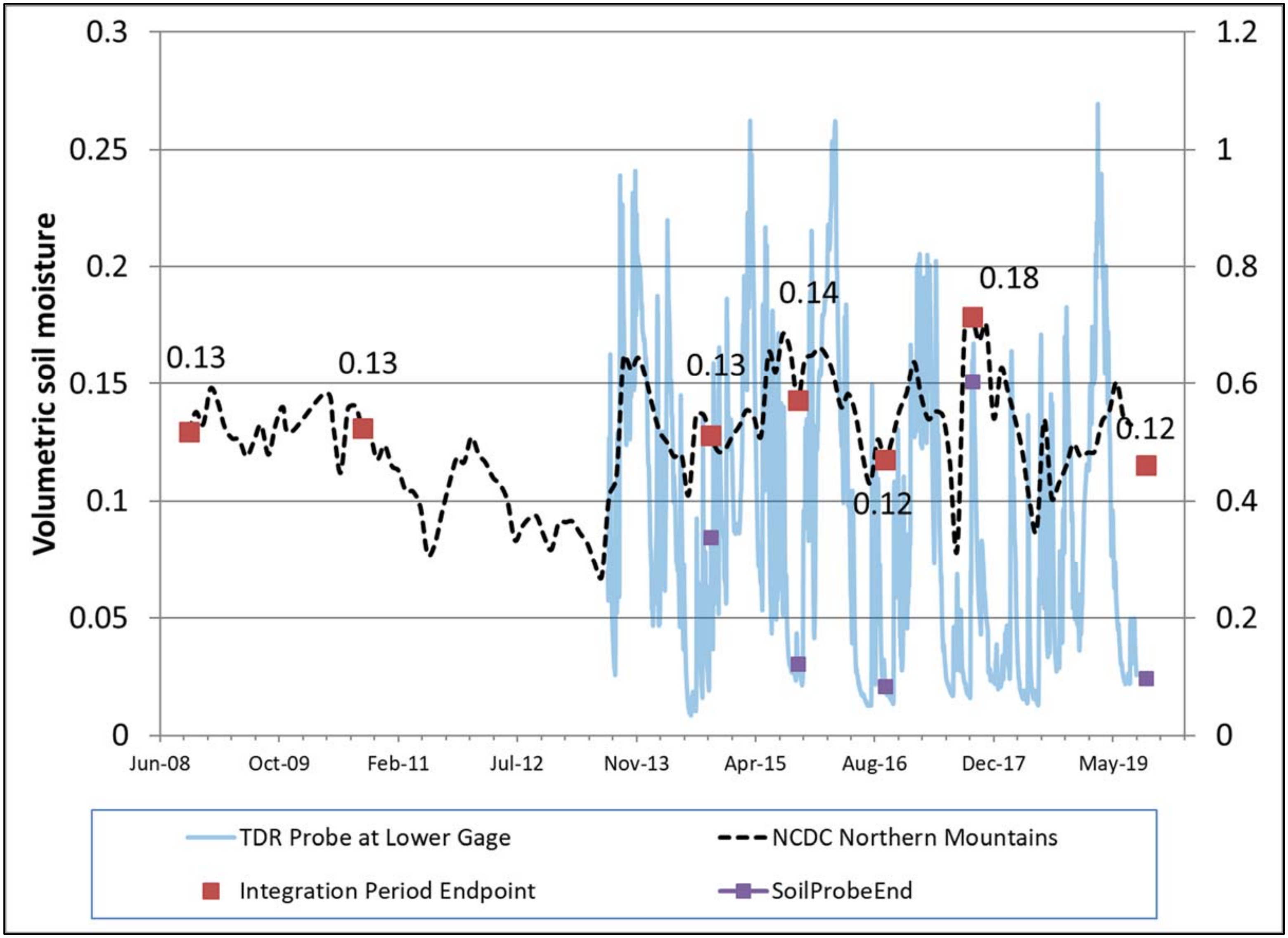


Report Tables Precipitation.xls/Fig 19 PercentWinterPrec

3.4 Soil Moisture Monitoring Results

Soil moisture estimates at the Lower gage and for the Northern Mountains is shown in Figure 20 along with the value at the end of each integration period based on the NCDC Northern Mountains. The soil moisture at the Lower gage fluctuates much more than the estimate for the Northern Mountains, but the relative change from the beginning and ending of each integration period follows is consistently either higher or lower, except in the third integration period. The value for the Northern Mountains increases by 1 percent whereas the TDR probe decreases by about 5 percent from the beginning to end of the 3rd integration period.

Figure 20. Soil moisture estimates from the TDR probe at the Lower precipitation station and Northern Mountains (October 2008 through September 2019).



LowerRain062017.xls/SoilMoisture(2009-2019)

4. Water Budget Summary

The water budget components are estimated here for six integration periods:

1) October 2008 through September 2010,
2) October 2010 through September 2014,
3) October 2014 through September 2015,
4) October 2015 through September 2016,
5) October 2016 through September 2017, and
6) October 2017 through September 2019

The first five integration periods remain unchanged to those published in 2018 (Lewis, 2018), but the sixth period is new. The measured and estimated inflows and outflows to each of the basins differ by a small percent demonstrating the success of the monitoring efforts. The term "water budget" in this sense is not an allocation of water but an assessment of the components. The intent of this investigation is to monitor these components over a period of years sufficient to assess the impact of forest treatments on these components.

The water budgets were developed for these integration periods to reflect the cycle of chloride entering and exiting the basins, rather than the water years presented in previous reports.

The water budgets for each of the basins were calculated assuming (Claassen and Halm, 1996):

$$P = RO + E + T + R + \Delta S \qquad (1)$$

(Where P is Precipitation, RO is Runoff, E is Evaporation, T is Transpiration, R is Recharge, and ∆S = change in Storage.)

This section describes how each water budget component was calculated and what assumptions were involved in the various estimates. The parameters used to estimate the volume of water from ET, recharge and change in soil moisture for each integration period are shown in Table 4, 6 and 7, with all water budget components shown in Table 7.

4.1 Estimation of Inflow from Precipitation

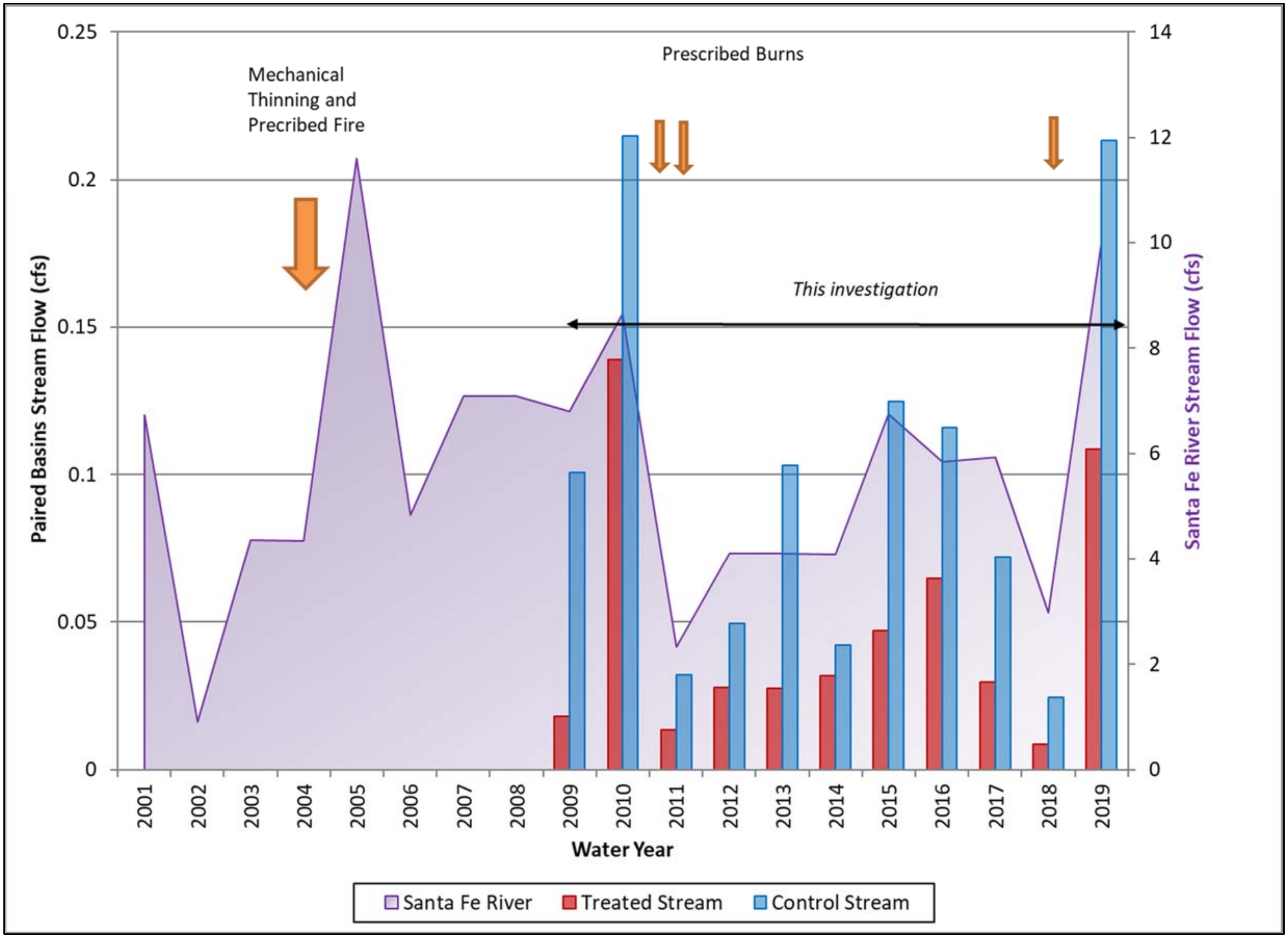
To estimate the volume of precipitation falling on each of the watersheds, the daily rainfall for each station was averaged and then multiplied by the area of each watershed. Because no orographic effect was observed between the three stations (see Lewis 2018), an average value over the entire watershed was applied, rather than an elevation weighted value precipitation. The annual water year precipitation over the period of study ranges from 10.5 inches in 2012 to 22.3 inches in 2015 (Figure 15).

4.2 Estimation of Runoff Outflow through Stream Gages

Annual runoff was calculated by totaling the mean daily flow from each stream gage. The amount of water that may have bypassed measurement through underflow beneath the flumes is not known, but thought to be relatively small because the soil profile is shallow and no springs have been observed downstream of the flume (where the channel is very steep) during dry periods (Lewis, 2017).

The total runoff (RO) for integration periods (Table 7) was based on the sum of the monthly flows. Figure 8 shows the annual stream flow in each of the paired basins and Figure 21 includes the flow at the Santa Fe River above McClure Reservoir for eight years preceding this investigation.

Figure 21. Annual stream flow in the Santa Fe River Above McClure Reservoir and in the Paired Basins.



Annual Precipitation.xls/FlowBars

4.3 Estimation of Evapotranspiration and Recharge

Quantification of ET was based on the mass-balance of chloride in each watershed (Claassen and Halm, 1996) which assumes that the only source of chloride is derived from precipitation and that all chloride is discharged from the watershed after some period of time (hence the "integration periods"). Chloride is present in the atmosphere as suspended liquid droplets or solid particles which are then deposited by gravity through dry or wet precipitation.

Accuracy of the method depends on the assumption that there is no inter-basin flow and that recharge is a small fraction of ET. A water level map would help examine inter-basin flow; however, no wells are installed in either basin, thus the water level gradients are not known. The flow direction in the regional aquifer is from east to west, which is perpendicular to the slope of each stream. If recharged water does not reappear in the stream, but flows towards the west with the regional gradient, then the assumption regarding no inter-basin flow would not be valid. To determine if a significant volume of inter-basin flow (or recharge) is occurring, the mass of chloride entering through precipitation and existing through stream flow in the paired basins can be examined. The cumulative mass balance of chloride is discussed later in this section to assess the amount of chloride that may be exiting the watersheds.

Recharge is estimated using equation 4 below. The relation between the mass of chloride entering the basin and the mass exiting the basin (Claassen and Halm, 1996) is:

$$\sum_{n=0}^{n=\tau} Pn * [Cl_p]n = \int_0^{\tau} (RO * Cl_s)\, dt \qquad (2)$$

where, P is precipitation in (L^3), L is a unit of length, Cl_s is the flow-weighted concentration of chloride (M/L^3) in stream, M is a unit of mass, Cl_p (M/L^3) is the volume-weighted concentration of chloride in precipitation, n is the number of precipitation events, n_t is the integration period chosen, and RO (L^3) is equal to runoff.

If recharge to the regional aquifer is a sink for chloride (and we assume that the chloride concentration of recharge water is equivalent to the chloride concentration in stream flow) then the equation for each integration period water budget (Claassen and Halm, 1996) is:

$$Cl_p * P = Cl_s * RO + Cl_r * R \qquad (3)$$

where, Cl_r is the total chloride in recharge (mg/L) and assumed to be equal to Cl_s.

Rearranging eq (3) becomes:

$$R = \frac{Cl_p * P - Cl_s * RO}{Cl_s} \quad (4)$$

Assuming that the change in storage is negligible compared to the other terms, eq (4) can be substituted into eq (1):

$$ET = P - RO - R = P - RO - \frac{Cl_p * P - Cl_s * RO}{Cl_s} \quad (5)$$

$$ET = P - RO - \frac{Cl_p * P}{Cl_s} + \frac{Cl_s * RO}{Cl_s} = P * (1 - \frac{Cl_p}{Cl_s}) \quad (6)$$

The volume of recharged water drops out of eq (5); therefore, we can use the chloride mass balance approach to estimate ET without knowing the volume of recharge. Although the volume of runoff is not explicit in eq (6), the amount of runoff is used to estimate the volume-weighted chloride concentration in stream flow.

How good is the assumption that Cl_r=Cl_s? It appears to be valid based on the results of samples collected at various times and locations upstream of the flume. Most of the flow at the flumes is derived from groundwater discharging from shallow soil drainage (completed in a few days or weeks after a storm event) and a deep groundwater drainage. For more discussion see Lewis, 2018.

Figure 12 and Figure 13 include the chloride concentrations during the periods when no flow occurred at the flumes. During these dry periods, a small amount of water could usually be found about 150 feet upstream of the flume in a spring. The concentration in the spring water (representing the deeper groundwater component) is nearly the same as the concentration in stream water sampled at the flume before and after dry periods. The difference in chloride concentrations from samples collected in the treated stream, when flowing, at locations upstream were either the same or plus or minus 0.1 to 0.2 mg/l when sampled on the same day, much less than the variation from month to month as shown in Figure 22, Figure 23, and Figure 24.

Figure 22. Chloride concentrations in stream and spring samples collected on April 1, 2011.

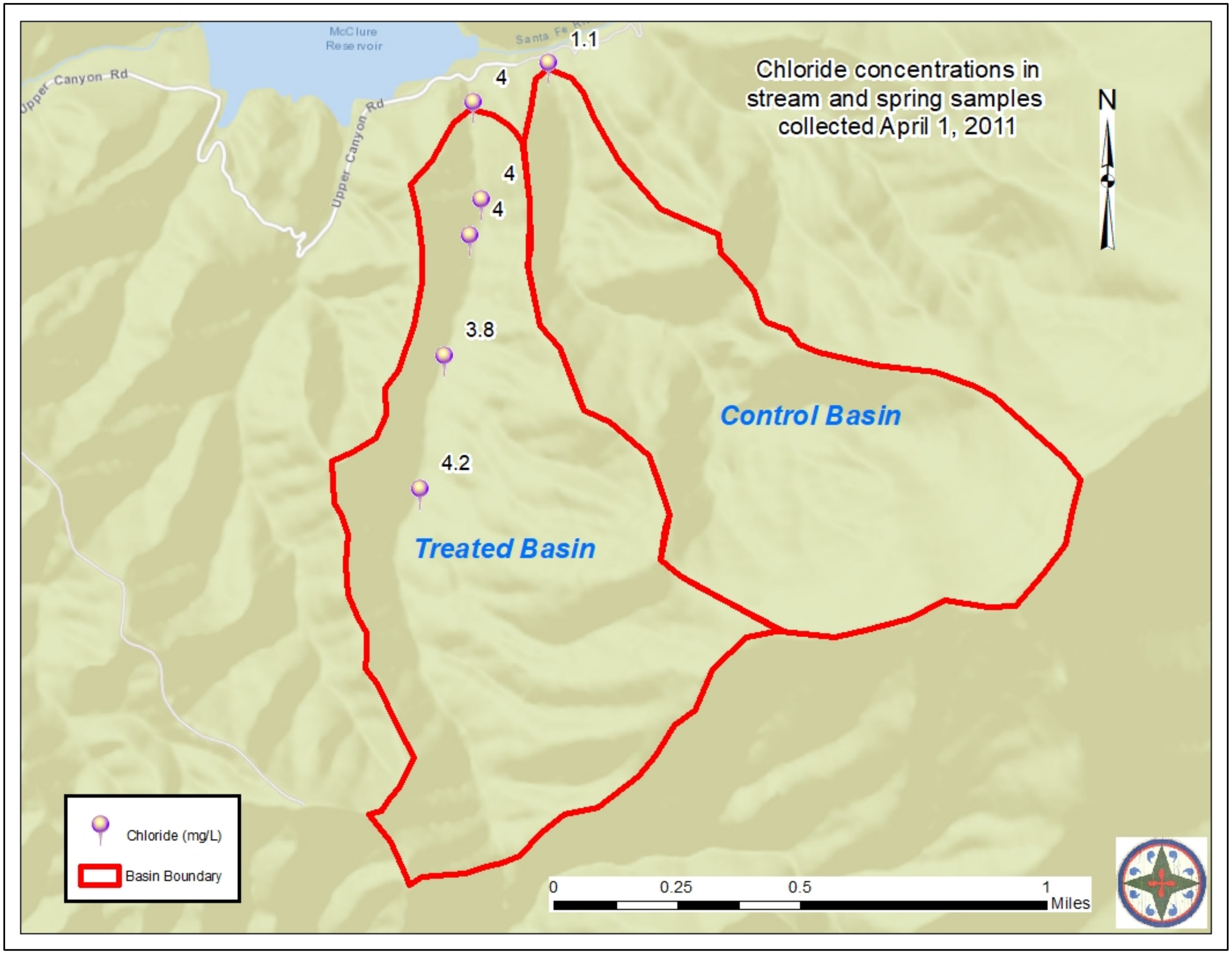


Figure 23. Chloride concentrations in stream and spring samples collected on September 24, 2013.

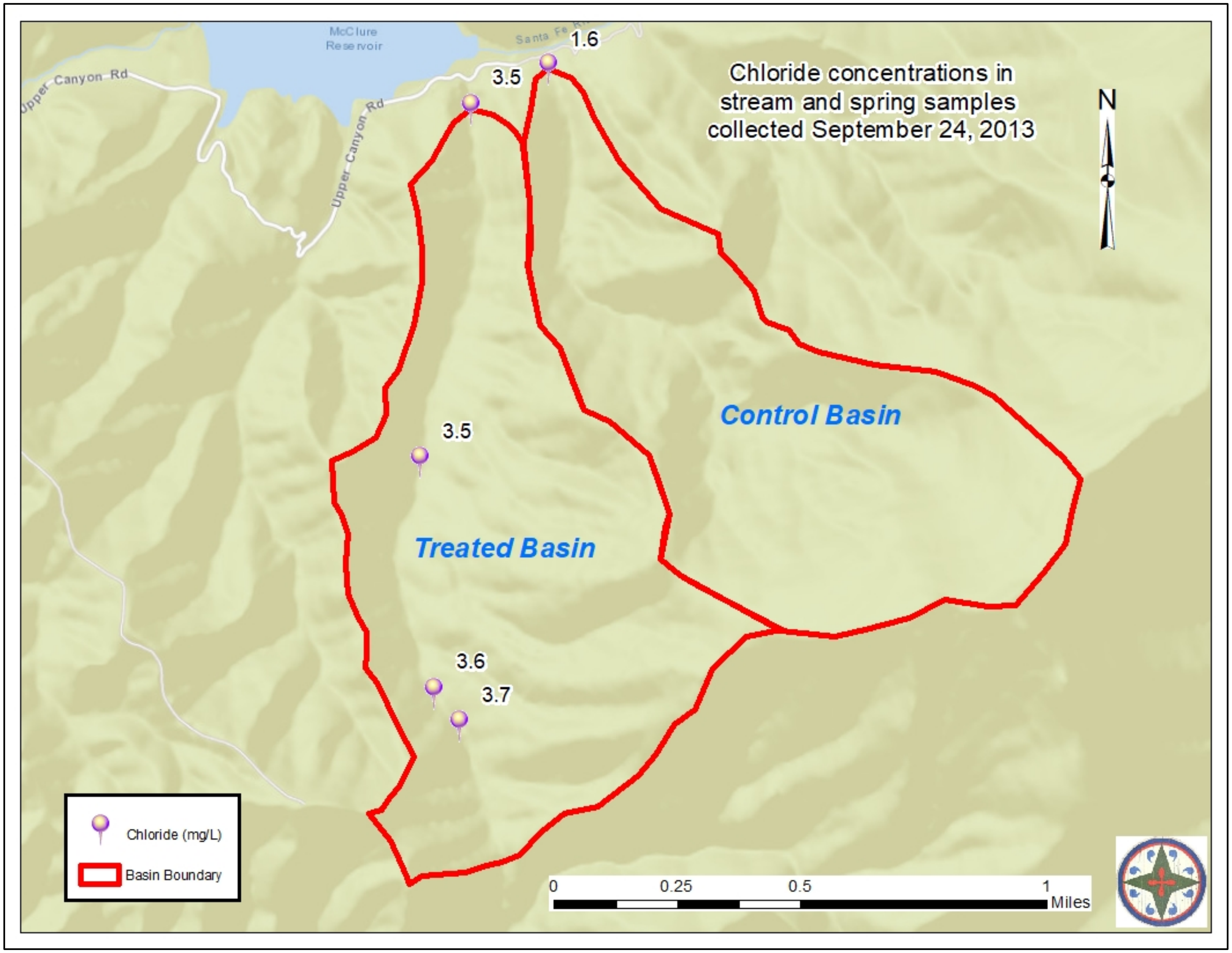
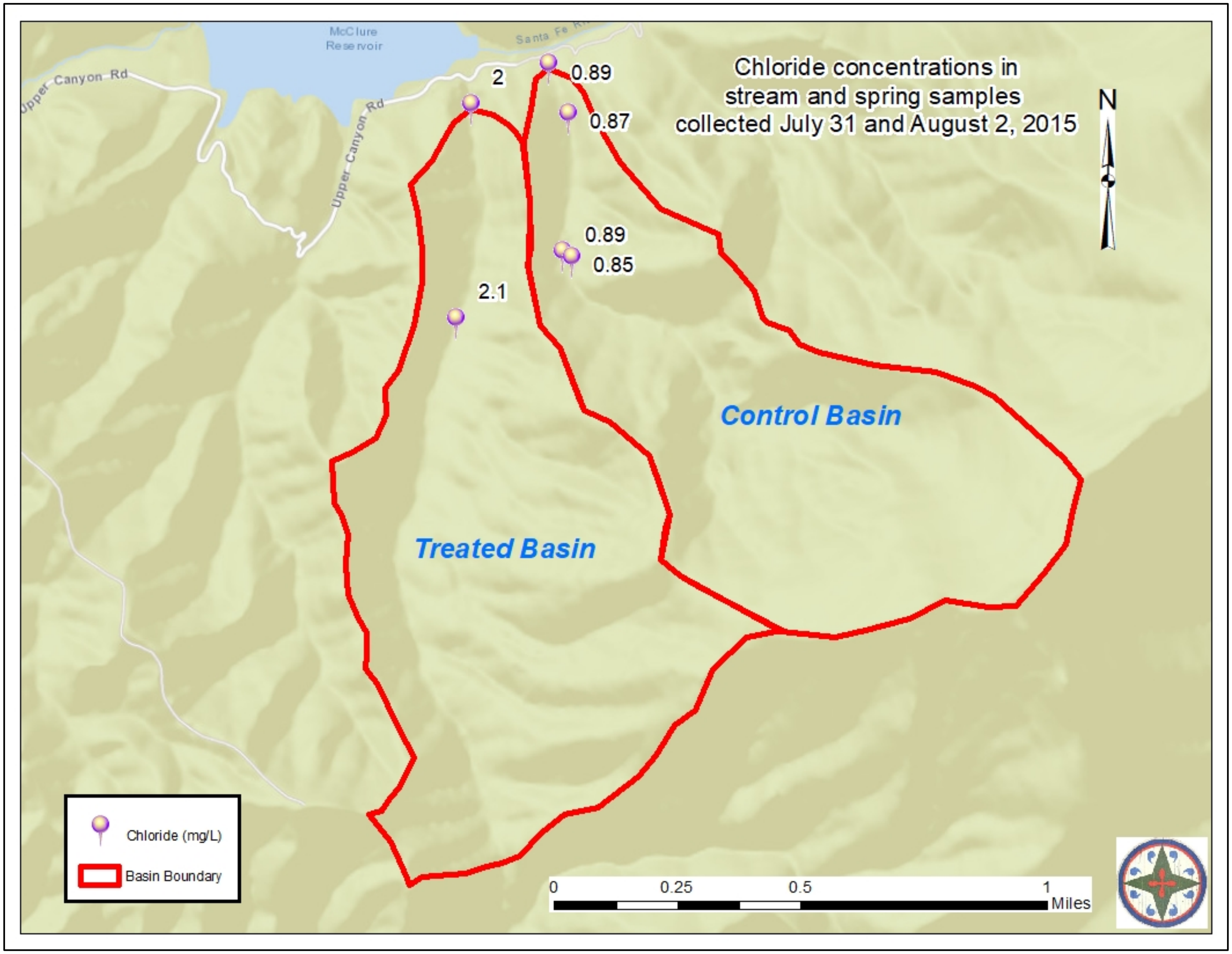


Figure 24. Chloride concentrations in stream and spring samples collected July 31 and August 2, 2015.



ET as a percent of precipitation was estimated using equation 6 based on the volume-weighted concentration of chloride entering and exiting the basins in each stream. To obtain the total mass of chloride, the average adjusted chloride concentration in precipitation was multiplied by the average volume of precipitation per day from three stations. The mass of chloride exiting in stream flow was calculated by multiplying the mean daily stream flow by the mean daily chloride concentration. The volume-weighted concentration in precipitation for each integration period was calculated by dividing the total mass of chloride by the total volume of precipitation and the volume percent-weighted concentration in stream flow was calculated similarly.

Estimates of ET for each integration period (Table 4) are based on the volume-weighted chloride concentration in precipitation which ranges from 0.18 to 0.24 mg/L. The flow-weighted mean concentration in the treated basin stream was ranged from 2.2 to 3.2 mg/L as compared to the concentrations of 0.9 to 1.4 mg/L in the control basin stream. ET is consistently higher in the treated basin (ranging from 90 to 94 percent) than the control basin where ET is 77 to 86 percent of precipitation.

Because the chloride mass-balance technique for estimating ET assumes that all chloride entering the basins will exit the basin over some integration period, the total mass of chloride input in precipitation and outflow through stream flow is examined. Figure 25 and Figure 26 show the cumulative mass of chloride deposited through precipitation and exiting through stream flow. Chloride continues to be deposited through precipitation and dry deposition even in dry years, but none exits the stream, obviously, when it is dry. Thus, the chloride builds up in the soil profile during dry periods. For instance, from June 2012 through August 2013 very little chloride exited the basins because both streams had minimal or no flow. Then, in September 2013, eight inches of rain fell resulting in the highest measured flows and relatively high chloride concentrations.

Both estimates of recharge and evapotranspiration are impacted by the chloride concentration in precipitation. A sensitivity analysis was performed by applying two different estimates of the average chloride concentration in precipitation: 1) eliminating the chloride data collected from the Upper station precipitation collector and only averaging the chloride data from the Lower and Middle gages, and 2) using all chloride data from the three stations without adjusting for evaporation within the collector. The results of this sensitivity analysis shown in Figure 27 (for the Treated Basin) and Figure 28 (for the Control Basin) reveal that the recharge estimates are highly sensitive to the concentration of chloride in precipitation. With the higher, unadjusted chloride concentrations, the recharge rate is higher by up to a factor of seven in the first integration period over the adjusted chloride concentrations applied in this study. If the data collected from the Upper station is removed, the estimated recharge rate is lowered by more than a factor of two in the fourth, fifth and sixth integration periods. The recharge rate remains below 9% in the Treated Basin and below 21% in the Control Basin for each of the six integration periods.

The volume of recharge is estimated for each integration period and each basin as shown in Table 5 using equation 4. The volume of recharge for each period is then compared to the volume of runoff over the same period in order to obtain a multiplier for estimating the cumulative volume of water recharging the deeper regional aquifer per month (and not reappearing as stream flow at the stream gage). The cumulative volume entering and exiting the treated basin (Figure 29) and the control basin (Figure 30) is based on the volume of runoff because recharge to the deeper aquifer would only occur when the streams are flowing. The mass of chloride exiting through recharge is also calculated by multiplying the mass of chloride exiting each basin monthly through stream flow by the same multiplier.

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Figure 25. Cumulative mass of chloride deposited through precipitation in the Treated Basin and exiting through stream flow and recharge.

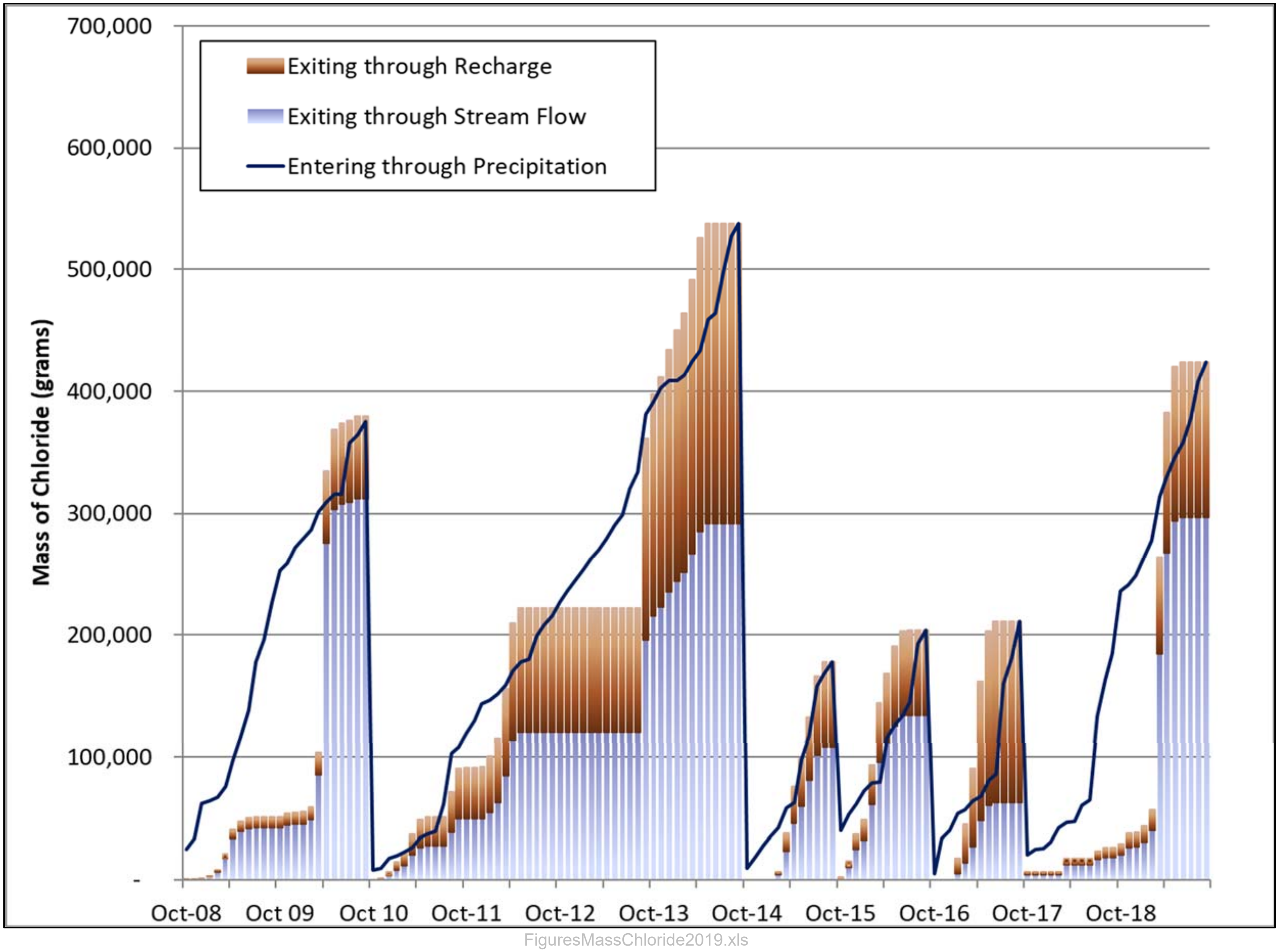
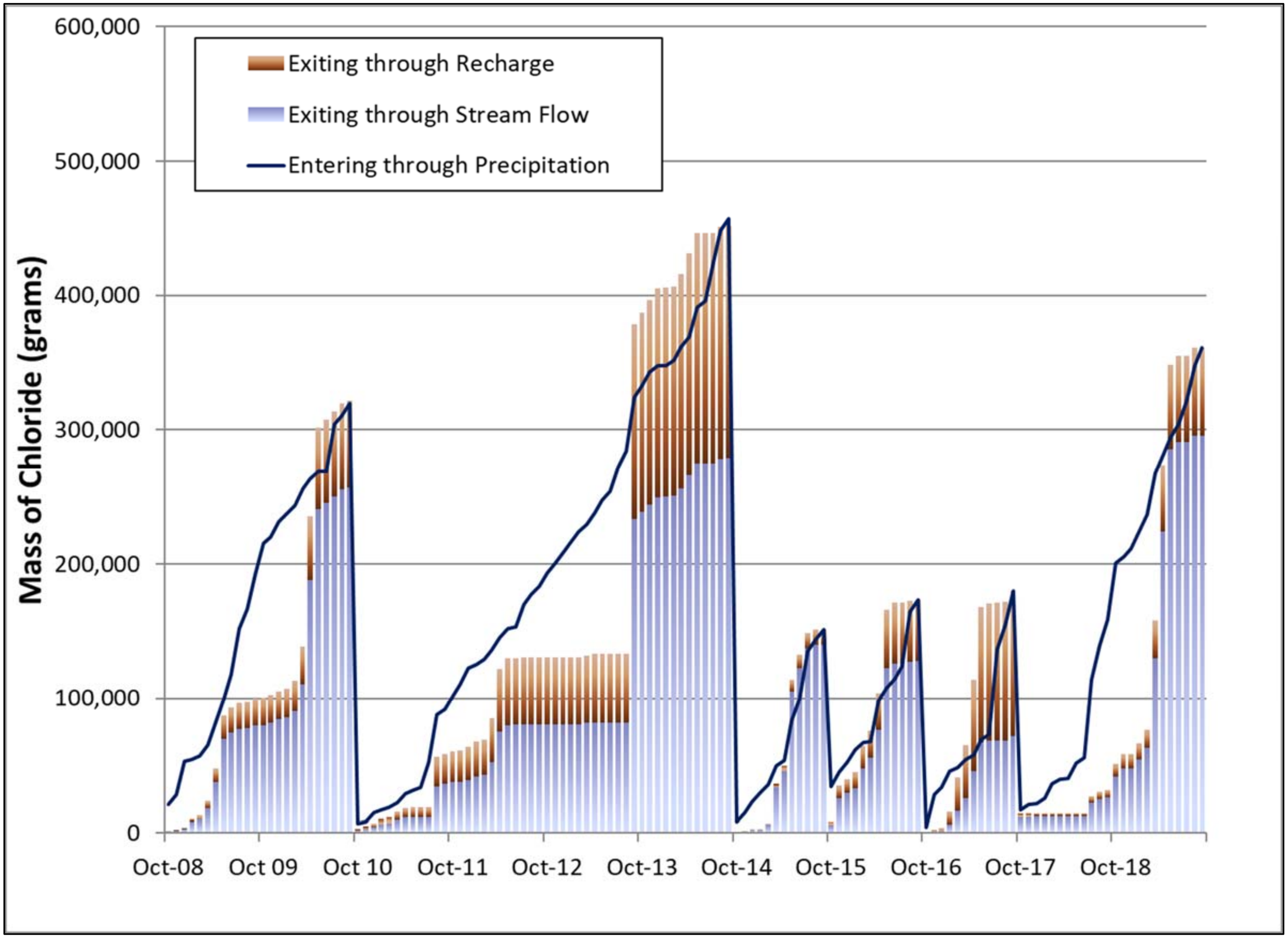
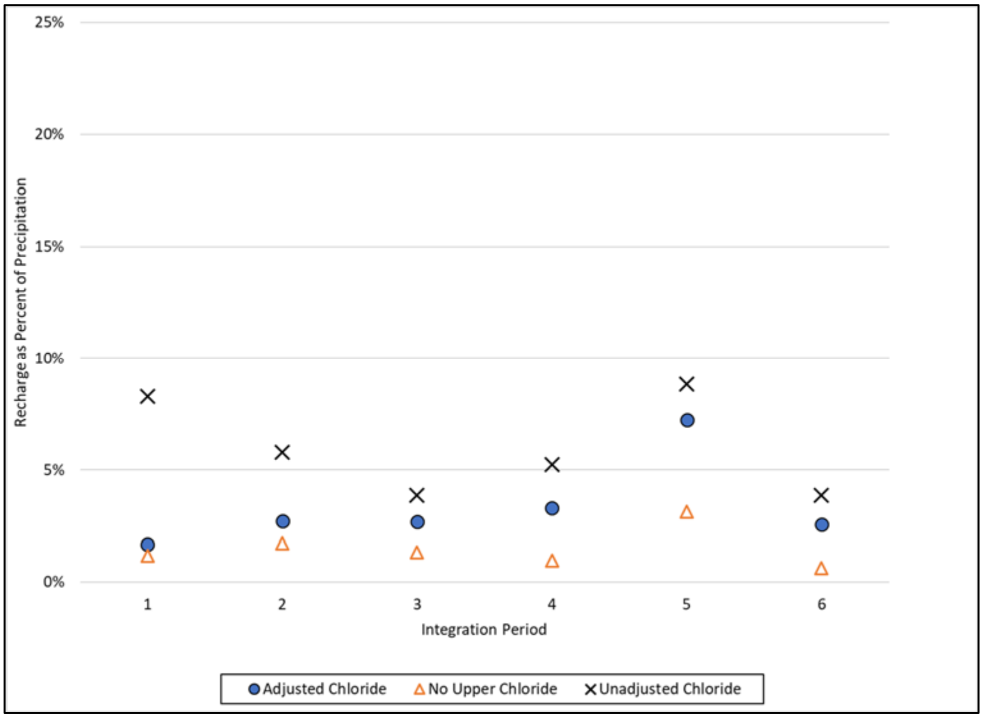


Figure 26. Cumulative mass of chloride deposited through precipitation in the Control Basin and exiting through stream flow and recharge.



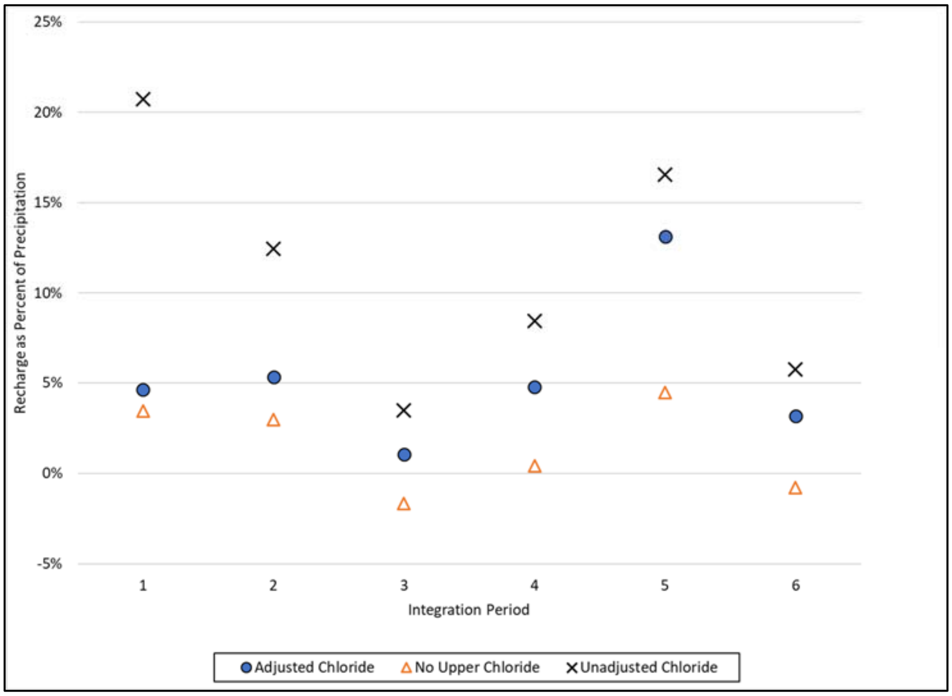
FiguresMassChloride2019.xls

Figure 27. Sensitivity analysis of chloride concentrations in precipitation to estimates of recharge in the Treated Basin.



ChlorideSensitivity.xls/Treat

Figure 28. Sensitivity analysis of chloride concentration in precipitation to estimates of recharge in the Control Basin.



ChlorideSensitivity.xls/Control

4.4 Estimation of Change in Soil Moisture

The change in storage was estimated by comparing the soil moisture at the beginning and end of the integration periods. To estimate soil moisture changes over integration periods the NWS Climate Prediction Center model estimates were used and compared to measured soil moisture at the lower gage. The NWS estimates soil moisture at the end of each month using a one-layer hydrological model based on observed precipitation and temperature (NWS 2011).

To estimate the total change in the volume of water in storage in each basin, the thickness and porosity of the soil are approximated. The dominant soils are described as Entisols that are Typic Dystrocryepts (loamy soil), which do not have a distinct soil horizon (USFS, 2009). The soil thickness measured in the lower reaches of the basins (Section 3.3) averaged 2.6 feet in the treated basin and 2.0 feet in the control basin. The percent of rock coverage varies from 40 percent in the upper third of the control basin to 70 percent at the top of the treated basin. The majority of the area has 60 percent rock cover; thus, the soil horizon is very thin. For calculating the volume of soil, it is assumed that the soil profile in this steep, mountainous terrain is 1.0 feet deep, with a porosity of 40 percent. The water budgets are not significantly impacted by a change in the depth of soil from 1 to 3 feet.

While the soil moisture fluctuates throughout the year the difference between the beginning and end of the integration periods has been relatively insignificant for water budget accounting (Figure 20). The estimated change in soil moisture was less than 6.4 percent for the six integration periods. In the third and fifth integration periods the soil moisture increased, thus for the water budget, the increase represents an outflow of water into soil storage.

4.5 Estimated of Water Budgets

ET is overwhelmingly the largest component of outflow. It makes up to 94 and 86 percent of the outflow in the treated and control basins, respectively (Table 7). Changes in soil moisture storage were not significant between the basins or at the start or ending of the six integration periods. The cumulative water budgets are illustrated in Figure 29 (treated basin) and Figure 30 (control basin) for the six integration periods. Recharge is estimated to be 1.7 to 7.2 percent of precipitation in the treated basin and 1.1 to 13.1 percent in the control basin. The amount of error in the water budgets is equivalent to the estimated inflow or outflow into in soil moisture storage.

Table 4. Evapotranspiration (ET) estimates for six integration periods.

Parameter	Integration Period 1		2		3		4		5		6	
	10 2008 thru 9 2010 (2 years)		10 2010 thru 9 2014 (4 years)		10 2014 thru 9 2015 (1 year)		10 2015 thru 9 2016 (1 year)		10 2016 thru 9 2017 (1 year)		10 2017 thru 9 2019 (2 years)	
	Treated	Control	Treated	Control	Treated	Control	Treated	Control	Treated	Control	Treated	Control
Area (acres)	443	377	443	377	443	377	443	377	443	377	443	377
Precipitation (in)	39.7		60.9		22.2		19.9		19.0		38.0	
*Precipitation (in/year)**	*19.9*		*15.2*		*22.2*		*19.9*		*19.0*		*19.1*	
Volume of Precipitation (acre-feet)	1,466	1,248	2,249	1,914	821	698	734	624	703	598	1,411	1,201
Mass of chloride deposited through precipitation (grams)	380,894	324,148	579,679	457,299	178,066	151,537	203,925	173,543	211,190	179,726	424,195	360,997
Volume-weighted chloride in precipitation (Clp) (mg/L)	0.21		0.19		0.18		0.23		0.24		0.24	
Volume of stream flow (acre-feet)	114	228	73	164	34	90	47	84	22	52	85	172
Mass of chloride discharged through stream flow (grams)	313,565	258,846	291,477	281,981	108,181	140,032	134,593	127,892	62,822	71,715	296,944	295,799
Weighted chloride in stream flow (Cls) (mg/L)	2.2	0.9	3.2	1.4	2.6	1.3	2.3	1.2	2.4	1.1	2.8	1.4
ET = (Cls-Clp)/Cls	91%	77%	94%	86%	93%	86%	90%	82%	90%	78%	91%	82%
ET (ac-ft)	1,328	962	2,115	1648	765	601	663	510	630	467	1,289	990
ET (inches per year)	18.0	15.3	14.3	13.1	20.7	19.1	17.9	16.2	17.1	14.9	17.5	15.8

Table 5. Recharge estimates for six integration periods.

Parameter	Integration Period											
	1		2		3		4		5		6	
	10/2008 thru 9/2010 (2 years)		10/2010 thru 9/2014 (4 years)		10/2014 thru 9/2015 (1 year)		10/2015 thru 9/2016 (1 year)		10/2016 thru 9/2017 (1 year)		10/2017 thru 9/2019 (2 years)	
	Treated	Control	Treated	Control	Treated	Control	Treated	Control	Treated	Control	Treated	Control
Precipitation (ac-ft)	1,466	1,248	2,249	1,914	821	698	734	624	703	598	1,411	1,201
Volume Weighted Cl in P (mg/L)	0.21		0.19		0.18		0.23		0.24		0.24	
Volume Weighted Cl in RO (mg/L)	2.2	0.9	3.2	1.4	2.6	1.3	2.3	1.2	2.4	1.1	2.8	1.5
Volume of RO (ac-ft)	114	228	73	164	34	90	47	84	22	52	85	172
Volume of R = (ClpP-ClsRO)/Cls (ac-ft)	24	58	61	102	22	7	24	30	51	79	36	38
R as a percent of P	*1.7%*	*4.6%*	2.7%	5.3%	2.7%	1.1%	3.3%	4.8%	7.2%	13.1%	2.6%	3.2%
R as a percent of RO	*21%*	*25%*	84%	62%	65%	8%	52%	36%	236%	151%	43%	22%

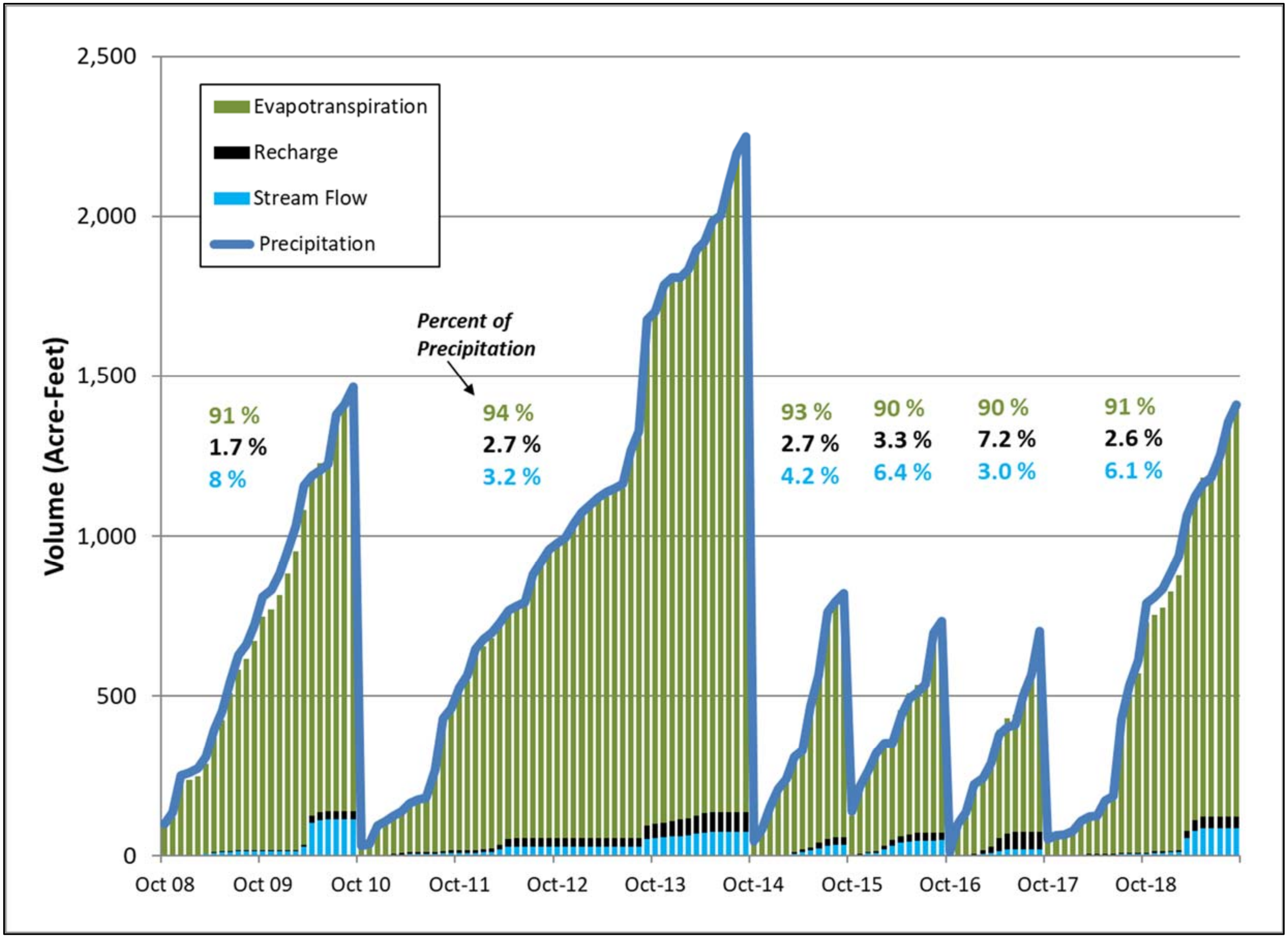
Table 6. Estimate of the volume of water released from soil moisture storage in the Control and Treated basins for six integration periods.

Parameter	Integration Period											
	1		2		3		4		5		6	
	10/2008 thru 9/2010 (2 years)		10/2010 thru 9/2014 (4 years)		10/2014 thru 9/2015 (1 year)		10/2015 thru 9/2016 (1 year)		10/2016 thru 9/2017 (1 year)		10/2017 thru 9/2019 (2 years)	
	Treated	Control	Treated	Control	Treated	Control	Treated	Control	Treated	Control	Treated	Control
Area (acres)	443	377	443	377	443	377	443	377	443	377	443	377
Average Soil Depth (feet)	1	1	1	1	1	1	1	1	1	1	1	1
Porosity of soil	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Change in Soil Moisture over water year	-0.1%		-0.3%		1.5%		-2.5%		6.1%		-6.4%	
Change in Soil Moisture (S) (ac-ft)	-0.3	-0.2	-0.6	-0.5	2.7	2.3	-4.5	-3.8	10.8	9.2	-11.3	-9.6

Table 7. Water budget components estimated for six integration periods.

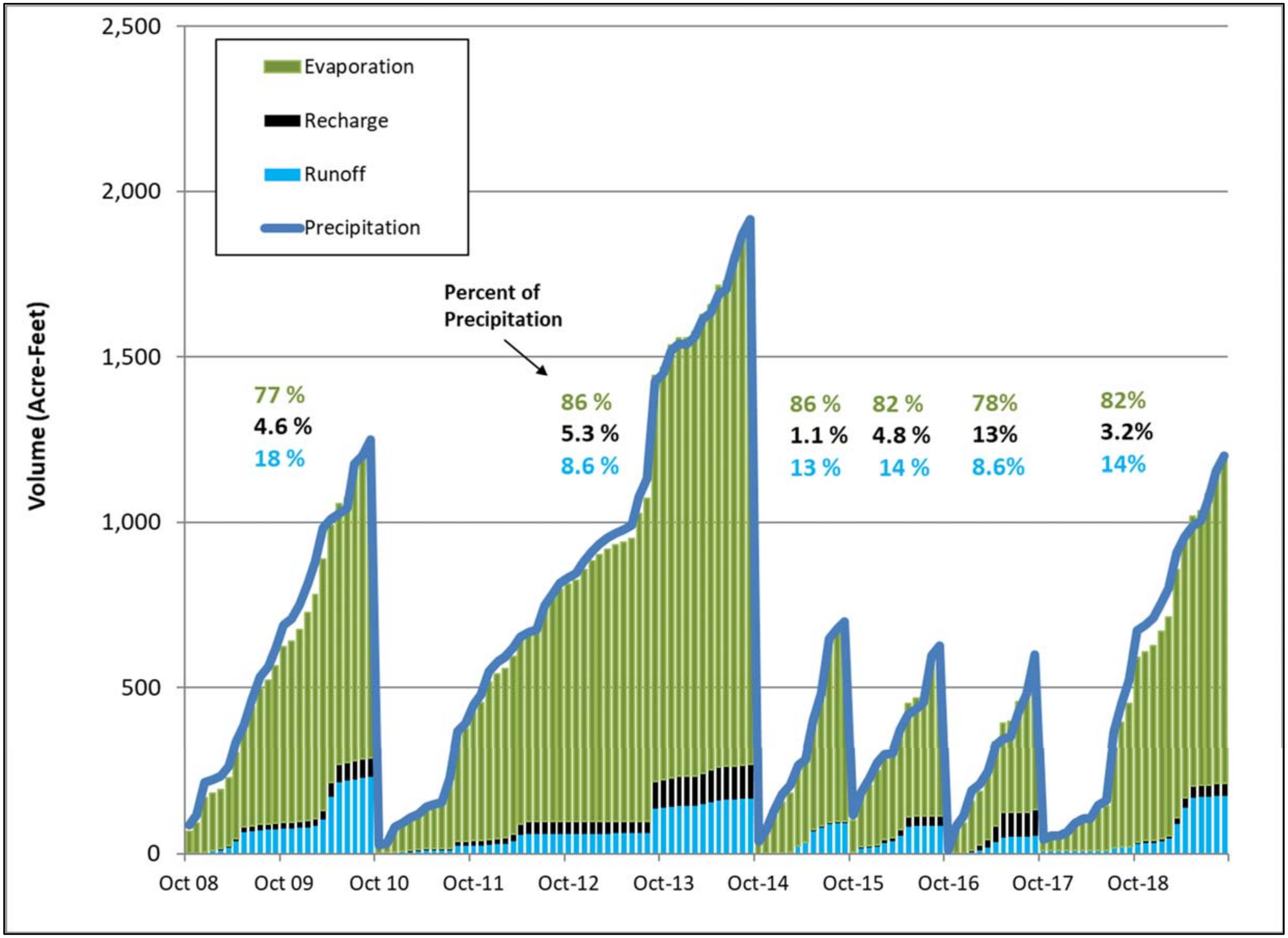
Parameter	Integration Period 1: 10/2008 thru 9/2010 (2 years)		2: 10/2010 thru 9/2014 (4 years)		3: 10/2014 thru 9/2015 (1 year)		4: 10/2015 thru 9/2016 (1 year)		5: 10/2016 thru 9/2017 (1 year)		6: 10/2017 thru 9/2019 (2 years)	
	Treated	Control	Treated	Control	Treated	Control	Treated	Control	Treated	Control	Treated	Control
Area (acres)	443	377	443	377	443	377	443	377	443	377	443	377
Volume in												
Precipitation (acre-feet)	1,466	1,248	2,249	1,914	821	698	734	624	703	598	1,411	1,201
Inter-basin flow (acre-feet)	0	0	0	0	0	0	0	0	0	0	0	0
Decrease in Soil Storage (acre-feet)	0.3	0.2	0.6	0.5	0	0	4.5	3.8	0	0	11.3	9.6
Total In (acre-feet)	**1,466**	**1,248**	**2,250**	**1,915**	**821**	**698**	**738**	**628**	**703**	**598**	**1,422**	**1,210**
Volume out												
RO (acre-feet)	114	228	73	164	34	90	47	84	22	52	85	172
ET (acre-feet)	1,328	962	2,115	1,648	765	601	663	510	630	467	1,296	990
Increase in soil storage (acre-feet)	0	0	0	0	2.7	2.3	0	0	10.8	9.2	0	0
Recharge	24	58	61	102	22	7	24	30	51	79	36	38
Total Out (acre-feet)	**1,466**	**1,248**	**2,249**	**1,914**	**823**	**701**	**734**	**624**	**714**	**607**	**1,411**	**1,201**
Remaining (acre-feet)	0	0	1	1	3	2	5	4	11	9	11	10
Percent remaining of total precipitation	*0%*	*0%*	*0%*	*0%*	*0%*	*0%*	*1%*	*1%*	*2%*	*2%*	*1%*	*1%*

Figure 29. Cumulative water volume entering and exiting the Treated Basin for six integration periods.



GraphWaterBudgets2019.xls/TreatWater

Figure 30. Cumulative water volume entering and exiting the Control Basin for six integration periods.



GraphWaterBudgets2019.xls/ControlWater

5. Discussion

Calculation of water budgets for six integration periods reflect periods for the cycling of chloride through the watersheds. The difference between the measured amount of water and chloride entering and exiting each basin shows that some chloride and water is not exiting through stream flow but leaving each basin to recharge the regional aquifer. The discussion here is intended to supplement the discussion provided in Lewis 2018 and focuses on new information collected and calculation performed following the publication of the NMBGMR Bulletin 163.

The calculated evapotranspiration and recharge estimates are highly sensitive to the estimated chloride concentration in precipitation. Concentration of chloride in precipitation is very consistent between the Middle and Lower precipitation collectors, but much more erratic at the Upper station. Precipitation samples collected at the Upper station usually contain more debris and tannins as compared to the other two stations. While the overstory coverage at the Upper station is greater than ideal, it is not much greater than the overstory coverage at the Lower station. To examine the potential impact of the overstory on the chloride concentrations, a new site was installed in an open clearing about 300 ft higher in elevation than the Upper gage. Results of two samples collected at the new site (Upper 2) showed much lower chloride concentrations than samples collected from the Upper site. These results point directly to the overstory and debris as the cause of the higher chloride, but it does not explain why samples collected from the Lower site are not equally impacted by the overstory. One suspected theory is that horizontal precipitation from cloud cover, which is greater at 10,000 ft elevation than at 8,000 ft may be contributing to increase deposition of chloride onto the overhanging vegetation. Examination of cloud ceiling height at the Santa Fe Airport reveals that the cloud cover at or below 8000 ft occurs less than half the time that it occurs at 10,000 ft. Vegetation at the Upper gage is mixed conifer (fir and spruce with moss) as compared to primarily ponderosa at the Lower gage which may also impact the rate of condensation of water from cloud cover.

If indeed chloride is deposited from water droplets in clouds it is important to measure because it is a source of chloride in the mass balance. This horizontal precipitation of water is not recorded by the tipping bucket and likely evaporates without providing a measurable water supply. Thus, while the recommended location of precipitation stations is in an open area without any obstructions (within a 45-degree angle of line of sight), such locations may underestimate chloride deposition.

The sensitivity analysis of chloride concentrations in precipitation on the calculated recharge rate (and evapotranspiration rate) shows the impact of the estimated chloride concentrations in precipitation. If we eliminate the chloride data from the Upper site, recharge estimates are reduced by less than half compared to using the adjusted concentrations from all three stations. Likewise, if we use the unadjusted chloride concentrations, the estimated recharge in both watersheds is much higher by a factor of two and up to five times greater in the first integration period. The method applied in this study includes the data from the Upper gage and no changes are recommended to the calculations presented here, however, future investigations could be enhanced with increase coverage of precipitation monitoring.

ET as a percent of precipitation is relatively consistent in the treated basin, ranging from 90 to 94 percent of precipitation over the six integration periods. The control basin on the other hand, is more variable, ranging from 77 to 86 percent.

Recharge as a percent of precipitation for the integration periods is less in the treated than the control except for the fourth integration period. Recharge ranges from 1.7 to 3.3 percent in the treated basin, except for the fifth period where recharge is estimated to be 7.2 percent. Recharge in the control basin varies from 1.1 to 13 percent. The overall average recharge rate for the 11-year period is 3.1 percent in the treated basin and 5.0 in the control, with an average precipitation of 18.2 inches/year. The recharge estimates are consistent with other studies in the area as shown in Table 8, however, the wettest integration period in this study produced the lowest recharge rate. The reason for the low value of recharge during this wetter period is not understood and may be an artifact of the integration period that is too short to reflect the travel times of the precipitation entering each watershed. Future studies could examine the travel time and determine the appropriate minimum period for an integration period.

The error in the water budgets are about 0.02 to 1.5 percent, which is equivalent to the estimated change in soil moisture as a percent of precipitation. Review of the chloride ratios of the treated stream to the control stream shows a somewhat declining trend, indicating that ET is declining in the treated basin with respect to the control basin (Figure 14). However, cross plots of the mean daily flow in each basin before and after treatment (Figure 9) shows little change in runoff from before and after treatment.

The yields in cm per month in stream flow and recharge calculated for each integration period are shown in Figure 31 and Figure 32. The relationship between stream flows (RO) in the treated basin versus the control shows no trend with successive integration periods. Likewise, recharge shows no trend in the treated basin relative to the control.

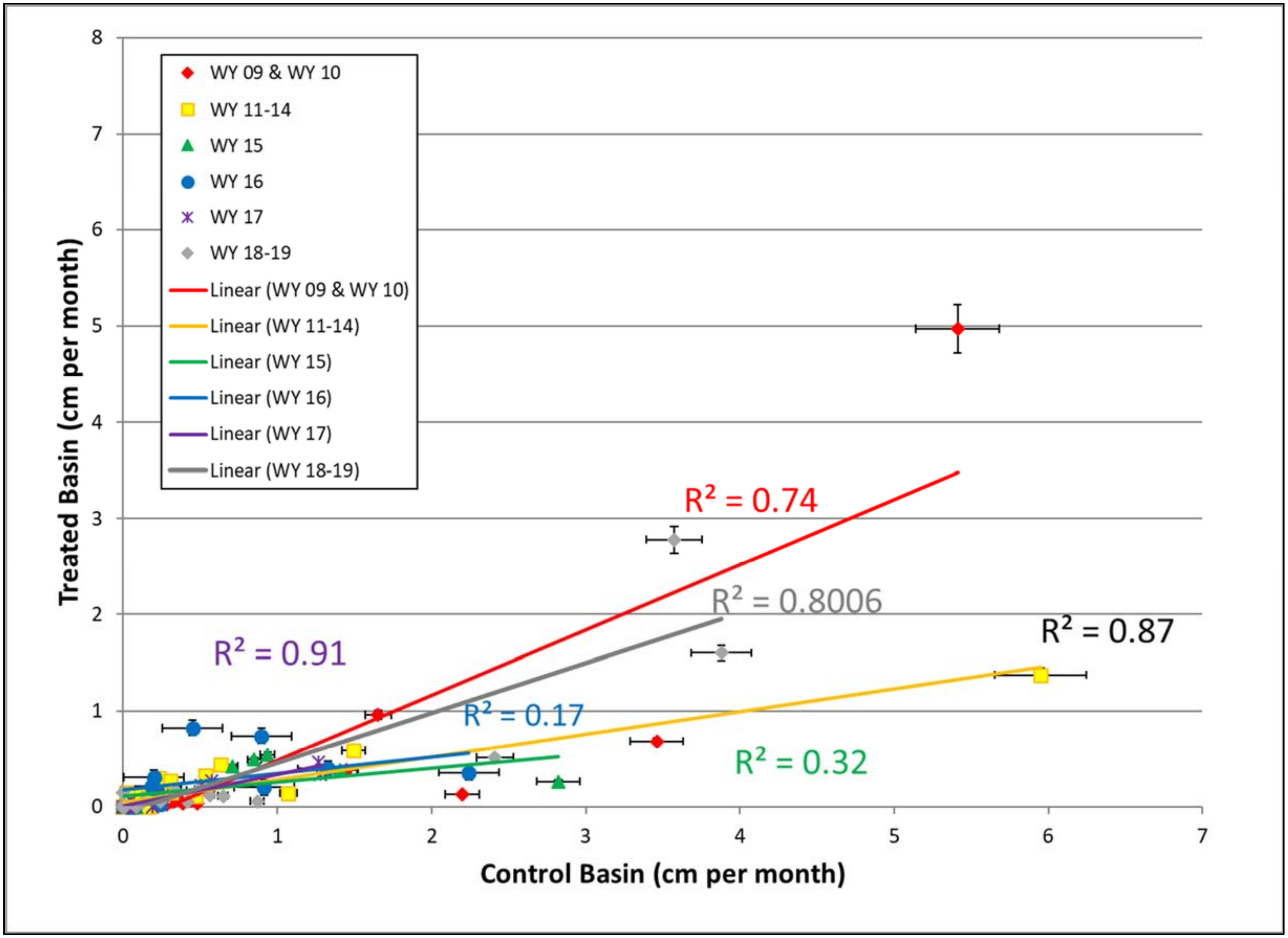
The strong correlation between the percentage of winter precipitation and the relative increase in stream flow in the treated basin reveals an important difference between a thinned and untreated area. With a reduced snow canopy in the thinned basin, more snow reaches the ground compared to the untreated basin where snow may be trapped in the canopy and sublimate. But other differences between the two basins also impact the amount of evapotranspiration, runoff and recharge that are unique to this study. The large west-facing slope in the treated basin receives more afternoon sun than the control basin during summer months when the sun is at a higher angle. For more discussion see Lewis 2018.

Table 8. Estimates of recharge as a percent of precipitation for this study and water planning regions in New Mexico

Annual Precipitation (inches)	Recharge as a Percent of Precipitation					
	This Study (10/2008-9/2019)	Estimates for New Mexico Water Planning Regions*	Wasiolek, 1995			
	Santa Fe Paired Basins		Santa Fe	Rio Nambe	Rio En Medio	Tesuque Creek
12-15	3.2 (treated 6.4 (control)	1 - 4.7	--	--	--	--
16-20	3.1 (treated) 5.0 (control)	2 - 4.7	--	--	--	--
>20	2.7 (treated) 1.1 (control)	4.7 - 10	11	12	16	10

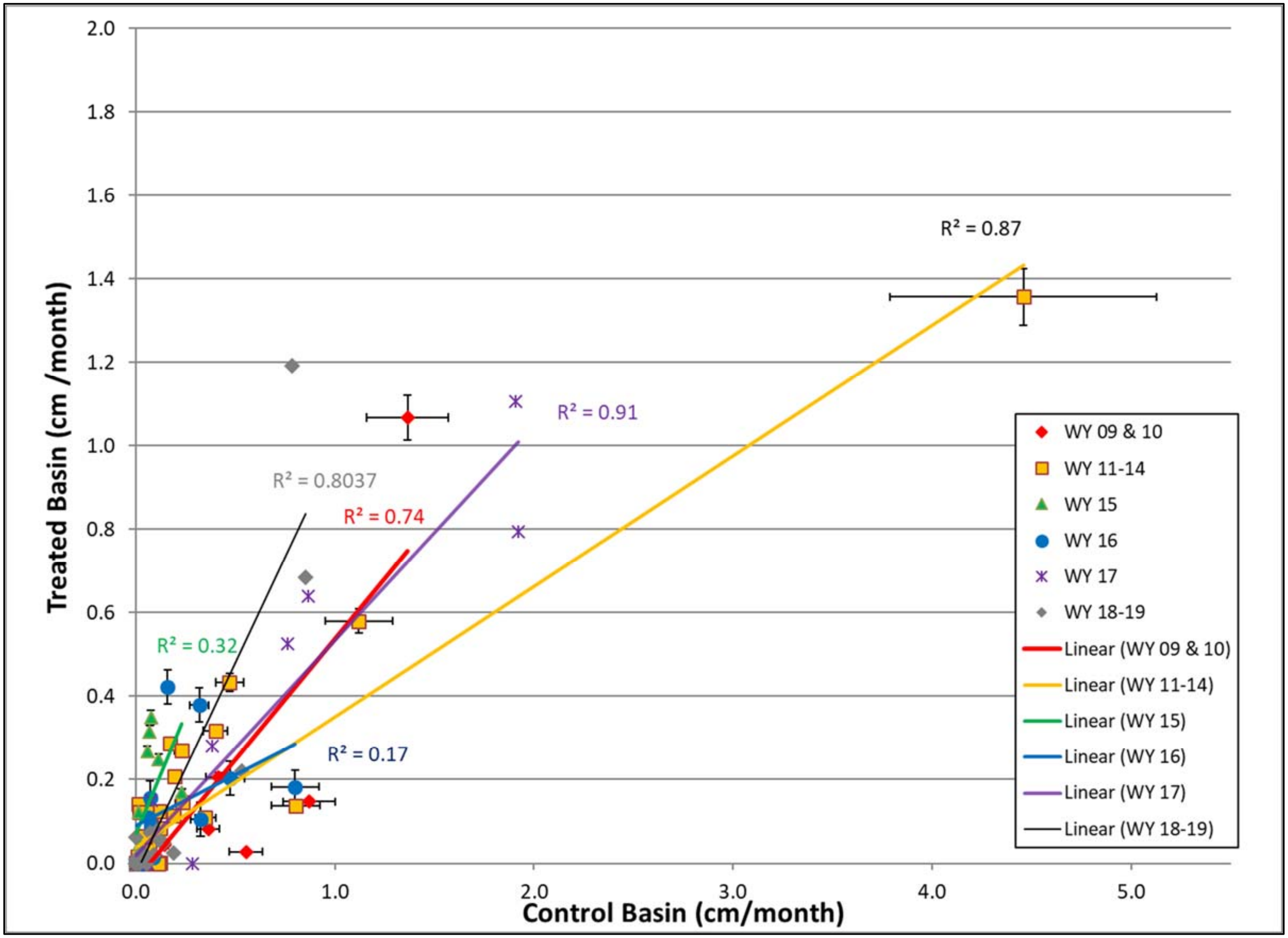
** Based on literature review (Lewis & Hilton, 2007)*

Figure 31. Cross-plot of stream flow yield (RO) per month for each integration period.



Monthlysummary.xls/RO6-per

Figure 32. Cross-plot of recharge (R) yield per month for each integration period.



Monthlysummary.xls/R6per

6. Conclusions and Recommendations

The paired basin investigation has estimated water budget components for six integration periods and eleven water years and shown that runoff increases in the treated basin relative to the control basin when a greater percentage of precipitation falls during the winter months (from October through April). ET, while greater in the treated basin compared to the control basin, was greater prior to treatments (based on one chloride sampling event in 1995) and appears to be declining in the treated basin over successive integration periods. However, no overall increase in stream flow in the treated basin from the forest treatments has been detected, except in years with a greater percentage of winter precipitation. Stream flow in the treated basin appears to increase relative to the control basin in response to winters with significantly large snow fall. When snow is the predominant form of precipitation, more of the moisture reaches the ground due to the reduced tree canopy compared to the control basin. During the winter, the impact of the western facing slope in the treated basin is less significant because the sun is at a low angle. Thus, while more rainfall also reaches the ground in the treated basin following forest treatments, more sunlight also reaches the ground in summer months.

Precipitation and stream flow were measured year-round, but ET and recharge were estimated using the chloride mass balance approach, which assumed that the chloride concentration in the stream flow is equal to water that recharges the regional aquifer. If the concentration of chloride in the recharge water is significantly lower, then the calculated ET would be less, and recharge would be greater. However, no wells are available to confirm this assumption and the steep terrain is not amenable to drilling a well.

While the chloride mass balance and water budget equations force agreement in the water budget components, the choice of integration periods impacts the estimated ET and recharge rates. Integration periods that do not consider the cycling of chloride through each basin can result in apparent negative recharge rates (or inter-basin flow) that are not observed. The cumulative mass of chloride entering the basin through precipitation is always more than the amount exiting through stream flow, thus some chloride must exit through recharge and no inter-basin flow is occurring.

While no orographic effect in precipitation has been observed in this paired basin study, the chloride concentrations may be impacted by horizontal precipitation occurring more frequently at higher elevations.

This paired basin study would have benefited from more complete pre-treatment data (in line with the data collected for this investigation), and ideally, the pre-treatment and post-treatment years would be wetter than average, rather than drought years. Wells that tap the fractured bedrock would allow for water level measurements to determine flow direction and chloride samples to test the hypothesis that the chloride concentration in stream flow is equivalent to recharge.
The landscape is continuing to be treated, with prescribed fires every five to seven years that will result in tree mortality and continued changes to the understory vegetation. This report provides an important baseline of the current state of the basins and outlines methods to pursue during continued investigations of the Santa Fe paired basins or establishment of new field areas.

Recommendations for future investigations:

1. Install more robust electric exclusions around precipitation equipment
2. Increase coverage of precipitation collectors and tipping buckets with and without canopy cover at various elevations
3. Conduct tracer studies to determine travel time through each basin

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Appendices

Appendix A. Monthly and Annual Summary of Paired Basin Monitoring Data

Monthly Summary, 2009

Parameter	Units	Jan 09	Feb 09	Mar 09	Apr 09	May 09	Jun 09	Jul 09	Aug 09	Sep 09	Oct 09	Nov 09	Dec 09	*Average/* Total
Precipitation														
Upper Precipitation Gage [a, b]	inches	-	0.12	1.01	2.14	1.15	2.11	1.75	-	-	-	0.7	1.53	-
Middle Precipitation Gage [a,b]	inches	-	0.25	0.91	1.90	1.61	-	-	-	-	-	0.49	1.16	-
Lower Precipitation Gage [c]	inches	0.21	0.44	0.63	1.67	-	2.92	2.60	0.89	1.66	2.35	0.61	1.59	-
Average of Daily Precipitation	inches	0.22	0.36	0.99	2.29	1.61	2.49	2.17	0.96	1.66	2.32	0.60	1.38	17.07
Chloride, Precipitation														
Average adjusted chloride [d]	mg/L	0.20	0.20	0.20	0.20	0.27	0.19	0.40	0.40	0.40	0.25	0.21	0.21	*0.27*
Mean Stream Flow														
Control basin	cfs	0.10	0.04	0.11	0.30	0.44	0.07	0.06	0.01	0.03	0.025	0.027	0.022	*0.102*
Treated basin	cfs	0.01	0.02	0.05	0.09	0.03	0.01	0.01	0.0005	0.0000	0.005	0.008	0.002	*0.020*
Control basin	ac-ft	5.9	2.4	7.1	17.9	27.2	3.9	3.5	0.5	1.7	1.6	1.6	1.4	74.5
Treated basin	ac-ft	0.6	1.1	3.0	5.5	1.9	0.7	0.3	0.0	0.0	0.3	0.5	0.2	14.0
Chloride, Stream Flow														
Control basin, mean	mg/L	0.73	0.83	0.94	0.90	1.07	1.03	0.65	0.38	0.98	1.15	1.05	1.25	*0.91*
Treated basin, mean	mg/L	2.90	3.01	2.94	2.47	2.40	2.48	2.44	2.79	3.05	3.09	3.48	3.70	*2.64*
Control basin, mass	grams	5,320	2,460	8,210	19,190	31,930	4,500	2,930	300	2,470	2,210	2,050	2,100	83,670
Treated basin, mass	grams	1,980	4,310	10,760	16,330	5,330	2,180	920	100	10	1,170	1,990	690	45,770

[a] Partial record for January, station installed on January 24, 2009

[b] Bear damage to station, missing records

[c] Tipping bucket clogged in May, 0.8 inches in collector (April 22 to May 31, 2009)

[d] Chloride calculated by using chloride concentrations adjusted to account for evaporation in collector (see Appendix E)

Appendix A. Monthly and Annual Summary of Paired Basin Monitoring Data (Continued)

Monthly Summary, 2010

Parameter	Units	Jan 10	Feb 10	Mar 10	Apr 10	May 10	Jun 10	Jul 10	Aug 10	Sep 10	Oct 10	Nov 10	Dec 10	*Average/* Total
Precipitation														
Upper Precipitation Gage[a]	inches	1.70	2.06	3.06	0.81	-	0.6	3.52	0.66	1.04	-	0.05	-	13.44
Middle Precipitation Gage	inches	1.61	2.89	3.47	0.75	0.53	0.54	4.69	1.04	1.63	0.88	0.04	1.59	19.66
Lower Precipitation Gage	inches	2.65	1.3	3.6	0.96	0.42	0.42	4.1	0.96	1.87	0.86	0.37	1.4	18.91
Average of Daily Precipitation	inches	1.99	2.08	3.38	0.84	0.48	0.53	4.20	0.83	1.51	0.84	0.15	1.54	18.37
Chloride, Precipitation														
Average adjusted chloride[b]	mg/L	0.08	0.07	0.10	0.22	0.30	0.23	0.22	0.18	0.16	0.22	0.20	0.11	*0.15*
Mean Stream Flow														
Control basin	cfs	0.02	0.07	0.33	1.12	0.70	0.07	0.08	0.09	0.02	0.02	0.02	0.02	*0.21*
Treated basin	cfs	0.00	0.01	0.23	1.21	0.16	0.02	0.01	0.01	0.00	0.00	0.00	0.01	*0.14*
Control basin	ac-ft	1.5	3.9	20.5	66.9	42.8	4.2	4.8	5.4	1.0	1.3	1.0	1.1	154.5
Treated basin	ac-ft	0.1	0.7	13.9	72.2	9.9	1.4	0.5	0.9	0.0	0.0	0.2	0.5	100.5
Chloride, Stream Flow														
Control basin, mean	mg/L	1.0	0.9	0.8	0.9	1.0	0.9	0.8	0.7	0.9	1.0	1.0	1.0	*0.93*
Treated basin, mean	mg/L	3.6	3.5	2.3	2.2	2.3	2.6	2.7	2.7	3.4	3.4	3.6	3.8	*2.18*
Control basin, mass	grams	1,660	4,490	20,630	77,260	52,490	4,940	4,770	5,000	1,370	1,640	1,320	1,410	176,890
Treated basin, mass	grams	620	3,130	36,890	190,210	27,700	4,450	1,520	2,860	90	-	830	2,460	270,760

[a] Bear damage to tipping bucket and collector on May 7, 2010. Data logger malfunctions in October and December.

[b] Mass of chloride calculated by using chloride concentrations adjusted to account for evaporation in collector (See Appendix E)

Appendix A. Monthly and Annual Summary of Paired Basin Monitoring Data (Continued)

Monthly Summary, 2011

Parameter	Units	Jan 11	Feb 11	Mar 11	Apr 11	May 11	Jun 11	Jul 11	Aug 11	Sep 11	Oct 11	Nov 11	Dec 11	*Average/* Total
Precipitation														
Upper Precipitation Gage[a]	inches	0.60	0.23	0.24	-	-	0.14	1.77	3.04	0.64	1.08	0.42	2.40	-
Middle Precipitation Gage[b]	inches	0.37	0.71	0.21	0.84	0.34	0.26	2.43	5.41	0.75	0.92	0.25	2.13	-
Lower Precipitation Gage	inches	0.10	0.42	0.36	0.54	0.22	0.20	2.84	4.83	1.05	2.34	1.05	2.18	16.13
Average of Daily Precipitation	inches	0.41	0.45	0.36	0.69	0.27	0.20	2.35	4.43	0.81	1.76	1.02	2.24	14.98
Chloride, Precipitation														
Average adjusted chloride[c]	mg/L	0.13	0.14	0.21	0.26	0.77	0.21	0.21	0.19	0.13	0.15	0.22	0.14	*0.19*
Mean Stream Flow														
Control basin	cfs	0.02	0.01	0.03	0.02	0.00	0.00	0.00	0.22	0.01	0.02	0.01	0.02	*0.03*
Treated basin	cfs	0.02	0.02	0.03	0.02	0.00	0.00	0.00	0.03	0.03	0.00	0.00	0.001	*0.01*
Control basin	ac-ft	1.4	0.8	2.0	1.3	0.2	0.0	0.05	13.2	0.9	1.09	0.37	1.12	22.4
Treated basin	ac-ft	1.0	0.9	1.8	1.3	0.2	0.0	0.008	2.0	1.8	0.01	0.000	0.082	9.2
Chloride, Stream Flow														
Control basin, mean	mg/L	1.04	1.01	1.04	1.09	1.00	1.00	1.14	1.56	1.09	0.99	0.99	0.96	*1.26*
Treated basin, mean	mg/L	3.59	3.63	3.64	4.11	3.75	4.00	3.98	4.15	4.65	4.17	3.95	3.79	*4.10*
Control basin, mass	grams	1,880	980	2,500	1,730	200	-	110	22,880	1,420	1,320	450	1,320	34,790
Treated basin, mass	grams	4,480	4,110	8,160	6,500	1,140	-	40	11,080	10,540	50	-	370	46,470

[a] Upper gage data logger not recording in April and May, Oct 26-Nov 15.
[b] Middle gage data loss Oct 26 to Nov 15, 2011
[c] Average adjusted chloride calculated by using chloride concentrations adjusted to account for evaporation in collector (See Appendix E)

Appendix A. Monthly and Annual Summary of Paired Basin Monitoring Data (Continued)

Monthly Summary, 2012

Parameter	Units	Jan 12	Feb 12	Mar 12	Apr 12	May 12	Jun 12	Jul 12	Aug 12	Sep 12	Oct 12	Nov 12	Dec 12	*Average/* Total
Precipitation														
Upper Precipitation Gage	inches	0.59	0.72	0.98	1.10	0.34	0.27	2.11	1.03	1.08	0.58	0.55	0.92	10.27
Middle Precipitation Gage[a]	inches	1.01	0.35	0.68	1.01	0.39	0.25	1.92	1.21	1.01	-	-	-	-
Lower Precipitation Gage	inches	0.79	0.70	0.85	1.07	0.37	0.31	2.54	1.06	0.98	0.57	0.29	1.36	10.89
Average of Daily Precipitation	inches	0.80	0.59	0.84	1.06	0.37	0.28	2.36	1.10	1.02	0.57	0.42	1.14	10.54
Chloride, Precipitation														
Average adjusted chloride [b]	mg/L	0.09	0.19	0.20	0.23	0.45	0.18	0.18	0.18	0.16	0.45	0.45	0.18	*0.30*
Mean Stream Flow														
Control basin	cfs	0.03	0.02	0.13	0.31	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.05*
Treated basin	cfs	0.02	0.03	0.10	0.14	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	*0.03*
Control basin	ac-ft	2.0	0.9	7.8	18.5	3.9	0.0	0.2	0.0	0.0	0.0	0.0	0.0	33.3
Treated basin	ac-ft	1.2	1.8	6.4	8.5	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0
Chloride, Stream Flow														
Control basin, mean	mg/L	0.99	0.99	1.01	1.00	1.00	0.84	0.82	0.81	0.81	0.81	0.81	0.81	*1.00*
Treated basin, mean	mg/L	3.22	3.59	2.87	2.75	2.56	2.41	2.40	2.40	2.40	2.40	2.40	2.40	*2.87*
Control basin, mass	grams	2,440	1,140	9,780	2,800	4,780	20	230	-	-	-	-	-	41,190
Treated basin, mass	grams	4,760	7,930	22,280	9,160	6,680	-	-	-	-	-	-	-	70,810

[a] Damaged cable, erroneous readings Oct-Dec, 2012

[b] Average adjusted chloride calculated by using chloride concentrations adjusted to account for evaporation in collector (See Appendix E)

Appendix A. Monthly and Annual Summary of Paired Basin Monitoring Data (Continued).

Monthly Summary, 2013

Parameter	Units	Jan 13	Feb 13	Mar 13	Apr 13	May 13	Jun 13	Jul 13	Aug 13	Sep 13	Oct 13	Nov 13	Dec 13	*Average/* Total
Precipitation														
Upper Precipitation Gage	inches	1.07	0.62	0.61	0.49	0.30	0.31	2.53	1.25	11.53	0.73	1.74	0.78	21.96
Middle Precipitation Gage[a]	inches	0.00	0.00	0.34	0.41	0.41	0.30	2.52	1.99	8.30	0.64	2.16	0.44	17.51
Lower Precipitation Gage	inches	0.99	0.75	0.75	0.45	0.32	0.50	3.40	1.82	8.23	0.83	2.82	0.74	21.60
Average of Daily Precipitation	inches	1.03	0.68	0.59	0.45	0.34	0.37	2.82	1.69	9.36	0.73	2.24	0.65	20.95
Chloride in Precipitation														
Average adjusted chloride [b]	mg/L	0.18	0.32	0.22	0.47	0.72	0.49	0.17	0.18	0.11	0.28	0.12	0.20	*0.17*
Mean Stream Flow														
Control basin	cfs	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	1.24	0.05	0.05	0.05	*0.12*
Treated basin	cfs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.07	0.03	0.05	*0.04*
Control basin	ac-ft	0.0	0.0	0.8	0.3	0.0	0.0	0.0	0.0	73.6	2.9	3.1	3.3	83.9
Treated basin	ac-ft	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	19.9	4.2	1.7	3.0	28.9
Chloride, Stream Flow														
Control basin, mean	mg/L	0.94	1.19	1.25	1.35	1.30	1.30	1.30	1.30	1.52	1.50	1.46	1.35	*1.64*
Treated basin, mean	mg/L	2.95	3.39	3.28	3.40	3.40	3.40	3.08	2.40	3.12	3.79	3.77	3.29	*3.23*
Control basin, mass	grams	-	-	1,100	500	-	-	-	-	151,200	5,340	5,740	5,500	169,380
Treated basin, mass	grams	-	-	30	-	-	-	-	-	75,340	19,760	7,680	12,170	114,980

[a] Replaced tipping bucket March 2013
[b] Average adjusted chloride calculated by using chloride concentrations adjusted to account for evaporation in collector (See Appendix E)

Appendix A. Monthly and Annual Summary of Paired Basin Monitoring Data (Continued).

Monthly Summary, 2014

Parameter	Units	Jan 14	Feb 14	Mar 14	Apr 14	May 14	Jun 14	Jul 14	Aug 14	Sep 14	Oct 14	Nov 14	Dec 14	*Average*/ Total
Precipitation														
Upper Precipitation Gage[a]	inches	0.00	0.77	1.57	0.76	1.71	0.38	1.39	-	1.73	1.00	1.09	1.70	12.10
Middle Precipitation Gage[b]	inches	0.01	0.61	1.37	0.49	1.83	0.35	3.14	2.33	1.11	1.18	0.85	0.36	13.63
Lower Precipitation Gage	inches	0.00	0.67	1.50	0.69	1.82	0.57	2.67	2.57	1.35	1.40	1.22	1.97	16.43
Average of Daily Precipitation	inches	0.00	0.68	1.65	0.67	1.79	0.43	2.85	2.45	1.40	1.19	1.05	1.85	16.02
Chloride in Precipitation														
Average adjusted chloride [c]	mg/L	0.14	0.14	0.16	0.29	0.32	0.26	0.26	0.26	0.16	0.18	0.18	0.11	*0.21*
Mean Stream Flow														
Control basin	cfs	0.004	0.006	0.062	0.111	0.094	0.034	0.000	0.030	0.008	0.003	0.005	0.018	*0.031*
Treated basin	cfs	0.034	0.032	0.064	0.078	0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.000	*0.020*
Control basin	ac-ft	0.3	0.3	3.8	6.6	5.8	2.0	0.011	1.9	0.5	0.165	0.324	1.076	22.8
Treated basin	ac-ft	2.1	1.8	4.0	4.7	1.6	0.0	0.000	0.0	0.0	0.000	0.000	0.000	14.06
Chloride, Stream Flow														
Control basin, mean	mg/L	1.21	1.15	1.21	1.18	1.30	1.30	1.30	1.28	1.20	1.04	1.15	1.10	*1.22*
Treated basin, mean	mg/L	3.41	3.40	3.10	3.20	3.20	3.10	3.10	3.10	3.10	3.10	3.10	3.17	*3.22*
Control basin, mass	grams	380	480	5,650	9,660	9,220	3,260	20	2,850	720	210	450	1,460	34,350
Treated basin, mass	grams	8,730	7,520	15,030	18,380	6,240	10	0	0	0	0	0	0	55,910

[a] Upper gage funnel clogged, missed readings in August.
[b] Middle gage clogged March 6-April 9, 2014, but precipitation was minimal during this period.
[c] Average adjusted chloride calculated by using chloride concentrations adjusted to account for evaporation in collector (See Appendix E)

Appendix A. Monthly and Annual Summary of Paired Basin Monitoring Data (Continued).

Monthly Summary, 2015

Parameter	Units	Jan 15	Feb 15	Mar 15	Apr 15	May 15	Jun 15	Jul 15	Aug 15	Sep 15	Oct 15	Nov 15	Dec 15	*Average/* Total
Precipitation														
Upper Precipitation Gage[a]	inches	1.37	0.95	2.18	0.58	3.74	2.12	4.48	0.87	0.60	3.79	1.78	1.89	24.35
Middle Precipitation Gage	inches	0.68	0.60	1.76	0.47	3.50	2.04	5.89	0.92	0.63	3.57	2.04	0.45	22.55
Lower Precipitation Gage	inches	1.71	1.08	1.71	0.50	4.13	3.62	5.53	1.02	0.87	3.80	2.58	1.52	28.07
Average of Daily Precipitation	inches	1.53	0.88	1.88	0.52	3.79	2.59	5.30	0.94	0.70	3.72	2.13	1.29	25.27
Chloride in Precipitation														
Average adjusted chloride[b]	mg/L	0.11	0.18	0.19	0.20	0.20	0.17	0.17	0.24	0.28	0.24	0.13	0.14	*0.18*
Mean Stream Flow														
Control basin	cfs	0.00	0.05	0.28	0.15	0.57	0.18	0.19	0.04	0.00	0.05	0.19	0.04	*0.14*
Treated basin	cfs	0.00	0.02	0.09	0.10	0.06	0.12	0.13	0.04	0.00	0.01	0.05	0.07	*0.06*
Control basin	ac-ft	0.3	3.0	17.4	8.8	34.9	10.5	11.6	2.4	0.0	3.0	11.3	2.5	105.6
Treated basin	ac-ft	0.0	1.0	5.6	6.0	3.8	7.1	7.9	2.7	0.0	0.4	2.9	4.5	41.9
Chloride, Stream Flow														
Control basin, mean	mg/L	1.05	1.00	1.21	1.14	1.37	1.31	1.01	0.89	0.90	1.13	1.47	1.23	*1.28*
Treated basin, mean	mg/L	3.35	3.24	2.78	3.08	2.95	2.44	2.10	2.11	2.20	2.43	2.60	2.66	*2.57*
Control basin, mass	grams	360	3,680	27,370	12,180	59,770	16,930	15,000	2,620	0	5,910	19,640	3,830	167,270
Treated basin, mass	grams	-	4,050	18,980	22,990	13,670	21,230	20,330	6,910	0	1,480	8,570	14,470	132,680

[a] Upper gage under reporting March 15-Nov 30, 2015, adjusted measurement according to amount in collector.
[b] Average adjusted chloride calculated by using chloride concentrations adjusted to account for evaporation in collector (See Appendix E)

Appendix A. Monthly and Annual Summary of Paired Basin Monitoring Data (Continued).

Monthly Summary, 2016

Parameter	Units	Jan 16	Feb 16	Mar 16	Apr 16	May 16	Jun 16	Jul 16	Aug 16	Sep 16	Oct 16	Nov 16	Dec 16	*Average*/ Total
Precipitation														
Upper Precipitation Gage[a]	inches	1.40	0.90	0.01	2.63	1.58	0.41	0.39	4.27	1.03	0.42	2.37	1.11	16.51
Middle Precipitation Gage	inches	1.31	0.70	0.04	2.42	1.59	0.52	0.83	3.87	0.93	0.26	2.34	0.55	15.36
Lower Precipitation Gage	inches	1.93	0.81	0.05	2.06	1.06	0.83	0.67	5.08	0.93	0.35	2.25	1.24	17.26
Average of Daily Precip	inches	1.55	0.80	0.03	2.37	1.41	0.59	0.62	4.40	0.96	0.34	2.32	0.97	16.36
Chloride in Precipitation														
Average adjusted chloride[b]	mg/L	0.15	0.19	0.19	0.33	0.17	0.32	0.37	0.24	0.24	0.32	0.27	0.15	*0.24*
Mean Stream Flow														
Control basin	cfs	0.04	0.19	0.09	0.28	0.45	0.038	0.000	0.015	0.006	0.000	0.008	0.006	*0.094*
Treated basin	cfs	0.04	0.19	0.19	0.10	0.08	0.051	0.002	0.000	0.000	0.000	0.000	0.000	*0.054*
Control basin	ac-ft	2.7	11.1	5.6	16.4	27.7	2.3	0.003	0.9	0.4	0.000	0.503	0.363	67.9
Treated basin	ac-ft	2.4	10.7	11.9	5.7	5.1	3.1	0.129	0.0	0.0	0.000	0.000	0.000	39.11
Chloride, Stream Flow														
Control basin, mean	mg/L	1.11	1.08	1.22	1.00	1.32	1.27	1.20	1.24	1.02	0.97	1.56	1.31	*1.19*
Treated basin, mean	mg/L	2.61	2.26	2.32	2.30	2.21	2.27	2.40	2.40	2.25	2.20	2.32	2.64	*2.28*
Control basin, mass	grams	3,680	14,450	8,530	20,250	46,030	3,710	0	1,340	510	0	800	540	99,840
Treated basin, mass	grams	7,790	29,340	33,770	16,260	14,030	8,450	380	0	50	0	0	0	110,060

[a] Upper gage under reporting June 3-November, 2016. Daily values adjusted according to amount in collector.
[b] Average adjusted chloride calculated by using chloride concentrations adjusted to account for evaporation in collector (See Appendix E)

Appendix A. Monthly and Annual Summary of Paired Basin Monitoring Data (Continued).

Monthly Summary, 2017

Parameter	Units	Jan 17	Feb 17	Mar 17	Apr 17	May 17	Jun 17	Jul 17	Aug 17	Sep 17	Oct 17	Nov 17	Dec 17	*Average/* Total
Precipitation														
Upper Precipitation Gage[a]	inches	2.51	0.42	-	2.27	0.61	0.14	1.85	1.53	4.22	0.72	-	-	-
Middle Precipitation Gage	inches	1.90	0.55	1.02	2.53	0.62	0.27	2.91	1.91	3.62	0.88	0.26	0.09	16.56
Lower Precipitation Gage	inches	2.70	0.75	1.48	2.65	0.67	0.25	2.57	1.82	3.23	1.36	0.32	0.06	17.86
Average of Daily Precip	inches	2.37	0.57	1.24	2.48	0.63	0.22	2.44	1.75	3.69	1.37	0.29	0.08	17.14
Chloride in Precipitation														
Average adjusted chloride[b]	mg/L	*0.13*	*0.12*	*0.13*	*0.03*	*0.45*	*0.52*	*0.67*	*0.26*	*0.18*	*0.32*	*0.33*	*0.33*	*0.25*
Mean Stream Flow														
Control basin	cfs	*0.05*	*0.11*	*0.12*	*0.26*	*0.26*	*0.01*	*0.00*	*0.00*	*0.04*	*0.13*	*0.00*	*0.00*	*0.082*
Treated basin	cfs	*0.028*	*0.06*	*0.06*	*0.11*	*0.08*	*0.02*	*0.00*	*0.00*	*0.00*	*0.03*	*0.00*	*0.00*	*0.032*
Control basin	ac-ft	3.1	6.3	7.1	15.7	15.8	0.6	0.119	0.2	2.3	8.013	0.142	0.009	59.4
Treated basin	ac-ft	1.7	3.2	3.9	6.8	4.9	0.9	0.000	0.0	0.0	1.620	0.000	0.000	23.12
Chloride, Stream Flow														
Control basin, mean	mg/L	*1.23*	*1.30*	*1.15*	*1.00*	*1.15*	*1.15*	*1.10*	*1.10*	*1.10*	*1.18*	*1.10*	*1.20*	*1.12*
Treated basin, mean	mg/L	*2.47*	*2.10*	*2.79*	*2.53*	*2.04*	*2.05*	*2.10*	*2.10*	*2.10*	*2.18*	*2.35*	*2.93*	*2.36*
Control basin, mass	grams	4,850	10,040	9,730	19,390	21,780	960	160	270	3,180	11,770	180	10	82,320
Treated basin, mass	grams	5,070	8,360	3,560	21,280	12,280	2,260	-	-	-	4,390	-	-	67,200

[a] Upper gage damaged by bear in March 2017, gage under reporting March 30- June 2, 2017. Daily values adjusted according to amount in collector.
[b] Average adjusted chloride calculated by using chloride concentrations adjusted to account for evaporation in collector (See Appendix E)

Appendix A. Monthly and Annual Summary of Paired Basin Monitoring Data (Continued).

Monthly Summary, 2018

Parameter	Units	Jan 18	Feb 18	Mar 18	Apr 18	May 18	Jun 18	Jul 18	Aug 18	Sep 18	Oct 18	Nov 18	Dec 18	*Average/* Total
Precipitation														
Upper Precipitation Gage[a]	inches	0.14	0.64	-	-	-	-	1.52	3.35	2.70	4.98	0.51	0.00	13.82
Middle Precipitation Gage	inches	0.26	0.72	0.41	0.05	0.80	0.44	5.76	2.40	1.93	4.44	0.49	0.91	18.61
Lower Precipitation Gage	inches	0.45	1.18	0.37	0.06	1.69	0.46	7.32	2.84	1.77	4.91	0.51	0.51	22.07
Average of Daily Precip	inches	0.34	0.86	0.39	0.06	1.25	0.45	6.54	2.86	2.13	4.78	0.50	0.71	20.86
Chloride in Precipitation														
Average adjusted chloride[b]	mg/L	*0.32*	*0.31*	*0.25*	*0.23*	*0.23*	*0.23*	*0.23*	*0.23*	*0.23*	*0.23*	*0.23*	*0.23*	*0.23*
Mean Stream Flow														
Control basin	cfs	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.11*	*0.03*	*0.02*	*0.17*	*0.07*	*0.00*	*0.034*
Treated basin	cfs	*0.000*	*0.000*	*0.034*	*0.000*	*0.000*	*0.000*	*0.029*	*0.013*	*0.000*	*0.013*	*0.041*	*0.006*	*0.011*
Control basin	ac-ft	0.0	0.0	0.0	0.0	0.0	0.0	6.981	1.6	1.0	10.739	4.212	0.019	24.6
Treated basin	ac-ft	0.0	0.0	2.1	0.0	0.0	0.0	1.758	0.8	0.0	0.818	2.430	0.346	8.22
Chloride, Stream Flow														
Control basin, mean	mg/L	1.11	2.10	2.79	2.53	2.04	2.05	2.10	2.10	2.10	2.18	2.35	2.93	*1.18*
Treated basin, mean	mg/L	3.00	3.00	2.42	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	1.87	*2.25*
Control basin, mass	grams	-	-	-	-	-	-	10,330	2,350	1,530	15,670	5,720	20	35,620
Treated basin, mass	grams	-	-	7,690	-	-	-	4,340	1,940	-	2,020	5,990	850	22,830

[a] Upper gage under reporting March 2018-December 2018. Daily values adjusted according to amount in collector.
[b] Average adjusted chloride calculated by using chloride concentrations adjusted to account for evaporation in collector (See Appendix E)

Appendix A. Monthly and Annual Summary of Paired Basin Monitoring Data (Continued).

Monthly Summary, 2019 (partial year)

Parameter	Units	Jan 19	Feb 19	Mar 19	Apr 19	May 19	Jun 19	Jul 19	Aug 19	Sep 19	Oct 19	Nov 19	Dec 19	*Average/ Total*
Precipitation														
Upper Precipitation Gage[a]	inches	1.63	2.00	5.23	0.00	0.35	0.30	1.85	3.05	1.61				16.01
Middle Precipitation Gage	inches	0.90	0.82	2.00	1.52	1.05	0.70	2.03	3.39	2.00				14.41
Lower Precipitation Gage	inches	1.69	1.35	3.10	1.65	1.09	0.60	1.87	1.94	0.95				14.24
Average of Daily Precip	inches	1.41	1.39	3.44	1.58	1.05	0.53	1.92	2.79	1.50				15.62
Chloride in Precipitation														
Average adjusted chloride[b]	mg/L	*0.23*	*0.23*	*0.23*	*0.23*	*0.31*	*0.48*	*0.23*	*0.24*	*0.23*				*0.25*
Mean Stream Flow														
Control basin	cfs	*0.08*	*0.11*	*0.72*	*0.81*	*0.48*	*0.05*	*0.00*	*0.05*	*0.00*				*0.256*
Treated basin	cfs	*0.012*	*0.046*	*0.657*	*0.390*	*0.121*	*0.012*	*0.000*	*0.000*	*0.000*				*0.138*
Control basin	ac-ft	5.2	6.0	44.2	48.0	29.8	3.0	0.017	3.2	0.1				139.5
Treated basin	ac-ft	0.7	2.6	40.4	23.2	7.4	0.7	0.000	0.0	0.0				75.11
Chloride, Stream Flow														
Control basin, mean	mg/L	1.60	1.60	1.62	1.70	1.65	1.43	1.40	1.18	1.14				*1.44*
Treated basin, mean	mg/L	2.62	2.90	2.90	2.90	2.90	3.00	3.00	3.00	3.00				*2.91*
Control basin, mass	grams	7,020	8,150	66,810	94,710	60,910	5,720	30	4,660	190				248,200
Treated basin, mass	grams	3,540	9,210	44,620	83,080	26,620	2,640	-	-	-				269,710

[a] Upper gage under reporting January through December 2019. Daily values adjusted according to amount in collector.
[b] Average adjusted chloride calculated by using chloride concentrations adjusted to account for evaporation in collector (See Appendix E)

Appendix B. Mean Daily Flow in the Treated Basin.

Location South of McClure Reservoir on a tributary to the Santa Fe River with a confluence in McClure Reservoir

Latitude/Longitude 35.68688 N, 105.82631 W **Elevation** 7,922 feet above mean sea level
UTM (NAD 83) 13S 425228, 3949550 **Drainage area** 443 acres
Gage 9-inch Parshall flume equipped with Instrumentation Northwest, Inc. AquiStar PT2X Smart Sensor pressure transducer installed Jan 1, 2009

	Mean Daily Discharge (cfs*) Treated Basin											
Day	Jan 17	Feb 17	Mar 17	Apr 17	May 17	Jun 17	Jul 17	Aug 17	Sep 17	Oct 17	Nov 17	Dec 17
01	0.00	0.03	0.06	0.08	0.13	0.06	0.00	0.00	0.00	0.00	0.00	0.00
02	0.00	0.03	0.06	0.09	0.12	0.05	0.00	0.00	0.00	0.00	0.00	0.00
03	0.00	0.04	0.07	0.11	0.10	0.05	0.00	0.00	0.00	0.00	0.00	0.00
04	0.00	0.04	0.06	0.11	0.09	0.04	0.00	0.00	0.00	0.00	0.00	0.00
05	0.00	0.04	0.06	0.12	0.08	0.04	0.00	0.00	0.00	0.06	0.00	0.00
06	0.00	0.04	0.06	0.13	0.08	0.03	0.00	0.00	0.00	0.16	0.00	0.00
07	0.00	0.04	0.06	0.13	0.08	0.03	0.00	0.00	0.00	0.12	0.00	0.00
08	0.00	0.05	0.06	0.13	0.08	0.03	0.00	0.00	0.00	0.09	0.00	0.00
09	0.00	0.06	0.06	0.13	0.09	0.03	0.00	0.00	0.00	0.08	0.00	0.00
10	0.03	0.08	0.06	0.13	0.10	0.02	0.00	0.00	0.00	0.06	0.00	0.00
11	0.03	0.09	0.06	0.13	0.09	0.02	0.00	0.00	0.00	0.06	0.00	0.00
12	0.03	0.09	0.06	0.13	0.09	0.02	0.00	0.00	0.00	0.03	0.00	0.00
13	0.03	0.08	0.06	0.12	0.09	0.02	0.00	0.00	0.00	0.02	0.00	0.00
14	0.03	0.06	0.06	0.12	0.08	0.01	0.00	0.00	0.00	0.02	0.00	0.00
15	0.06	0.06	0.06	0.12	0.08	0.01	0.00	0.00	0.00	0.02	0.00	0.00
16	0.10	0.06	0.06	0.11	0.07	0.01	0.00	0.00	0.00	0.01	0.00	0.00
17	0.09	0.06	0.06	0.11	0.07	0.00	0.00	0.00	0.00	0.01	0.00	0.00
18	0.08	0.06	0.05	0.11	0.07	0.00	0.00	0.00	0.00	0.01	0.00	0.00
19	0.06	0.06	0.05	0.11	0.07	0.00	0.00	0.00	0.00	0.01	0.00	0.00
20	0.05	0.06	0.05	0.11	0.06	0.00	0.00	0.00	0.00	0.01	0.00	0.00
21	0.04	0.06	0.05	0.11	0.06	0.00	0.00	0.00	0.00	0.01	0.00	0.00
22	0.04	0.06	0.06	0.11	0.07	0.00	0.00	0.00	0.00	0.01	0.00	0.00
23	0.03	0.06	0.06	0.11	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	0.03	0.06	0.07	0.11	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	0.03	0.06	0.08	0.11	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.03	0.06	0.08	0.11	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	0.04	0.06	0.08	0.11	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	*0.00*	0.07	0.08	0.11	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	*0.00*		0.08	0.11	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	*0.00*		0.08	0.11	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.03		0.08		0.06		0.00	0.00		0.00		0.00
Mean	0.031	0.06	0.06	0.11	0.080	0.02	0.00	0.00	0.00	0.03	0.00	0.00
Instantaneous flow												
Maximum	0.11	0.09	0.09	0.14	0.13	0.06	0.00	0.00	0.00	0.19	0.00	0.00
Minimum	0.00	0.02	0.04	0.08	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total (ac-ft)	1.91	3.23	3.94	6.80	4.89	0.92	0.00	0.00	0.00	1.62	0.00	0.00

Appendix B. Mean Daily Flow in the Treated Basin (continued)

Day	Mean Daily Discharge (cfs*) Treated Basin											
	Jan 18	Feb 18	Mar 18	Apr 18	May 18	Jun 18	Jul 18	Aug 18	Sep 18	Oct 18	Nov 18	Dec 18
01	0.00	*0.00*	*0.00*	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.07	0.02
02	0.00	*0.00*	0.18	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.08	0.02
03	0.00	*0.00*	0.10	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.06	0.02
04	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.05	0.03
05	0.00	0.00	0.26	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.04	0.03
06	0.00	*0.00*	0.23	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.04	0.02
07	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.04	0.02
08	0.00	*0.00*	0.03	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.04	0.02
09	0.00	*0.00*	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.04	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.05	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.05	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.05	0.00
17	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.05	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.04	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.04	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.04	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.04	0.00
22	*0.00*	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.03	0.00
23	*0.00*	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.03	0.00
24	*0.00*	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.04	0.03	0.00
25	*0.00*	*0.00*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.03	0.00
26	*0.00*	*0.00*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.03	0.00
27	*0.00*	*0.00*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.02	0.00
28	*0.00*	*0.00*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.00
29	*0.00*		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.00
30	*0.00*		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.02	*0.00*
31	*0.00*		0.00		0.00		0.02	0.00		0.04		*0.00*
Mean	0.000	0.00	0.03	0.00	0	0.00	0.03	0.013	0.00	0.01	0.04	0.01
Instantaneous flow												
Maximum	0.00	0.00	1.23	0.00	0.00	0.00	0.22	0.09	0.00	0.17	0.09	0.06
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
Total (ac-ft)	0.00	0.00	2.15	0.00	0.00	0.00	1.76	0.79	0.00	0.82	2.43	0.37

Italicized numbers are estimated

Appendix B. Mean Daily Flow in the Treated Basin (continued)

	Mean Daily Discharge (cfs*) Treated Basin											
Day	Jan 19	Feb 19	Mar 19	Apr 19	May 19	Jun 19	Jul 19	Aug 19	Sep 19	Oct 19	Nov 19	Dec 19
01	*0.00*	0.03	0.09	0.80	0.21	0.04	0.00	0.00	0.00	0.00		
02	*0.00*	0.03	0.11	0.67	0.20	0.04	0.00	0.00	0.00	0.00		
03	*0.00*	0.03	0.16	0.58	0.19	0.04	0.00	0.00	0.00	0.00		
04	0.01	0.03	0.17	0.51	0.18	0.04	0.00	0.00	0.00	0.00		
05	0.00	0.04	0.13	0.47	0.17	0.03	0.00	0.00	0.00	0.00		
06	0.00	0.06	0.13	0.44	0.17	0.03	0.00	0.00	0.00	0.00		
07	0.00	0.05	0.16	0.41	0.16	0.03	0.00	0.00	0.00	0.00		
08	0.00	0.05	0.20	0.40	0.16	0.03	0.00	0.00	0.00	0.00		
09	0.00	0.04	0.21	0.41	0.16	0.02	0.00	0.00	0.00	0.00		
10	0.00	0.04	0.21	0.43	0.15	0.01	0.00	0.00	0.00	0.00		
11	0.00	0.03	0.22	0.47	0.15	0.01	0.00	0.00	0.00	0.00		
12	0.00	0.03	0.58	0.46	0.14	0.01	0.00	0.00	0.00	0.00		
13	0.00	0.03	1.36	0.45	0.14	0.01	0.00	0.00	0.00	0.00		
14	0.00	0.03	1.32	0.44	0.13	0.01	0.00	0.00	0.00	0.00		
15	0.00	0.05	0.99	0.42	0.12	0.00	0.00	0.00	0.00	0.00		
16	0.00	0.11	0.82	0.38	0.12	0.00	0.00	0.00	0.00	0.00		
17	0.00	0.09	0.78	0.36	0.11	0.00	0.00	0.00	0.00	0.00		
18	0.01	0.07	0.82	0.33	0.11	0.00	0.00	0.00	0.00	0.00		
19	0.02	0.06	0.84	0.32	0.10	0.00	0.00	0.00	0.00	0.00		
20	0.03	0.05	0.82	0.31	0.10	0.00	0.00	0.00	0.00	0.00		
21	0.03	0.05	0.82	0.30	0.10	0.00	0.00	0.00	0.00	0.00		
22	0.03	0.05	0.88	0.29	0.09	0.00	0.00	0.00	0.00	0.00		
23	0.03	0.04	0.86	0.30	0.08	0.00	0.00	0.00	0.00	0.00		
24	0.03	0.04	0.80	0.28	0.08	0.00	0.00	0.00	0.00	0.00		
25	0.03	0.04	0.78	0.28	0.08	0.00	0.00	0.00	0.00	0.00		
26	0.03	0.04	0.78	0.27	0.07	0.00	0.00	0.00	0.00	0.00		
27	0.03	0.05	0.87	0.25	0.07	0.00	0.00	0.00	0.00	0.00		
28	0.03	0.07	1.09	0.24	0.06	0.00	0.00	0.00	0.00	0.00		
29	0.02		1.26	0.23	0.06	0.00	0.00	0.00	0.00	0.00		
30	0.02		1.15	0.22	0.06	0.00	0.00	0.00	0.00	0.00		
31	0.02		0.96		0.05		0.00	0.00		0.00		
Mean	0.013	0.05	0.66	0.39	0.12	0.01	0.00	0.00	0.00	0.00		
Instantaneous flow												
Maximum	0.03	0.11	1.58	0.87	0.22	0.05	0.00	0.00	0.00	0.00		
Minimum	0.00	0.02	0.08	0.21	0.04	0.00	0.00	0.00	0.00	0.00		
Total (ac-ft)	0.81	2.58	40.43	23.22	7.44	0.71	0.00	0.00	0.00	0.00		

*unless otherwise noted

Italicized numbers are estimated

Appendix C. Mean Daily Flow in the Control Basin.

Location South of McClure Reservoir on a tributary to the Santa Fe River with a confluence below Replogle Flume that measures flow into McClure Reservoir
Latitude/Longitude 35.68806 N, 105.82353 W **Elevation** 7932 feet above mean sea level
UTM (NAD 83) 13S 425486, 3949663 **Drainage area** 377 acres
Gage 9-inch Parshall flume equipped with Instrumentation Northwest, Inc. AquiStar PT2X Smart Sensor pressure transducer installed Jan 1, 2009

Day	Mean Daily Discharge (cfs*) Control Basin											
	Jan 17	Feb 17	Mar 17	Apr 17	May 17	Jun 17	Jul 17	Aug 17	Sep 17	Oct 17	Nov 17	Dec 17
01	0.01	0.09	0.05	0.21	0.26	0.03	0.00	0.01	0.00	0.31	0.01	0.00
02	0.01	0.10	0.04	0.24	0.33	0.04	0.00	0.01	0.00	0.28	0.01	0.00
03	0.01	0.10	0.03	0.27	0.48	0.04	0.00	0.01	0.00	0.20	0.01	0.00
04	0.00	0.09	0.03	0.30	0.49	0.04	0.00	0.02	0.00	0.16	0.01	0.00
05	0.00	0.08	0.03	0.33	0.48	0.03	0.00	0.01	0.00	0.49	0.00	0.00
06	0.01	0.08	0.03	0.33	0.52	0.03	0.00	0.01	0.00	0.79	0.00	0.00
07	0.01	0.08	0.03	0.33	0.56	0.02	0.00	0.01	0.00	0.43	0.00	0.00
08	0.00	0.08	0.03	0.31	0.56	0.02	0.00	0.01	0.00	0.29	0.01	0.00
09	0.03	0.09	0.03	0.32	0.54	0.02	0.00	0.00	0.00	0.21	0.01	0.00
10	0.07	0.10	0.03	0.31	0.50	0.01	0.00	0.00	0.00	0.16	0.00	0.00
11	0.05	0.15	0.03	0.27	0.41	0.01	0.00	0.00	0.00	0.13	0.00	0.00
12	0.04	0.21	0.05	0.23	0.33	0.01	0.00	0.01	0.00	0.10	0.00	0.00
13	0.03	0.19	0.06	0.22	0.29	0.01	0.00	0.01	0.00	0.08	0.00	0.00
14	0.03	0.17	0.07	0.26	0.27	0.01	0.00	0.00	0.00	0.07	0.00	0.00
15	0.12	0.14	0.08	0.29	0.25	0.00	0.00	0.00	0.00	0.05	0.00	0.00
16	0.15	0.12	0.09	0.26	0.23	0.00	0.00	0.00	0.00	0.05	0.00	0.00
17	0.12	0.12	0.10	0.25	0.21	0.00	0.00	0.00	0.00	0.04	0.00	0.00
18	0.12	0.12	0.12	0.26	0.18	0.00	0.00	0.00	0.00	0.03	0.00	0.00
19	0.10	0.12	0.13	0.27	0.16	0.00	0.00	0.00	0.00	0.03	0.00	0.00
20	0.09	0.12	0.16	0.29	0.14	0.00	0.00	0.00	0.00	0.02	0.00	0.00
21	0.08	0.11	0.16	0.30	0.12	0.00	0.00	0.00	0.00	0.02	0.00	0.00
22	0.07	0.11	0.18	0.28	0.11	0.00	0.00	0.00	0.00	0.02	0.00	0.00
23	0.06	0.12	0.20	0.25	0.09	0.00	0.00	0.00	0.00	0.02	0.00	0.00
24	0.07	0.12	0.23	0.24	0.08	0.00	0.00	0.00	0.00	0.01	0.00	0.00
25	0.06	0.10	0.23	0.24	0.07	0.00	0.00	0.00	0.00	0.01	0.00	0.00
26	0.05	0.09	0.23	0.24	0.06	0.00	0.00	0.00	0.00	0.01	0.00	0.00
27	0.04	0.08	0.23	0.22	0.06	0.00	0.00	0.00	0.00	0.01	0.00	0.00
28	0.03	0.07	0.23	0.20	0.05	0.00	0.02	0.00	0.26	0.01	0.00	0.00
29	0.03		0.24	0.19	0.05	0.00	0.02	0.00	0.49	0.01	0.00	0.00
30	0.03		0.23	0.21	0.04	0.00	0.01	0.00	0.43	0.01	0.00	0.00
31	0.06		0.21		0.04		0.01	0.00		0.01		0.00
Mean	0.05	0.11	0.12	0.26	0.26	0.01	0.00	0.00	0.04	0.13	0.00	0.00
	Instantaneous flow											
Maximum	0.19	0.22	0.25	0.34	0.59	0.03	0.03	0.02	0.60	1.03	0.01	0.00
Minimum	0.00	0.06	0.02	0.18	0.03	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Total (ac-ft)	3.1	6.3	7.1	15.7	15.8	0.6	0.1	0.2	2.3	8.0	0.1	0.0

Appendix C. Mean Daily Flow in the Control Basin (Continued)

	Mean Daily Discharge (cfs*) Control Basin											
Day	Jan 18	Feb 18	Mar 18	Apr 18	May 18	Jun 18	Jul 18	Aug 18	Sep 18	Oct 18	Nov 18	Dec 18
01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.03	0.00	0.32	0.00
02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.10	0.00	0.29	0.00
03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.07	0.00	0.26	0.00
04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.06	0.00	0.22	0.00
05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.05	0.00	0.18	0.00
06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.04	0.00	0.14	0.00
07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.04	0.00	0.11	0.00
08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.04	0.00	0.08	0.00
09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.00	0.07	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.06	0.00
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.05	0.00
12	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.01	0.00	0.04	0.00
13	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.01	0.00	0.04	0.00
14	0.00	0.00	0.00	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.03	0.00
15	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.03	0.00
16	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.00	0.00	0.01	0.03	0.00
17	*0.00*	0.00	0.00	0.00	0.00	0.00	0.45	0.00	0.00	0.01	0.03	0.00
18	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.00	0.01	0.02	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.02	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.02	0.00
21	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.02	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.02	0.00
23	*0.00*	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.01	0.00
24	*0.00*	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	1.77	0.01	0.00
25	*0.00*	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	1.57	0.01	0.00
26	*0.00*	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.72	0.01	0.00
27	*0.00*	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.42	0.01	0.00
28	*0.00*	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.30	0.01	0.00
29	*0.00*		0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.21	0.00	0.00
30	*0.00*		0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.15	0.00	*0.00*
31	0.00		0.00		0.00		0.07	0.00		0.25		*0.00*
Mean	0.00	0.00	0.00	0.00	0.000	0.00	0.11	0.03	0.02	0.17	0.07	0.00
Instantaneous flow												
Maximum	0.00	0.00	0.00	0.00	0.00	0.00	1.06	0.17	0.12	3.15	0.33	0.01
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total (ac-ft)	0.0	0.0	0.0	0.0	0.0	0.0	7.0	1.6	1.0	10.7	4.2	0.0

*unless otherwise noted

Italicized numbers are estimated

Appendix C. Mean Daily Flow in the Control Basin (Continued)

	Mean Daily Discharge (cfs*) Control Basin											
Day	Jan 19	Feb 19	Mar 19	Apr 19	May 19	Jun 19	Jul 19	Aug 19	Sep 19	Oct 19	Nov 19	Dec 19
01	*0.00*	0.05	0.21	0.55	1.10	0.14	0.00	0.00	0.00	0.00		
02	0.00	0.05	0.26	0.45	0.90	0.13	0.00	0.00	0.00	0.00		
03	*0.00*	0.04	0.39	0.38	0.81	0.12	0.00	0.00	0.00	0.00		
04	0.00	0.05	0.42	0.33	0.77	0.12	0.00	0.02	0.00	0.00		
05	0.00	0.07	0.35	0.32	0.74	0.11	0.00	0.01	0.00	0.03		
06	0.03	0.10	0.33	0.35	0.74	0.10	0.00	0.00	0.00	0.02		
07	0.07	0.10	0.42	0.42	0.75	0.09	0.00	0.17	0.00	0.01		
08	0.09	0.09	0.52	0.59	0.71	0.08	0.00	0.23	0.00	0.00		
09	0.09	0.08	0.48	0.88	0.64	0.07	0.00	0.19	0.00	0.00		
10	0.09	0.07	0.39	1.11	0.56	0.07	0.00	0.15	0.00	0.00		
11	0.10	0.07	0.37	0.84	0.49	0.06	0.00	0.13	0.00	0.00		
12	0.11	0.06	1.64	0.61	0.45	0.05	0.00	0.12	0.00	0.00		
13	0.10	0.05	3.36	0.48	0.43	0.05	0.00	0.10	0.00	0.00		
14	0.10	0.05	1.27	0.41	0.44	0.04	0.00	0.08	0.00	0.00		
15	0.09	0.13	0.75	0.39	0.49	0.04	0.00	0.07	0.01	0.00		
16	0.12	0.27	0.69	0.39	0.59	0.04	0.00	0.06	0.03	0.00		
17	0.13	0.26	0.69	0.48	0.63	0.03	0.00	0.05	0.02	0.00		
18	0.13	0.22	0.68	0.55	0.56	0.04	0.00	0.04	0.01	0.00		
19	0.13	0.18	0.65	0.66	0.46	0.03	0.00	0.03	0.00	0.00		
20	0.13	0.15	0.61	0.87	0.39	0.02	0.00	0.02	0.00	0.00		
21	0.14	0.12	0.57	1.08	0.35	0.02	0.00	0.02	0.00	0.00		
22	0.15	0.11	0.59	1.07	0.30	0.01	0.00	0.02	0.00	0.00		
23	0.14	0.10	0.56	1.08	0.25	0.01	0.00	0.02	0.00	0.00		
24	0.13	0.08	0.50	1.07	0.22	0.01	0.00	0.03	0.00	0.00		
25	0.11	0.08	0.44	1.03	0.20	0.01	0.00	0.01	0.00	0.00		
26	0.10	0.09	*0.56*	1.36	0.19	0.00	0.00	0.01	0.00	0.00		
27	0.08	0.13	0.69	1.72	0.19	0.00	0.00	0.00	0.00	0.00		
28	0.07	0.17	1.13	1.69	0.19	0.00	0.00	0.00	0.00	0.00		
29	0.07		1.18	1.58	0.18	0.00	0.00	0.00	0.00	0.00		
30	0.06		0.91	1.43	0.17	0.00	0.00	0.00	0.00	0.00		
31	0.05		0.70		0.16		0.00	0.00		0.00		
Mean	0.09	0.11	0.72	0.81	0.485	0.05	0.00	0.05	0.00	0.00		
Instantaneous flow												
Maximum	0.15	0.28	5.47	1.89	1.25	0.15	0.00	0.27	0.03	0.04		
Minimum	0.00	0.04	0.19	0.31	0.14	0.00	0.00	0.00	0.00	0.00		
Total (ac-ft)	5.5	6.0	44.5	48.0	29.8	3.0	0.0	3.2	0.1	0.1		

*unless otherwise noted

Italicized numbers are estimated

Appendix D. Chloride Concentrations in Surface Water Samples.

Sample Date	Chloride Concentration (mg/L)	
	Control Stream	Treated Stream
1/22/2009	0.7	2.9
2/13/2009	0.8	3.1
3/4/2009	1.0	3.0
3/4/2009	—	3.0
3/4/2009	—	2.9
3/25/2009	0.9	2.8
3/31/2009	1.0	2.7
4/10/2009	0.9	2.5
4/29/2009	0.8	2.2
5/15/2009	1.2	2.5
5/31/2009	1.1	2.4
6/16/2009	1.2	2.8
6/25/2009	0.74	2.2
8/17/2009	0.26	3.0
9/15/2009	—	3.4
9/21/2009	1.2	2.9
10/1/2009	1.1	3.0
10/10/2009	1.2	3.1
10/26/2009	1.1	3.2
10/31/2009	1.0	3.3
11/11/2009	0.9	3.4
11/23/2009	1.2	3.7
12/11/2009	1.3	—
1/5/2010	1.2	3.5
1/16/2010	1.0	3.7
1/30/2010	0.9	3.5
2/12/2010	0.9	3.5
2/27/2010	0.8	3.1
3/11/2010	0.8	2.0
3/29/2010	0.8	2.3
4/14/2010	0.8	2.0
4/28/2010	1.4	2.2
5/11/2010	0.9	2.3
5/11/2010	0.9	2.3
5/20/2010	0.9	2.4
5/26/2010	0.9	2.4
6/2/2010	1.0	2.4
6/10/2010	0.9	2.6
6/23/2010	—	2.7
6/30/2010	0.758	2.56

Sample Date	Chloride Concentration (mg/L)	
	Control Stream	Treated Stream
7/15/2010	0.84	2.8
7/22/2010	0.82	2.9
8/11/2010	0.71	2.4
8/25/2010	0.04	3
9/7/2010	0.84	3.4
9/25/2010	1.2	-
10/11/2010	0.91	3.4
10/29/2010	1.1	3.6
11/8/2010	1.1	3.6
11/15/2010	1	3.6
12/1/2010	1	3.7
12/13/2010	0.98	3.8
12/19/2010	0.99	4.1
12/29/2010	1.1	3.6
1/5/2011	1.1	3.6
1/13/2011	1	3.5
1/27/2011	0.98	3.8
2/11/2011	0.98	3.5
2/26/2011	1.1	3.7
3/6/2011	1	3.6
3/24/2011	1.1	3.7
4/1/2011	—	4
4/17/2011	1.1	4.3
4/29/2011	1	3.9
5/14/2011	1	3.6
5/30/2011	—	4
7/27/2011	1.7	3.9
09/05/2011	1.1	5
9/19/2011	0.98	4.3
9/28/2011	1	4.3
10/19/2011	0.97	4
11/04/2011	1	3.8
11/26/2011	1	4.1
12/12/2011	0.95	3.7
01/04/2012	1	3.3
01/14/2012	0.99	3.1
02/04/2012	1	3.4
02/17/2012	0.99	3.9
03/03/2012	0.96	2.9
03/16/2012	1.1	2.5

Appendix D. Chloride Concentrations in Surface Water Samples (continued).

	Chloride Concentration (mg/L)	
Sample Date	Control Stream	Treated Stream
03/23/2012	1	2.9
03/31/2012	1	2.9
4/11/2012	1	2.5
4/25/2012	1	2.3
5/5/2012	1	2.5
5/18/2012	0.99	2.6
06/02/2012	0.83	2.4
1/3/2013	0.93	2.9
1/24/2013	0.99	3.2
2/3/2013	1.2	3.4
3/2/2013	1.1	3.2
3/21/2013	1.5	3.4
4/8/2013	1.3	3.4
4/26/2013	1.3	3.4
7/22/2013	—	2.4
9/7/2013	1.3	3.1
9/13/2013	1.7	2.9
9/24/2013	1.6	3.5
9/28/2013	1.6	3.6
10/5/2013	1.5	3.8
10/17/2013	1.5	3.8
11/2/2013	1.4	3.8
11/14/2013	1.5	3.8
11/30/2013	1.4	2.9
12/16/2013	1.3	3.5
1/4/2014	1.2	3.4
1/15/2014	1.2	3.4
1/30/2014	1.2	3.4
2/14/2014	1.1	3.4
3/5/2014	1.2	3.0
3/25/2014	1.3	3.2
4/8/2014	1.1	3.2
4/22/2014	1.2	3.2
5/2/2014	1.3	3.2
5/10/2014	1.3	3.2
5/22/2014	1.3	3.2
6/1/2014	1.3	3.1
8/27/14	1.2	3.1
10/02/14	1	—
10/22/14	1.1	—

	Chloride Concentration (mg/L)	
Sample Date	Control Stream	Treated Stream
11/15/2014	1.2	—
11/30/14	1.1	—
12/21/14	1.1	3.3
01/18/15	1	3.4
02/06/15	1	3.2
03/01/15	1.1	2.9
03/15/15	1.3	2.6
03/22/15	1.4	2.6
03/29/15	1.1	3.1
04/08/15	1.1	3.1
04/25/15	1.3	3
05/06/15	1.4	3
05/29/15	1.3	2.4
05/31/15	1.3	2.5
6/7/2015	1.4	2.6
6/11/2015	1.3	2.4
6/30/2015	1.1	2.3
7/16/2015	0.92	1.9
7/31/2015	0.89	2.2
8/2/2015	0.89	2.0
8/12/2015	0.9	2.1
8/17/2015	0.89	2.1
8/23/2015	0.9	2.2
10/22/2015	1.6	2.9
11/8/2015	1.2	2.1
11/18/2015	1.3	2.2
12/4/2015	1.3	2.7
12/9/2015	1.2	2.9
12/21/2015	1.2	2.5
1/5/2016	1.1	2.5
1/14/2016	1.1	2.8
1/27/2016	1.1	2.4
2/10/2016	1.0	2.2
2/25/2016	1.3	2.2
3/10/2016	1.2	2.3
3/15/2016	1.3	--
4/13/2016	1	2.3
5/4/2016	1.3	2.2
5/16/2016	1.4	2.2
6/3/2016	1.3	2.2

Appendix D. Chloride Concentrations in Surface Water Samples (continued).

Sample Date	Chloride Concentration (mg/L)	
	Control Stream	Treated Stream
6/21/2016	1.2	2.4
8/5/2016	1.2	-
9/8/2016	0.97	2.2
11/22/2016	1.5	2.6
12/09/2016	1.3	2.7
12/20/2016	1.2	2.6
01/04/2017	1.1	2.8
01/10/2017	1.2	2.8
01/18/2017	1.3	2.2
02/01/2017	1.3	2.1
02/14/2017	1.3	2.1
03/01/2017	1.2	2.8
03/18/2017	1.1	2.8
03/30/2017	1	2.7
04/15/2017	1	2.4
04/30/2017	1.1	2.1
05/03/2017	—	2
05/17/2017	1.2	2.2
05/22/207	1.2	2
06/02/2017	1.2	2
07/29/17	1.1	-
8/16/17	1.1	-
10/02/17	1.2	2.2
10/29/17	1	2
11/16/17	1.2	2.7
03/13/18	1.2	3
10/28/18	1.1	2
03/25/19	1.6	2.9
05/09/19	1.7	2.9
17-May-19	1.7	2.9
05/31/19	1.6	2.9
06/09/19	1.5	3
06/20/19	1.4	3
08/04/19	1.2	-
08/22/19	1.1	-

“—“ = Stream dry, no sample collected

Sample Date	Chloride Concentration (mg/L)	
	Control Stream	Treated Stream
09/19/19	1.2	-

Appendix E. Chloride Concentrations in Precipitation Samples and Adjusted Concentrations.

Sample Date or Date Range*	Chloride Concentrations of Precipitation Samples (mg/l)				Percent of Precipitation Sample in Collector (Volume in Collector/Volume Measured by Tipping Bucket				Adjusted Chloride (mg/L)			Adjusted Chloride (mg/L)
Date	**Lower**	**Middle**	**Upper**		**Lower**	**Middle**	**Upper**		**Lower**	**Middle**	**Upper**	**Average**
4/22/2009	0.3	—	—		113%	—	—		0.3	—	—	
4/26/2009	—	0.29	0.3		—	66%	68%			0.19	0.21	
1/1/2009 - 4/26/2009	**0.3**	**0.29**	**0.3**		**67%**	**66%**	**68%**		**0.20**	**0.19**	**0.21**	**0.20**
5/31/2009	**0.51**	**0.49**	**NS**		**TBE (54%)**	**54%**	**NA**		**0.28**	**0.26**	**NA**	**0.27**
6/16/2009	0.53	—	—		91%	—	—		0.48	—	—	
6/25/2009	0.13	0.13	0.18		76%	TBE (59%)	41%		0.10	0.08	0.07	
6/1/2009 - 6/25/2009	**0.28**	**0.13**	**0.18**		**82%**	**59%**	**41%**		**0.23**	**0.08**	**0.07**	**0.13**
9/15/2009	0.67	—	—		60%	—	—		0.40	—	—	
10/1/2009	0.55	—	—		88%	—	—		0.48	—	—	
10/10/2009	0.57	—	—		80%	—	—		0.46	—	—	
10/11/2009	—	0.56	NS		—	TBE (67%)	NA		—	0.38	NA	
6/26/2009 - 10/11/2009	**0.64**	**0.56**	**NS**		***67%***	**67%**	**NA**		**0.43**	**0.38**	**NA**	**0.40**
11/3/2009	—	*ND (0.04)*	—		—	77%	—		—	0.04	—	
11/4/2009	0.11	—	—		65%	—	—		0.07	—	—	
12/11/2009	0.54	—	—		55%		—		0.30	—	—	
12/16/2009	—	0.55	—		—	51%	—		—	0.28	—	
1/9/2010	0.19	0.22	0.49		TBE (43%)	43%	TBE (59%)		0.08	0.09	0.29	
10/12/2009-1/9/2010	**0.31**	**0.25**	**0.49**		**58%**	**61%**	**59%**		**0.18**	**0.16**	**0.29**	**0.21**
2/12/2010	0.21	—	—		60%	—	—		0.13	—	—	
3/21/2010	0.18	0.18	*ND (0.04)*		87%	27%	72%		0.16	0.05	0.03	
1/10/2010-3/21/2010	**0.19**	**0.18**	***0.04***		**75%**	**27%**	**72%**		**0.15**	**0.05**	**0.03**	**0.07**

Sample Date or Date Range*	Chloride Concentrations of Precipitation Samples (mg/l)				Percent of Precipitation Sample in Collector (Volume in Collector/Volume Measured by Tipping Bucket				Adjusted Chloride (mg/L)			Adjusted Chloride (mg/L)
4/14/2010	0.22	—	—		74%	—	—		0.16	—	—	
4/25/2010	—	0.27	0.33		—	59%	97%		—	0.16	0.32	
4/29/2010	0.25	—	—		81%	—	—		0.20	—	**—**	
3/22/2010-4/29/2010	**0.235**	**0.27**	**0.33**		**78%**	**59%**	**97%**		**0.18**	**0.16**	**0.32**	**0.22**
6/6/2010	—	—	1.5		—	—	21%		—	—	0.31	
6/10/2010	2.5	3.9	—		16%	5%	—		0.39	0.20	—	
4/30/2010-6/10/2010	**2.5**	**3.9**	**1.5**		**16%**	**5%**	**21%**		**0.39**	**0.20**	**0.31**	**0.30**
6/30/2010	0.862	—	—		29%	—	—		0.25	—	—	
7/15/2010	0.18	—	—		TBE (70%)	—	—		0.13	—	—	
8/11/2010	0.21	—	—		70%	—	—		0.15	—	—	
8/14/2010	—	0.23	0.45		—	69%	73%		—	0.16	0.33	
6/11/2010-8/14/2010	**0.24**	**0.23**	**0.45**		**67%**	**69%**	**73%**		**0.16**	**0.16**	**0.33**	**0.22**
9/25/2010	0.15	0.14	—		70%	70%	—		0.11	0.10	—	
10/11/2010	—	—	0.4		—	—	66%		—	—	0.26	
8/15/2010-10/11/2010	**0.15**	**0.14**	**0.4**		**70%**	**70%**	**66%**		**0.11**	**0.10**	**0.26**	**0.16**
10/29/2010	0.35	—	—		53%	—	—		0.19	—	—	
11/20/2010	—	0.18	0.75		—	47%	TBE (50%)		—	0.09	0.38	
10/12/2010-11/20/2010	**0.35**	**0.18**	**0.75**		**53%**	**47%**	**50%**		**0.19**	**0.09**	**0.38**	**0.22**
12/19/2010	**0.2**	**0.12**	**0.25**		**61%**	**80%**	**46%**		**0.12**	**0.10**	**0.11**	**0.11**
1/13/2011	**0.17**	**0.16**	**0.22**		**83%**	**44%**	**TBE (63%)**		**0.14**	**0.07**	**0.14**	**0.12**

Sample Date or Date Range*	Chloride Concentrations of Precipitation Samples (mg/l)			Percent of Precipitation Sample in Collector (Volume in Collector/Volume Measured by Tipping Bucket			Adjusted Chloride (mg/L)			Adjusted Chloride (mg/L)
2/11/2011	0.22	—	—	TBE (83%)	—	—	0.22	—	—	
3/6/2011	—	0.26	0.13	—	54%	TBE (54%)	—	0.14	—	
2/12/2011-3/6/2011	**0.22**	**0.26**	**0.13**	**83%**	**54%**	**TBE (54%)**	**0.18**	**0.14**	**0.09**	**0.14**
4/17/2011	**0.36**	**0.37**	**0.56**	**81%**	**28%**	**TBE (55%)**	**0.29**	**0.10**	**0.31**	**0.23**
5/13/2011	**0.68**	**0.53**	**0.35**	**52%**	**80%**	**TBE (66%)**	**0.35**	**0.42**	**0.23**	**0.34**
7/27/2011	0.83	—	—	40%	—	—	0.33	—	—	
8/18/2011	0.22	—	—	45%	—	—	0.10	—	—	
9/5/2011	0.125	0.23	0.52	72%	67%	47%	0.09	0.15	0.25	
5/14/2011-9/5/2011	**0.40**	**0.23**	**0.52**	**55%**	**67%**	**47%**	**0.22**	**0.15**	**0.25**	**0.21**
9/24/2011	**0.21**	**0.19**	**0.33**	**52%**	**68%**	**28%**	**0.11**	**0.13**	**0.09**	**0.11**
11/4/2011	**0.16**	**0.11**	**0.49**	**75%**	**TBE (63%)**	**51%**	**0.12**	**0.07**	**0.25**	**0.15**
12/12/2011	**0.25**	**0.29**	**0.75**	**78%**	**35%**	**48%**	**0.20**	**0.10**	**0.36**	**0.22**
1/4/2012	0.12	—	—	75%	—	—	0.09	—	—	
1/14/2012	—	0.14	—	—	77%	—	—	0.11	—	
2/4/2012	0.18	0.17	0.19	78%	TBE (55%)	32%	0.14	0.09	0.06	
12/13/2011 - 2/4/2012	**0.14**	**0.15**	**0.19**	**76%**	**66%**	**32%**	**0.11**	**0.10**	**0.06**	**0.09**
3/4/2012	**0.29**	**0.20**	**0.29**	**81%**	**103%**	**56%**	**0.24**	**0.20**	**0.16**	**0.20**
4/11/2012	**0.32**	**0.3**	**0.29**	**63%**	**76%**	**63%**	**0.20**	**0.23**	**0.18**	**0.20**
5/5/2012	**1.3**	**0.44**	**T**	**50%**	**35%**	**T**	**0.65**	**0.15**	**T**	**0.40**

Sample Date or Date Range*	Chloride Concentrations of Precipitation Samples (mg/l)				Percent of Precipitation Sample in Collector (Volume in Collector/Volume Measured by Tipping Bucket				Adjusted Chloride (mg/L)			Adjusted Chloride (mg/L)
6/2/2012	**1**	**0.38**	**1.5**		**38%**	**61%**	**50%**		**0.38**	**0.23**	**0.75**	**0.45**
8/30/2012	**0.5**	**0.34**	**NS**		**42%**	**TBE (42%)**	**NS**		**0.21**	**0.14**	**NS**	**0.18**
9/19/2012	**0.12**	**0.24**	**NS**		**70%**	**79%**	**NS**		**0.08**	**0.19**	**NS**	**0.14**
11/21/2012	**0.39**	**0.16**	**0.96**		**93%**	**TBE (90%)**	**87%**		**0.36**	**0.14**	**0.84**	**0.45**
1/3/2013	0.15	0.12	—		100%	100%	—		0.15	0.12	—	
2/3/2013	0.16	0.17	0.4		74%	TBE (73%)	73%		0.12	0.12	0.29	
11/22/2012-2/3/2013	**0.15**	**0.15**	**0.4**		**89%**	**81%**	**73%**		**0.14**	**0.12**	**0.29**	**0.18**
3/2/2013	**0.49**	**0.44**	**0.66**		**64%**	**78%**	**58%**		**0.31**	**0.27**	**0.38**	**0.32**
4/13/2013	**0.24**	**0.27**	**0.25**		**79%**	**87%**	**82%**		**0.19**	**0.23**	**0.20**	**0.21**
5/13/2013	**1.3**	**0.71**	**1.1**		**48%**	**87%**	**83%**		**0.62**	**0.62**	**0.91**	**0.72**
6/22/2013	**0.81**	**1**	**NS**		**59%**	**77%**	**NS**		**0.48**	**0.77**	**NS**	**0.63**
7/25/2013	**0.17**	**0.2**	**NS**		**85%**	**86%**	**NS**		**0.14**	**0.17**	**NS**	**0.16**
9/7/2013	**0.18**	**0.21**	**0.45**		**69%**	**60%**	**TBE (65%)**		**0.12**	**0.13**	**0.29**	**0.18**
9/28/2013	**0.1**	**0.095**	**0.14**		**83%**	**82%**	**TBE(82%)**		**0.08**	**0.08**	**0.11**	**0.09**
11/2/2013	**0.24**	**0.23**	**0.43**		**100%**	**97%**	**89%**		**0.24**	**0.22**	**0.38**	**0.28**
11/30/2013	**0.109**	**0.1**	**0.215**		**88%**	**89%**	**79%**		**0.10**	**0.09**	**0.17**	**0.12**

Sample Date or Date Range*	Chloride Concentrations of Precipitation Samples (mg/l)				Percent of Precipitation Sample in Collector (Volume in Collector/Volume Measured by Tipping Bucket				Adjusted Chloride (mg/L)			Adjusted Chloride (mg/L)
1/4/2014	0.31	0.23	0.47		58%	100%	41%		0.18	0.23	0.19	0.20
3/5/2014	0.17	0.17	0.16		88%	63%	93%		0.15	0.11	0.15	0.14
4/9/2014	0.37	0.25	0.25		63%	TBE (72%)	81%		0.23	0.18	0.20	0.22
5/10/2014	0.3	0.22	0.7		61%	76%	79%		0.18	0.17	0.55	0.30
6/1/2014	0.26	0.19	0.56		78%	100%	100%		0.20	0.19	0.56	0.32
8/27/2014	0.23	0.28	0.41		78%	91%	TBE(84%)		0.18	0.25	0.35	0.26
10/2/2014	0.15	0.15	0.3		90%	86%	69%		0.13	0.13	0.21	0.16
11/30/2014	0.19	0.16	0.27		89%	98%	76%		0.17	0.16	0.21	0.18
2/10/2015	0.15	0.13	0.16		78%	75%	75%		0.12	0.10	0.12	0.11
3/15/2015	0.18	0.2	0.35		84%	79%	78%		0.15	0.16	0.27	0.19
4/25/2015	0.21	0.21	0.23		77%	91%	TBE(84%)		0.16	0.19	0.19	0.18
5/31/2015	0.2	0.18	0.33		83%	90%	TBE(86%)		0.17	0.16	0.29	0.20
6/30/2015	0.12	0.16	0.26		95%	81%	97%		0.11	0.13	0.25	0.17
8/2/2015	0.15	0.16	0.27		81%	TBE (87%)	93%		0.12	0.14	0.25	0.17
9/2/2015	0.2	0.22	0.44		81%	88%	TBE(84%)		0.16	0.19	0.37	0.24
9/30/2015	0.17	0.14	0.69		86%	84%	TBE(85%)		0.15	0.12	0.59	0.28

Sample Date or Date Range*	Chloride Concentrations of Precipitation Samples (mg/l)				Percent of Precipitation Sample in Collector (Volume in Collector/Volume Measured by Tipping Bucket				Adjusted Chloride (mg/L)			Adjusted Chloride (mg/L)
11/9/2015	0.21	0.14	0.5		71%	99%	TBE(85%)		0.15	0.14	0.42	0.24
12/9/2015	0.11	0.05	0.33		87%	62%	80%		0.10	0.03	0.26	0.13
1/12/2016	0.15	0.15	0.17		92%	100%	81%		0.14	0.15	0.14	0.14
3/17/2016	0.29	0.21	0.25		80%	80%	67%		0.23	0.17	0.17	0.19
5/4/2016	0.4	0.3	0.48		81%	89%	85%		0.32	0.27	0.41	0.33
6/3/2016	0.25	0.16	NS		62%	85%	NS		0.15	0.14	NS	0.14
8/9/2016	0.325	0.265	0.74		78%	92%	TBE(85%)		0.25	0.24	0.63	0.37
9/8/2016	0.14	0.15	0.23		87%	76%	TBE(81%)		0.12	0.11	0.19	0.14
11/8/2016	0.21	0.2	0.66		85%	94%	TBE(89%)		0.18	0.19	0.59	0.32
12/20/2016	0.17	0.17	0.35		86%	94%	74%		0.15	0.16	0.26	0.19
1/18/2017	0.17	0.14	0.16		88%	97%	81%		0.15	0.14	0.13	0.14
3/1/2017	0.15	0.12	0.18		85%	80%	81%		0.13	0.10	0.14	0.12
3/30/2017	0.17	0.14	0.19		76%	78%	TBE (77%)		0.13	0.11	0.15	0.13
4/30/2017	0.035	0.029	0.055		93%	74%	TBE(83%)		0.03	0.02	0.05	0.03
6/2/2017	0.54	0.47	0.85		75%	77%	TBE (76%)		0.40	0.36	0.64	0.47
7/29/2017	0.27	0.21	1.7		77%	84%	96%		0.21	0.18	1.63	0.67

Sample Date or Date Range*	Chloride Concentrations of Precipitation Samples (mg/l)				Percent of Precipitation Sample in Collector (Volume in Collector/Volume Measured by Tipping Bucket				Adjusted Chloride (mg/L)			Adjusted Chloride (mg/L)
9/5/2017	0.21	0.22	0.49		0.66	0.85	0.93		0.14	0.19	0.46	0.26
10/2/2017	0.19	0.17	0.27		77%	92%	TBE (84%)		0.15	0.16	0.23	0.18
1/19/2018	0.2	0.19	0.79		77%	91%	NS		0.15	0.17	0.66	0.33
3/13/2018	0.3	0.56	0.34		65%	84%	TBE (75%)		0.19	0.47	0.25	0.31
8/19/2018	0.25	0.3	NS		68%	76%	NS		0.17	0.23	NS	0.20
3/25/2019	0.19	NS	NS		83%	NS	NS		0.16	NS	NS	
5/17/2019	0.23	0.18	0.39		74%	94%	—		0.17	0.17	0.32	0.22
3/14/2018 to 5/17/2019	0.22	0.22	0.39		76%	94%	TBE (82%)		0.17	0.17	0.32	0.23
6/20/2019	0.52	0.5	NS		90%	99%	NS		0.47	0.49	NS	0.48
7/20/2019	NS	0.28	NS		NS	80%	84%		NS	0.22	NS	0.22
8/22/2019	0.18	0.17	0.49		73%	96%	85%		0.13	0.16	0.41	0.24
9/19/2019	0.25	0.17	0.41		78%	85%	82%		0.20	0.15	0.34	0.23

* Date Range for average chloride value is the time between the sample date and the previous sample date, or the range as stated

ND = No Detection of chloride in sample. Chloride concentrations reported as ND were assumed to be 1/2 of the detection limit

NS = No Sample available due to damage from bear(s)

TBE= Tipping Bucket Error based on data logger malfunction or under recording of precipitation (where volume in collector was greater than the amount measured by tipping bucket). The percent assumed to evaporate in the precipitation collector was set equal to the average of the two other gages.

'--' = No Site Visit

T = Trace of precipitation, insufficient sample for analysis

Appendix F. Daily Precipitation at the Upper Precipitation Gage

Location South of McClure Reservoir between two unnamed tributaries to the Santa Fe River

Latitude/Longitude 35 40.293 N, 105 48.892 W **Elevation** 9,910 feet above mean sea level
UTM (NAD 83) 13S 426253, 3947826 **Gage** Campbell Scientific TE525 Tipping Bucket with snow adapter

Day	Daily Precipitation (inches) Upper Precipitation Gage 2017											
	Jan 17	Feb 17	Mar 17	Apr 17	May 17	Jun 17	Jul 17	Aug 17	Sep 17	Oct 17	Nov 17	Dec 17
01	0.01	0.00	0.09	0.44	0.04	0.00	0.00	0.03	0.03	0.10		
02	0.00	0.00	0.00	0.10	0.00	0.12	0.00	0.20	0.00	0.04		
03	0.03	0.00	0.00	0.06	0.00	0.00	0.00	0.27	0.02	0.02		
04	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.00	0.00	0.02		
05	0.31	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.55		
06	0.04	0.00	0.00	0.06	0.00	0.00	0.00	0.01	0.00	0.00		
07	0.52	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00		
08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.10	0.00		
09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00		
11	0.00	0.00	0.00	0.00	0.14	0.00	0.03	0.24	0.10	0.00		
12	0.00	0.00	0.00	0.00	0.07	0.00	0.01	0.00	0.00	0.00		
13	0.00	0.19	0.00	0.00	0.04	0.00	0.41	0.14	0.08	0.00		
14	0.00	0.12	0.00	0.00	0.00	0.00	0.15	0.01	0.02	0.00		
15	0.10	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
16	0.38	0.03	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00		
17	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.02	0.00		
18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
19	0.07	0.00		0.00	0.00	0.00	0.00	0.03	0.00	0.00		
20	0.00	0.00		0.00	0.00	0.02	0.00	0.03	0.00	0.00		
21	0.01	0.00		0.00	0.00	0.00	0.00	0.15	0.00	0.00		
22	0.19	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00		
23	0.45	0.00		0.00	0.18	0.00	0.35	0.00	1.05	0.00		
24	0.40	0.00		0.00	0.14	0.00	0.00	0.00	0.00	0.00		
25	0.00	0.00		0.00	0.00	0.00	0.00	0.01	0.00	0.00		
26	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.02	0.00		
27	0.00	0.00		0.00	0.00	0.00	0.68	0.00	1.67	0.00		
28	0.00	0.05		0.00	0.00	0.00	0.01	0.08	0.89	0.00		
29	0.00	0.00		0.82	0.00	0.00	0.03	0.23	0.15	0.00		
30	0.00	0.00		0.21	0.00	0.00	0.01	0.00	0.08			
31	0.00	0.00		0.00	0.00		0.00	0.00	0.00			
Total	2.51	0.42	0.09	2.27	0.61	0.14	1.85	1.53	4.22	0.72		

Tipping bucket removed 10/30/2017

Appendix F. Daily Precipitation at the Upper Precipitation Gage (Continued)

Day	Daily Precipitation (inches) Upper Precipitation Gage 2018											
	Jan 18	Feb 18	Mar 18	Apr 18	May 18	Jun 18	Jul 18	Aug 18	Sep 18	Oct 18	Nov 18	Dec 18
01		0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.74	0.00	0.20	0.00
02		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.06	0.00
03		0.00	0.00	0.00	0.00	0.00	0.00	1.74	0.00	0.00	0.00	0.00
04		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
05		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67	0.00	0.00	0.00
06		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00
07		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00
08		0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.03	0.00	0.00	0.00
09		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00
10		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13		0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	0.00	0.11	0.00
14		0.02	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.14	0.00
15		0.52	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00
16		0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00
17		0.05	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00
18		0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	0.08	0.00	0.00	0.00	0.00	0.00	0.00	1.12	0.00	0.00	0.00	0.00
23	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.17	0.00	1.41	0.00	0.00
24	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	2.00	0.00	0.00
25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00
26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.06	0.00	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.03	0.00	0.00
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	0.00	0.00	0.00		0.00		0.08	0.00		1.32	0.00	0.00
Total	0.14	0.64	0.00	0.00	0.00	0.00	1.52	3.35	2.70	4.98	0.51	0.00

Tipping bucket reinstalled 1/19/2018

Appendix F. Daily Precipitation at the Upper Precipitation Gage (Continued)

Day	Daily Precipitation (inches) Upper Precipitation Gage 2019 Partial Year											
	Jan 19	Feb 19	Mar 19	Apr 19	May 19	Jun 19	Jul 19	Aug 19	Sep 19	Oct 19	Nov 19	Dec 19
01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	
02	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.00	0.00	0.00	
03	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.29	0.00	0.00	0.00	
04	0.00	0.00	0.00	0.00	0.00	0.13	0.01	0.00	0.00	0.99	0.00	
05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	
06	0.00	0.00	0.00	0.00	0.00	0.00	0.10	1.30	0.00	0.00	0.03	
07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.15	0.00	0.00	
09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00		
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.01	0.00		
11	0.00	0.00	0.45	0.00	0.00	0.00	0.00	0.21	0.00	0.00		
12	0.00	0.00	1.41	0.00	0.00	0.00	0.01	0.00	0.00	0.00		
13	0.39	0.00	1.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
14	0.17	0.00	1.80	0.00	0.00	0.00	0.25	0.00	1.06	0.00		
15	0.06	0.00	0.34	0.00	0.00	0.00	0.02	0.00	0.10	0.00		
16	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.10	0.00		
17	0.06	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.07	0.00		
18	0.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00		
19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
21	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.10	0.03	0.00		
22	0.00	0.51	0.20	0.00	0.33	0.00	0.10	0.00	0.00	0.00		
23	0.14	1.46	0.00	0.00	0.00	0.00	0.00	0.50	0.06	0.00		
24	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00		
25	0.00	0.00	0.00	0.00	0.00	0.00	0.91	0.00	0.00	0.00		
26	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00		
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01		
29	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03		
30	0.00		0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00		
31	0.00		0.00		0.00		0.05	0.04		0.00		
Total	1.63	2.00	5.23	0.00	0.35	0.30	1.85	3.05	1.61	1.04	0.03	

Tipping bucket removed November 8, 2019

Appendix G. Daily Precipitation at the Middle Precipitation Gage

Location South of McClure Reservoir between two unnamed tributaries to the Santa Fe River

Latitude/Longitude 35 40.661N, 105 49.269 W **Elevation** 9,077 feet above mean sea level
UTM (NAD 83) 13S 425691, 394850 **Gage** Campbell Scientific TE525 Tipping Bucket with snow adapter

	Daily Precipitation (inches) Middle Rain Gage 2017											
Day	Jan 17	Feb 17	Mar 17	Apr 17	May 17	Jun 17	Jul 17	Aug 17	Sep 17	Oct 17	Nov 17	Dec 17
01	0.00	0.00	0.06	0.38	0.00	0.03	0.00	0.04	0.02	0.03	0.00	0.00
02	0.00	0.00	0.01	0.14	0.00	0.20	0.00	0.23	0.00	0.00	0.00	0.00
03	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.18	0.00	0.00	0.00	0.00
04	0.00	0.00	0.01	0.27	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
05	0.00	0.00	0.01	0.09	0.02	0.00	0.00	0.00	0.00	0.75	0.00	0.00
06	0.10	0.00	0.00	0.04	0.00	0.00	0.00	0.02	0.00	0.03	0.00	0.00
07	0.07	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.07	0.03	0.00
08	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.02	0.19	0.00	0.16	0.00
09	0.00	0.03	0.02	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.04	0.04
10	0.01	0.00	0.00	0.00	0.10	0.00	0.00	0.02	0.00	0.00	0.01	0.01
11	0.00	0.00	0.00	0.00	0.11	0.00	0.02	0.41	0.06	0.00	0.00	0.01
12	0.02	0.00	0.00	0.00	0.01	0.00	0.10	0.00	0.00	0.00	0.00	0.00
13	0.00	0.36	0.00	0.01	0.01	0.00	0.48	0.16	0.06	0.00	0.00	0.00
14	0.00	0.01	0.00	0.01	0.00	0.00	0.32	0.01	0.03	0.00	0.00	0.00
15	0.79	0.10	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	0.31	0.04	0.00	0.02	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00
17	0.07	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.03	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.03	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00	0.03	0.04	0.00	0.01	0.00	0.00	0.00	0.00
21	0.42	0.01	0.00	0.00	0.02	0.00	0.00	0.23	0.00	0.00	0.00	0.00
22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
23	0.00	0.00	0.00	0.00	0.12	0.00	0.30	0.00	0.49	0.00	0.01	0.00
24	0.00	0.00	0.51	0.00	0.05	0.00	0.05	0.00	0.00	0.00	0.00	0.00
25	0.00	0.00	0.04	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00
27	0.00	0.00	0.00	0.00	0.00	0.00	1.17	0.01	1.64	0.00	0.00	0.00
28	0.02	0.00	0.20	0.45	0.00	0.00	0.16	0.17	0.48	0.00	0.00	0.02
29	0.05		0.07	0.85	0.00	0.00	0.03	0.35	0.36	0.00	0.00	0.00
30	0.01		0.04	0.12	0.00	0.00	0.01	0.00	0.25	0.00	0.00	0.01
31	0.00		0.00		0.00		0.01	0.00		0.00		0.00
Total	1.90	0.55	1.02	2.53	0.62	0.27	2.91	1.91	3.62	0.88	0.26	0.09

Appendix G. Daily Precipitation at the Middle Precipitation Gage (Continued)

Day	Daily Precipitation (inches) Middle Rain Gage 2018											
	Jan 18	Feb 18	Mar 18	Apr 18	May 18	Jun 18	Jul 18	Aug 18	Sep 18	Oct 18	Nov 18	Dec 18
01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.93	0.00	0.02	0.02
02	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.03	0.01	0.63	0.04	0.00
03	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.56	0.00	0.09	0.00	0.06
04	0.00	0.00	0.00	0.00	0.03	0.12	0.00	0.07	0.01	0.00	0.00	0.03
05	0.00	0.00	0.00	0.00	0.05	0.01	0.01	0.00	0.19	0.00	0.00	0.01
06	0.00	0.00	0.00	0.00	0.00	0.02	0.07	0.00	0.24	0.00	0.00	0.00
07	0.00	0.00	0.00	0.04	0.01	0.00	0.76	0.00	0.01	0.00	0.00	0.09
08	0.00	0.00	0.00	0.00	0.04	0.00	0.57	0.00	0.05	0.00	0.00	0.00
09	0.01	0.00	0.01	0.00	0.00	0.00	0.04	0.00	0.01	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.00	0.00
11	0.17	0.02	0.01	0.00	0.00	0.00	0.05	0.00	0.02	0.00	0.00	0.00
12	0.00	0.00	0.02	0.00	0.00	0.01	1.41	0.02	0.00	0.03	0.03	0.00
13	0.00	0.04	0.02	0.00	0.00	0.00	0.57	0.05	0.01	0.01	0.33	0.03
14	0.00	0.00	0.04	0.00	0.00	0.00	0.06	0.04	0.01	0.60	0.01	0.06
15	0.00	0.46	0.00	0.00	0.00	0.00	0.25	0.45	0.00	0.21	0.02	0.00
16	0.00	0.04	0.05	0.00	0.00	0.07	0.31	0.01	0.00	0.00	0.00	0.00
17	0.00	0.11	0.01	0.00	0.00	0.10	0.03	0.00	0.01	0.00	0.00	0.00
18	0.00	0.00	0.00	0.00	0.00	0.05	0.05	0.12	0.00	0.00	0.00	0.00
19	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.14	0.03	0.00	0.00
20	0.00	0.00	0.02	0.00	0.00	0.04	0.04	0.00	0.19	0.00	0.00	0.00
21	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.00
22	0.01	0.00	0.01	0.00	0.45	0.00	0.00	0.50	0.02	0.01	0.00	0.00
23	0.04	0.00	0.00	0.00	0.15	0.00	0.38	0.09	0.01	1.16	0.00	0.00
24	0.02	0.00	0.00	0.00	0.04	0.00	0.33	0.01	0.00	0.81	0.02	0.00
25	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.11	0.00	0.00	0.00	0.00
26	0.00	0.04	0.00	0.01	0.00	0.02	0.00	0.13	0.00	0.01	0.00	0.24
27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.03	0.02	0.02	0.06
28	0.01	0.00	0.10	0.00	0.00	0.00	0.15	0.02	0.01	0.01	0.00	0.01
29	0.00		0.01	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.25
30	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.17	0.00	0.05
31	0.00		0.03		0.00		0.66	0.04		0.62		0.00
Total	0.26	0.72	0.41	0.05	0.80	0.44	5.76	2.40	1.93	4.44	0.49	0.91

Appendix G. Daily Precipitation at the Middle Precipitation Gage (Continued)

Day	Daily Precipitation (inches) Middle Rain Gage 2019 Partial Year											
	Jan 19	Feb 19	Mar 19	Apr 19	May 19	Jun 19	Jul 19	Aug 19	Sep 19	Oct 19	Nov 19	Dec 19
01	0.01	0.00	0.00	0.01	0.00	0.04	0.02	0.01	0.00	0.00	0.00	
02	0.11	0.00	0.00	0.01	0.00	0.05	0.00	0.04	0.00	0.00	0.00	
03	0.02	0.00	0.06	0.10	0.00	0.12	0.00	0.74	0.00	0.00	0.00	
04	0.00	0.00	0.00	0.04	0.00	0.27	0.00	0.00	0.00	0.86	0.00	
05	0.00	0.00	0.08	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	
06	0.00	0.00	0.00	0.00	0.00	0.04	0.27	1.00	0.00	0.00	0.06	
07	0.00	0.03	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	
08	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.26	0.08	0.00	0.00	
09	0.00	0.01	0.02	0.02	0.27	0.00	0.00	0.29	0.00	0.00	0.00	
10	0.00	0.00	0.01	0.00	0.33	0.00	0.00	0.10	0.01	0.00		
11	0.15	0.03	0.46	0.00	0.03	0.00	0.00	0.12	0.00	0.00		
12	0.04	0.04	0.63	0.25	0.03	0.00	0.01	0.00	0.00	0.00		
13	0.00	0.00	0.01	0.43	0.03	0.00	0.00	0.00	0.00	0.00		
14	0.23	0.02	0.29	0.02	0.05	0.00	0.35	0.00	1.38	0.00		
15	0.00	0.17	0.04	0.00	0.02	0.00	0.04	0.00	0.37	0.00		
16	0.00	0.00	0.02	0.02	0.00	0.00	0.04	0.00	0.11	0.00		
17	0.00	0.02	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00		
18	0.15	0.02	0.00	0.05	0.00	0.03	0.00	0.00	0.00	0.00		
19	0.01	0.01	0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.00		
20	0.00	0.04	0.02	0.00	0.06	0.00	0.00	0.00	0.00	0.00		
21	0.00	0.00	0.17	0.00	0.16	0.00	0.00	0.22	0.00	0.00		
22	0.09	0.00	0.17	0.00	0.01	0.00	0.09	0.02	0.00	0.00		
23	0.04	0.40	0.01	0.31	0.01	0.00	0.05	0.38	0.05	0.00		
24	0.02	0.00	0.01	0.04	0.00	0.00	0.02	0.00	0.00	0.00		
25	0.01	0.00	0.00	0.00	0.00	0.00	0.76	0.00	0.00	0.00		
26	0.01	0.00	0.00	0.01	0.00	0.00	0.32	0.00	0.00	0.00		
27	0.00	0.00	0.00	0.18	0.01	0.00	0.01	0.00	0.00	0.00		
28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05		
29	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
30	0.00		0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00		
31	0.00		0.00		0.03		0.05	0.21		0.00		
Total	0.90	0.82	2.00	1.52	1.05	0.70	2.03	3.39	2.00	0.91	0.06	0.00

Tipping bucket removed November 8, 2019

Appendix H. Daily Precipitation at the Lower Precipitation Gage

Location South of McClure Reservoir between two unnamed tributaries to the Santa Fe River

Latitude/Longitude
UTM (NAD 83) 13S 425434, 3949630

Elevation 8,063 feet above mean sea level
Gage Campbell Scientific TE525 Tipping Bucket with snow adapter

	Daily Precipitation (inches) Lower Precipitation Gage 2017											
Day	Jan 17	Feb 17	Mar 17	Apr 17	May 17	Jun 17	Jul 17	Aug 17	Sep 17	Oct 17	Nov 17	Dec 17
01	0.04	0.01	0.01	0.37	0.01	0	0	0.04	0	0.02	0	0
02	0.01	0.00	0.01	0.06	0.01	0.15	0	0.13	0	0	0	0
03	0.00	0.00	0.01	0.03	0.01	0	0	0.22	0	0.15	0	0
04	0.01	0.00	0.01	0.29	0.01	0	0	0.01	0	0.04	0	0
05	0.23	0.00	0	0.05	0.01	0	0	0	0	1.11	0	0
06	0.00	0.00	0	0.02	0	0	0	0.01	0	0.02	0	0
07	0.00	0.01	0	0.02	0.01	0	0	0	0	0	0.24	0
08	0.39	0.00	0.02	0	0	0	0	0.02	0.08	0.01	0.01	0
09	0.01	0.00	0	0	0.08	0	0	0	0	0	0.01	0
10	0.00	0.01	0	0	0.18	0	0	0.04	0	0	0.02	0
11	0.00	0.00	0	0.01	0.08	0	0.01	0.51	0.06	0	0.01	0.01
12	0.00	0.00	0	0	0.02	0	0.12	0	0	0	0	0
13	0.00	0.30	0	0	0	0	0.52	0.12	0.05	0.01	0.01	0
14	0.03	0.08	0	0.01	0	0	0.11	0	0.05	0	0	0
15	0.76	0.01	0.01	0	0.01	0	0	0	0.01	0	0	0
16	0.44	0.01	0	0	0	0	0.12	0	0	0	0	0
17	0.01	0.01	0.01	0	0	0	0.22	0	0.03	0	0	0
18	0.02	0.00	0	0	0.02	0	0.01	0	0	0	0	0
19	0.01	0.00	0	0.01	0	0	0	0	0	0	0	0
20	0.00	0.01	0	0	0.02	0.10	0	0.05	0	0	0	0
21	0.37	0.02	0	0	0.03	0	0	0.24	0	0	0	0
22	0.04	0.00	0	0	0	0	0	0	0	0	0	0
23	0.10	0.00	0.12	0	0.13	0	0.29	0	0.51	0	0	0
24	0.17	0.00	0.94	0	0.04	0	0.20	0	0	0	0.02	0.03
25	0.02	0.00	0.01	0.31	0	0	0	0	0	0	0	0
26	0.01	0.00	0.01	0.04	0	0	0	0.02	0.11	0	0	0
27	0.00	0.00	0	0.01	0	0	0.86	0.01	1.41	0	0	0.01
28	0.00	0.28	0.22	0.31	0	0	0.09	0.22	0.39	0	0	0.01
29	0.01		0.07	1.00	0	0	0.01	0.18	0.33	0	0	0
30	0.01		0.02	0.1	0	0	0	0	0.20	0	0	0
31	0.01		0.01		0		0.01	0		0		0
Total	2.70	0.75	1.48	2.65	0.67	0.25	2.57	1.82	3.23	1.36	0.32	0.06

Appendix H. Daily Precipitation at the Lower Precipitation Gage (Continued)

Day	Daily Precipitation (inches) Lower Precipitation Gage 2018											
	Jan 18	Feb 18	Mar 18	Apr 18	May 18	Jun 18	Jul 18	Aug 18	Sep 18	Oct 18	Nov 18	Dec 18
01	0	0.01	0.01	0	0	0	0	0.01	0.75	0	0.03	0.01
02	0	0	0.01	0	0.08	0	0	0.12	0.01	0.78	0.04	0.02
03	0	0	0.02	0	0.06	0.02	0	0.48	0	0.03	0	0
04	0	0.01	0	0	0.04	0.11	0	0.03	0.04	0	0	0
05	0	0	0	0	0.04	0.02	0.45	0.01	0.12	0	0	0
06	0	0	0	0	0	0.01	0.06	0	0.05	0	0	0.01
07	0.01	0	0	0.03	0.01	0	0.75	0	0.03	0	0	0.15
08	0	0	0.01	0	0.02	0	0.23	0	0.03	0	0	0.01
09	0.02	0	0.01	0	0	0	0.04	0	0.03	0.08	0	0.05
10	0.03	0	0	0	0	0	0.10	0.01	0.04	0.02	0.01	0.02
11	0.03	0.06	0	0.01	0	0.01	0.07	0.02	0.01	0.01	0.05	0.01
12	0.03	0.06	0	0	0	0.01	1.36	0	0	0.01	0	0
13	0.01	0.02	0	0	0	0	0.87	0.03	0	0	0	0
14	0	0.12	0.02	0	0	0	0.76	0.43	0	0.59	0	0
15	0	0.67	0.04	0	0	0	0.25	0.09	0	0.11	0.17	0
16	0	0.02	0.04	0	0.01	0.1	0.59	0.01	0	0.05	0.07	0
17	0	0.02	0.01	0	0.01	0.08	0.19	0	0.01	0.02	0.03	0.01
18	0	0	0	0	0	0.06	0.03	0.03	0	0.03	0.02	0
19	0.03	0	0.02	0	0	0.01	0	0.02	0.23	0	0.02	0.01
20	0	0.07	0.02	0	0	0.01	0	0	0.24	0	0	0.03
21	0.14	0.03	0.03	0	0.16	0	0	0.07	0	0	0	0
22	0.02	0.03	0.03	0	1.04	0.02	0.01	0.59	0.01	0.05	0.01	0
23	0.03	0.03	0	0.01	0.16	0	0.74	0.03	0	1.34	0	0
24	0.06	0	0	0.01	0.03	0	0.12	0.01	0	0.92	0	0
25	0	0	0	0	0.02	0	0	0.34	0.15	0	0.02	0
26	0	0.01	0	0	0	0	0	0.33	0.01	0	0.04	0.17
27	0	0.02	0	0	0	0	0.05	0.1	0	0	0	0
28	0	0	0.03	0	0	0	0.06	0.01	0.01	0	0	0
29	0		0.03	0	0	0	0.02	0	0	0	0	0.01
30	0.02		0.01	0	0	0	0	0.01	0	0.22	0	0
31	0.02		0.03		0.01		0.57	0.06		0.65		0
Total	0.45	1.18	0.37	0.06	1.69	0.46	7.32	2.84	1.77	4.91	0.51	0.51

Appendix H. Daily Precipitation at the Lower Precipitation Gage (Continued)

Day	Daily Precipitation (inches) Lower Precipitation Gage 2019 (partial year)											
	Jan 19	Feb 19	Mar 19	Apr 19	May 19	Jun 19	Jul 19	Aug 19	Sep 19	Oct 19	Nov 19	Dec 19
01	0	0.03	0	0.01	0.01	0.01	0	0	0	0	0	
02	0	0	0.12	0.01	0	0.04	0	0.05	0	0	0	
03	0	0	0.14	0.15	0	0.04	0	0.53	0	0	0	
04	0.01	0	0	0.02	0	0.33	0	0	0	1.02	0	
05	0.52	0	0.02	0	0	0	0	0	0	0	0	
06	0.17	0.07	0	0	0	0	0.30	0.06	0	0	0	
07	0.03	0	0	0.01	0	0	0	0	0	0		
08	0.01	0.01	0.04	0	0.01	0	0	0.16	0.15	0		
09	0.02	0.01	0.03	0.01	0.28	0	0	0.28	0.01	0		
10	0	0	0	0	0.19	0	0	0.12	0.01	0		
11	0.16	0	0.59	0.03	0.03	0	0	0.11	0.01	0		
12	0.03	0	0.82	0.32	0	0	0.01	0	0	0		
13	0	0.02	0.28	0.43	0.04	0	0	0	0	0		
14	0	0.12	0.11	0.03	0.01	0	0.36	0	0.28	0		
15	0.01	0.26	0.53	0	0.02	0	0.05	0	0.29	0		
16	0.23	0.01	0.05	0	0	0	0.06	0	0.13	0		
17	0.02	0	0.02	0.05	0	0.18	0	0	0	0		
18	0.38	0.01	0	0.02	0	0	0	0	0	0		
19	0.07	0	0	0.01	0	0	0.01	0	0	0		
20	0.02	0	0	0	0.18	0	0	0	0	0		
21	0	0.01	0.2	0	0.17	0	0	0.14	0	0		
22	0	0.02	0.14	0.01	0.03	0	0.09	0.03	0	0		
23	0	0	0	0.34	0.01	0	0.03	0.42	0.07	0		
24	0	0.08	0	0.02	0	0	0	0	0	0		
25	0	0.16	0	0.01	0.01	0	0.62	0	0	0		
26	0	0.53	0.01	0.01	0.01	0	0.29	0	0	0		
27	0	0.01	0	0.03	0.02	0	0.01	0	0	0		
28	0	0	0	0	0	0	0	0	0	0		
29	0.01		0	0	0	0	0	0	0	0.10		
30	0		0	0.13	0.07	0	0	0.01	0	0.01		
31	0		0		0		0.04	0.03		0		
Total	1.69	1.35	3.10	1.65	1.09	0.60	1.87	1.94	0.95	1.13	0.00	0.00

Tipping bucket removed November 5, 2019

Appendix I. Monthly Precipitation for Stations in the Santa Fe Area

Monthly Precipitation, 2009

Precipitation Station	Elevation	Jan 09	Feb 09	Mar 09	Apr 09	May 09	Jun 09	Jul 09	Aug 09	Sep 09	Oct-09	Nov-09	Dec-09	**Total 2009**
	ft	inches												
Santa Fe SNOTEL	11,445	1.20	1.20	2.20	4.40	1.60	3.10	2.80	3.20	3.10	3.3	1.3	2.5	**29.9**
Upper Precipitation Gage	9,910	-	0.12	1.01	2.14	1.15	2.11	1.75	-	-	-	0.70	1.53	**-**
Middle Precipitation Gage	9,077	-	0.25	0.91	1.90	1.61	-	-	-	-	-	0.49	1.16	**-**
Elk Cabin SNOTEL	8,210	0.30	0.70	1.00	2.50	1.20	4.00	3.30	2.00	3.10	2.7	0.6	1.9	**23.3**
Lower Precipitation Gage	8,063	0.21	0.72	1.06	2.80	-	2.92	2.60	0.89	1.66	2.35	0.61	1.59	-
SFWN5	7,674	0.17	0.41	0.28	2.09	1.51	2.46	3.24	1.10	2.40	2.41	0.36	1.03	**17.5**
Santa Fe Seton	7,000	0.31	0.13	0.74	0.90	0.85	1.55	2.95	1.00	2.31	1.85	0.33	0.82	**13.7**

Monthly Precipitation, 2010

Precipitation Station	Elevation	Jan 10	Feb 10	Mar 10	Apr 10	May 10	Jun 10	Jul 10	Aug 10	Sep 10	Oct 10	Nov 10	Dec 10	**Total 2010**
	ft	inches												
Santa Fe SNOTEL	11,445	4.7	3.4	6.0	2.8	0.7	1.0	6.4	2.3	2.2	1.6	0.7	4.1	**35.9**
Upper Precipitation Gage	9,910	1.70	2.06	3.06	0.81	-	0.60	3.52	0.66	1.04	-	0.05	-	**-**
Middle Precipitation Gage	9,077	1.61	2.89	3.47	0.75	0.53	0.54	4.69	1.04	1.63	0.88	0.04	1.59	**19.7**
Elk Cabin SNOTEL	8,210	2.8	2.4	4.2	1.4	0.7	1.2	4.9	1.7	2.3	1.6	0.3	2.1	**25.6**
Lower Precipitation Gage	8,063	2.65	1.30	3.60	0.96	0.42	0.42	4.10	0.96	1.87	0.86	0.37	1.40	**18.9**
SFWN5	7,674	0.88	0.92	3.04	0.66	0.35	0.25	4.39	1.46	1.80	0.73	0.05	0.52	**15.1**
Santa Fe Seton	7,000	1.47	1.45	2.65	0.36	0.17	0.89	5.23	1.66	1.81	0.36	0.13	1.58	**17.8**

Appendix I. Monthly Precipitation for Stations in the Santa Fe Area (Continued)

Monthly Precipitation, 2011

Precipitation Station	Elevation	Jan 11	Feb 11	Mar 11	Apr 11	May 11	Jun 11	Jul 11	Aug 11	Sep 11	Oct 11	Nov 11	Dec 11	**Total 2011**
	ft	inches												
Santa Fe SNOTEL	11,445	0.9	2.5	1.2	2.1	1.6	0.2	3.4	4.3	2.1	1.8	4.5	2.3	**26.9**
Upper Precipitation Gage	9,910	0.60	0.23	0.24	-	-	0.14	1.77	3.04	0.64	1.08	0.42	2.40	**-**
Middle Precipitation Gage	9,077	0.37	0.71	0.21	0.84	0.34	0.26	2.43	5.41	0.75	0.92	0.25	2.13	**14.6**
Elk Cabin SNOTEL	8,210	0.4	1.3	0.7	1.3	0.4	0.2	2.9	6.2	1.1	2.4	1.3	2.5	**20.7**
Lower Precipitation Gage	8,063	0.10	0.42	0.36	0.54	0.22	0.20	2.84	4.83	1.05	2.34	1.05	2.18	**16.1**
SFWN5	7,674	0.74	0.37	0.28	0.39	0.15	0.01	1.88	5.19	1.06	2.43	0.93	1.86	**15.3**
Santa Fe Seton	7,000	0.03	0.45	0.20	0.21	0.07	0.04	1.92	3.58	0.65	2.29	0.38	1.44	**11.3**

Monthly Precipitation, 2012

Precipitation Station	Elevation	Jan 12	Feb 12	Mar 12	Apr 12	May 12	Jun 12	Jul 12	Aug 12	Sep 12	Oct 12	Nov 12	Dec 12	**Total 2012**
	ft	inches												
Santa Fe SNOTEL	11,445	2.3	2.9	2.3	1.5	0.9	0.5	4.8	2	1.2	0.3	1	3.6	**23.3**
Upper Precipitation Gage	9,910	0.59	0.72	0.98	1.10	0.34	0.27	2.11	1.03	1.08	0.58	0.55	0.92	**10.27**
Middle Precipitation Gage	9,077	1.01	0.35	0.68	1.01	0.39	0.25	1.92	1.21	1.01	-	-	-	-
Elk Cabin SNOTEL	8,210	1.3	1.2	1.1	1.1	0.7	0.4	3.4	1.1	1.1	0.5	0.3	1.8	**14.0**
Above McClure Gage	7,920	0.34	0.44	0.43	0.97	0.4	0.37	3.09	1.21	1.11	0.6	0.29	0.47	**9.7**
Lower Precipitation Gage	8,063	0.79	0.7	0.85	1.07	0.37	0.31	2.54	1.06	0.98	0.57	0.29	1.36	**10.9**
SFWN5	7,674	0.57	0.82	0.61	0.82	0.48	0.21	1.9	1.53	0.86	0.36	0.25	0.85	**9.3**
Below Nichols Gage	7240	0.5	0.57	0.43	0.78	0.58	0.15	1.57	2.88	0.96	0.44	0.14	0.48	**9.5**
Santa Fe Seton	7,000	0.54	0.47	0.3	0.53	0.31	0.15	1.82	1.22	0.97	0.23	0.08	1.18	**7.8**

Appendix I. Monthly Precipitation for Stations in the Santa Fe Area (Continued)

Monthly Precipitation, 2013

Precipitation Station	Elevation	Jan 13	Feb 13	Mar 13	Apr 13	May 13	Jun 13	Jul 13	Aug 13	Sep 13	Oct 13	Nov 13	Dec 13	**Total 2013**
	ft	inches												
Santa Fe SNOTEL	11,445	2.6	2.30	1.60	1.70	0.80	0.6	7.5	1.7	10.6	2	4.8	1.2	**37.40**
Upper Precipitation Gage	9,910	1.07	0.62	0.61	0.49	0.30	0.31	2.53	1.25	11.54	0.73	1.74	0.78	**21.97**
Middle Precipitation Gage	9,077	-	-	-	0.41	0.41	0.30	2.52	1.99	8.30	0.64	2.16	0.44	**17.17**
Elk Cabin SNOTEL	8,210	1.50	0.80	0.80	0.70	0.50	0.8	4.1	0.8	7.4	1.1	2.8	0.8	**22.10**
Above McClure Gage	7,920	0.70	0.51	0.38	0.38	0.53	0.50	4.04	2.18	9.63	1.26	2.9	0.14	**23.15**
Lower Precipitation Gage	8,063	0.99	0.75	0.75	0.45	0.32	0.50	3.40	1.82	8.23	0.83	2.82	0.74	**21.60**
SFWN5	7,674	0.66	0.50	0.48	0.24	0.17	0.5	3.22	1.28	4.65	0.65	2.11	0.78	**15.24**
Below Nichols Gage[a]	7,240	-	-	-	0.21	0.21	0.67	3.88	1.93	-	-	-	-	-
Santa Fe Seton	7,000	0.37	0.49	0.28	0.08	0.17	0.72	3.02	2.46	3.38	1.05	2.08	0.55	**14.65**

Monthly Precipitation, 2014

Precipitation Station	Elevation	Jan 14	Feb 14	Mar 14	Apr 14	May 14	Jun 14	Jul 14	Aug 14	Sep 14	Oct 14	Nov 14	Dec 14	**Total 2014**
	ft	inches												
Santa Fe SNOTEL	11,445	0.10	1.10	3.10	1.80	2.50	0.4	6	2.3	1.6	1.3	2.4	3.8	**26.40**
Upper Precipitation Gage	9,910	0.00	0.77	1.57	0.76	1.71	0.38	1.39	-	1.73	1.00	1.09	1.70	-
Middle Precipitation Gage	9,077	0.01	0.61	1.37	0.49	1.83	0.35	3.14	2.33	1.11	1.18	0.85	0.36	**13.63**
Elk Cabin SNOTEL	8,210	0.00	0.70	1.60	1.00	2.10	0.3	3.9	3	1.2	1.5	1.3	2.3	**18.90**
Above McClure Gage[a]	7,920	0.00	0.14	1.62	0.62	1.89	-	-	-	-	-	-	-	-
Lower Precipitation Gage	8,063	0.00	0.67	1.50	0.69	1.82	0.57	2.67	2.57	1.35	1.40	1.22	1.97	**16.43**
SFWN5	7,674	0.00	0.25	1.32	0.58	1.65	0.78	1.82	3.04	0.8	1.49	0.92	1.58	**14.23**
Santa Fe Seton	7,000	0.00	0.33	0.78	0.20	2.17	0.08	2.35	2.32	0.65	0.6	0.78	1.15	**11.41**

[a] Above McClure and Nichols Gages operated by City of Santa Fe were disconnected

Appendix I. Monthly Precipitation for Stations in the Santa Fe Area (Continued)

Monthly Precipitation, 2015

Precipitation Station	Elevation	Jan 15	Feb 15	Mar 15	Apr 15	May 15	Jun 15	Jul 15	Aug 15	Sep 15	Oct 15	Nov 15	Dec 15	**Total 2015**
	ft	inches												
Santa Fe SNOTEL	11,445	2.9	1.3	2.5	1.2	6.2	1.4	7.2	1.4	0.9	4.1	4.4	4.1	**37.6**
Upper Precipitation Gage	9,910	1.37	0.95	2.18	0.58	3.74	2.12	4.48	0.87	0.60	3.79	1.78	1.89	**24.35**
Middle Precipitation Gage	9,077	0.68	0.60	1.76	0.47	3.50	2.04	5.89	0.92	0.63	3.57	2.04	0.45	**22.55**
Elk Cabin SNOTEL	8,210	1.4	0.9	2.5	0.6	4.6	2.1	5.1	1.3	0.5	3.9	3	2.3	**28.20**
Above McClure Gage	7,920	-	-	-	-	-	-	-	-	-	-	-	-	-
Lower Precipitation Gage	8,063	1.71	1.08	1.71	0.50	4.13	3.62	5.53	1.02	0.87	3.80	2.58	1.52	**28.07**
SFWN5	7,674	0.96	0.75	1.25	0.46	3.47	2.15	5.4	1.13	1.03	3.6	1.7	0.92	**22.82**
Santa Fe Seton	7,000	0.86	0.89	0.52	0.59	3.22	1.01	3.07	0.6	0.98	2.78	1.36	1.34	**17.22**

Monthly Precipitation, 2016

Precipitation Station	Elevation	Jan 16	Feb 16	Mar 16	Apr 16	May 16	Jun 16	Jul 16	Aug 16	Sep 16	Oct 16	Nov 16	Dec 16	**Total 2016**
	ft	inches												
Santa Fe SNOTEL	11,445	3	2.1	0.2	3.9	0.5	0.6	1.3	6.4	1.6	1	2.4	2	**25.00**
Upper Precipitation Gage	9,910	1.40	0.90	0.01	2.63	1.58	0.41	0.39	4.27	1.03	0.42	2.37	1.11	**16.51**
Middle Precipitation Gage	9,077	1.31	0.70	0.04	2.42	1.59	0.52	0.83	3.87	0.93	0.26	2.34	0.55	**15.36**
Elk Cabin SNOTEL	8,210	1.9	0.8	0.3	2.4	0.8	1.4	0.6	4.6	1.5	0.4	2.7	1.7	**19.10**
Above McClure Gage	7,920		0.344	0.023	2.82	1.28	0.81	0.813	5.66	1.19	0.437	2.75	1.125	**17.25**
Lower Precipitation Gage	8,063	1.93	0.81	0.05	2.06	1.06	0.83	0.67	5.08	0.93	0.35	2.25	1.24	**17.26**
SFWN5	7,674	0.68	0.52	0	1.89	0.63	1.08	0.6	3.75	1.19	0.26	1.18	0	**11.78**
Below Nichols Gage	7,240		0.39	0	1.81	0.32	1.27	0.8	--	--	--	--	--	--
Santa Fe Seton	7,000	0.64	0.82	0	1.27	1.04	1.22	0.59	4.17	1.95	0.14	2.03	0.78	**14.65**

Appendix I. Monthly Precipitation for Stations in the Santa Fe Area (Continued)

Monthly Precipitation, 2017

Precipitation Station	Elevation	Jan 17	Feb 17	Mar 17	Apr 17	May 17	Jun 17	Jul 17	Aug 17	Sep 17	Oct 17	Nov 17	Dec 17	**Total 2017**
	ft	inches												
Santa Fe SNOTEL	11,445	5.9	1.4	3.4	3.6	1.4	0.2	6.9	3.1	4.2	1.4	0.8	0.1	**32.40**
Upper Precipitation Gage	9,910	2.51	0.42	-	2.27	0.61	0.14	1.85	1.53	4.22	0.72	--	--	--
Middle Precipitation Gage	9,077	1.90	0.55	1.02	2.53	0.62	0.27	2.91	1.91	3.62	0.88	0.26	0.09	**16.56**
Elk Cabin SNOTEL	8,210	3.1	0.7	1.9	2.6	0.9	0.3	3.9	2.9	4.1	1.4	0.3	0	**22.10**
Above McClure Gage	7,920	2	0.625	1	2	0.875	0.375	3.25	2.25	4.125	1	--	--	--
Lower Precipitation Gage	8,063	2.70	0.75	1.48	2.65	0.67	0.25	2.57	1.82	3.23	1.36	0.32	0.06	**17.86**
SFWN5	7,674	NA	NA	NA	1.12	0.45	0.31	3.2	1.86	3.54	0.76	0.09	0.11	**NA**
Santa Fe Seton	7,000	2.29	0.47	0.4	1.66	0.19	0.33	2.53	2.48	2.87	0.98	0.2	0.08	**14.48**

Monthly Precipitation, 2018

	Elevation	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18	Oct-18	Nov-18	Dec-18	**Total 2018**
Precipitation	ft	inches												
Santa Fe SNOTEL	11,445	1.7	2.6	0.6	0.4	1.8	0.8	6.3	2.7	3.9	4.8	2.1	2.2	**29.9**
Upper Precipitation Gage	9,910	--	0.64	0.00	0.00	0.00	0.00	1.52	3.35	2.70	4.98	0.51	0.00	--
Middle Precipitation Gage	9,077	0.26	0.72	0.41	0.05	0.80	0.44	5.76	2.40	1.93	4.44	0.49	0.91	**18.6**
Elk Cabin SNOTEL	8,210	0.9	1.4	0.4	0.2	1.5	0.3	8.7	2.2	1.7	4.1	0.8	1.6	**23.8**
Above McClure Gage	7,920	--	--	--	--	--	--	--	--	--	--	--	--	--
Lower Precipitation Gage	8,063	0.45	1.18	0.37	0.06	1.69	0.46	7.32	2.84	1.77	4.91	0.51	0.51	22.1
SFWN5	7,674	0.28	0.36	0.18	0	1.57	0.46	4.02	3.34	1.14	3.76	0.38	0.53	16.02
Below Nichols Gage	7,240	--	--	--	--	--	--	--	--	--	--	--	--	**--**
Santa Fe Seton	7,000	0.19	0.54	0.06	0	1.07	0.38	3.15	1.93	1.3	3.94	0.21	1.15	13.92

Appendix I. Monthly Precipitation for Stations in the Santa Fe Area (Continued)

Monthly Precipitation, 2019 (Partial Year)

	Elevation	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Total 2019
Precipitation	ft	inches												
Santa Fe SNOTEL	11,445	3.6	3.4	5.9	2.3	2.5	0.6	3.5	1.8	1.8	1.3			
Upper Precipitation Gage	9,910	1.63	2.00	5.23	0.00	0.35	0.30	1.85	3.05	1.61	1.04			
Middle Precipitation Gage	9,077	0.90	0.82	2.00	1.52	1.05	0.70	2.03	3.39	2.00	0.91			
Elk Cabin SNOTEL	8,210	1.60	2.1	3.6	1.5	1.3	0.3	2.9	2.8	1	1.2			
Lower Precipitation Gage	8,063	1.69	1.35	3.10	1.65	1.09	0.60	1.87	1.94	0.95	1.13			
SFWN5	7,674	1.1	0.98	2.59	1.12	0.95	0.56	2.83	2.05	0.81	1.08			
Santa Fe Seton	7,000	0.93	0.79	1.96	0.72	0.73	0.82	2.58	1.54	0.4	1.08			

Appendix J. Values for Monthly Precipitation and Chloride Concentrations Used to Estimate Mass of Chloride

First Integration Period Oct 2008-Sept 2009

(Part 1)

	Units	Oct 08	Nov 08	Dec 08	Jan 09	Feb 09	Mar 09	Apr 09	May 09	Jun 09	Jul 09	Aug 09	Sep 09
Precipitation													
Total of Average Daily[a]	in	2.70	0.95	3.15	0.22	0.36	0.99	2.29	1.61	2.49	2.17	0.96	1.66
Chloride in Precipitation[b]													
Avg Adjusted Chloride	mg/L	*0.20*	*0.20*	*0.20*	*0.20*	*0.20*	*0.20*	*0.20*	*0.27*	*0.19*	*0.40*	*0.40*	*0.40*
Avg Adjusted Chloride	mg/ft^3	*5.67*	*5.67*	*5.67*	*5.67*	*5.67*	*5.66*	*5.68*	*7.64*	*5.35*	*11.39*	*11.39*	*11.39*
Water Volume - Precipitation[c]													
Control Basin (377 ac)	ac-ft	85	30	99	7	11	31	72	51	78	68	30	52
Treated Basin (443 ac)	ac-ft	100	35	116	8	13	37	85	59	92	80	35	61
Chloride Mass - Precipitation[d]													
Control Basin	grams	20,935	7,366	24,425	1,680	2,820	7,700	17,830	16,840	18,270	33,900	14,960	25,870
Treated Basin	grams	24,600	8,656	28,701	1,974	3,314	9,048	20,951	19,788	21,468	39,835	17,579	30,399

[a] Average of daily from Lower, Middle & Upper gages. Oct, Nov & Dec 2008 based on the average precipitation measured at Elk Cabin & SFWN 5

[b] Avg. of chloride concentration adjusted to volume measured by tipping bucket versus amount in collector.

[c] Area of basin times average precipitation from three stations

[d] Average daily concentration of chloride times daily volume of water

Appendix J. Values for Monthly Precipitation and Chloride Concentrations Used to Estimate Mass of Chloride

First Integration Period Oct 2009-Sept 2010

(Part 2)

	Units	Oct 09	Nov 09	Dec 09	Jan 10	Feb 10	Mar 10	Apr 10	May 10	Jun 10	Jul 10	Aug 10	Sep 10	**First Integration Period Total/ *Average***
Precipitation														
Total of Average Daily[a]	in	2.32	0.60	1.38	1.99	2.08	3.38	0.84	0.48	0.53	4.20	0.83	1.51	**39.72**
Chloride in Precipitation[b]														
Avg Adjusted Chloride	mg/L	*0.25*	*0.21*	*0.21*	*0.08*	*0.07*	*0.10*	*0.22*	*0.30*	*0.23*	*0.22*	*0.18*	*0.16*	***0.21***
Avg Adjusted Chloride	mg/ft^3	*7.21*	*5.89*	*5.89*	*2.28*	*2.11*	*2.71*	*6.35*	*8.44*	*6.65*	*6.14*	*5.13*	*4.40*	***5.96***
Water Volume - Precipitation[c]														
Control Basin (377 ac)	ac-ft	73	19	43	62	65	106	26	15	17	132	26	48	**1,248**
Treated Basin (443 ac)	ac-ft	86	22	51	73	77	125	31	18	19	155	31	56	**1,466**
Chloride Mass - Precipitation[d]														
Control Basin	grams	22,930	4,840	11,150	6,190	6,010	12,500	7,300	5,600	4,790	35,320	5,810	9,110	**324,146**
Treated Basin	grams	26,944	5,687	13,102	7,274	7,062	14,688	8,578	6,580	5,629	41,503	6,827	10,705	**380,893**

[a] Average of daily from Lower, Middle & Upper gages

[b] Avg. of chloride concentration adjusted to volume measured by tipping bucket versus amount in collector.

[c] Area of basin times average precipitation from three stations

[d] Average daily concentration of chloride times daily volume of water

Appendix K. Values for Monthly Precipitation and Chloride Concentrations Used to Estimate Mass of Chloride for the Second Integration Period

Part 1 (Oct 2010-September 2011)

	Units	Oct 10	Nov 10	Dec 10	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11
Precipitation													
Average[a]	in	0.84	0.15	1.54	0.41	0.45	0.36	0.69	0.27	0.20	2.35	4.43	0.81
Chloride in Precipitation[b]													
Avg Adjusted Chloride	mg/L	*0.22*	*0.20*	*0.11*	*0.13*	*0.14*	*0.21*	*0.26*	*0.27*	*0.21*	*0.21*	*0.21*	*0.13*
Avg Adjusted Chloride	mg/ft^3	*6.10*	*5.62*	*3.18*	*3.62*	*3.88*	*5.91*	*7.32*	*7.51*	*5.85*	*5.86*	*5.86*	*3.73*
Water Volume - Precipitation[c]													
Control Basin (377 ac)	ac-ft	26	5	48	13	14	11	22	8	6	74	139	26
Treated Basin (443 ac)	ac-ft	31	6	57	15	17	13	25	10	7	87	163	30
Chloride Mass - Precipitation[d]													
Control Basin	grams	6,980	1,180	6,700	2,030	2,410	2,900	6,910	2,740	1,600	18,830	35,510	4,150
Treated Basin	grams	8,202	1,387	7,873	2,385	2,832	3,408	8,120	3,220	1,880	22,126	41,727	4,877

Appendix K. Values for Monthly Precipitation and Chloride Concentrations Used to Estimate Mass of Chloride for the Second Integration Period

Part 2 (Oct 2011-September 2012)

	Units	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12
Precipitation													
Average[a]	in	1.76	1.02	2.24	0.80	0.59	0.84	1.06	0.37	0.28	2.36	1.10	1.02
Chloride in Precipitation[b]													
Avg Adjusted Chloride	mg/L	*0.15*	*0.22*	*0.14*	*0.09*	*0.19*	*0.20*	*0.23*	*0.45*	*0.18*	*0.18*	*0.18*	*0.16*
Avg Adjusted Chloride	mg/ft^3	*4.13*	*6.18*	*3.86*	*2.50*	*5.26*	*5.78*	*6.44*	*12.73*	*5.02*	*5.02*	*5.02*	*4.47*
Water Volume - Precipitation[c]													
Control Basin (377 ac)	ac-ft	55	32	70	25	19	26	33	12	9	74	35	32
Treated Basin (443 ac)	ac-ft	65	38	83	29	22	31	39	14	10	87	41	38
Chloride Mass - Precipitation[d]													
Control Basin	grams	9,950	8,620	11,800	2,730	4,250	6,620	9,340	6,390	1,900	16,200	7,550	6,260
Treated Basin	grams	11,692	10,129	13,866	3,208	4,994	7,779	10,975	7,509	2,230	19,040	8,880	7,356

Appendix K. Values for Monthly Precipitation and Chloride Concentrations Used to Estimate Mass of Chloride for the Second Integration Period

Part 3 (Oct 2012-Sept 2013)

	Units	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13
Precipitation													
Average[a]	in	0.57	0.42	1.14	1.03	0.68	0.59	0.45	0.34	0.37	2.82	1.69	9.36
Chloride in Precipitation[b]													
Avg Adjusted Chloride	mg/L	*0.45*	*0.45*	*0.18*	*0.18*	*0.32*	*0.23*	*0.47*	*0.72*	*0.49*	*0.17*	*0.18*	*0.11*
Avg Adjusted Chloride	mg/ft^3	*12.69*	*12.68*	*5.10*	*5.09*	*8.97*	*6.50*	*13.38*	*20.35*	*13.90*	*4.68*	*5.11*	*3.12*
Water Volume - Precipitation[c]													
Control Basin (377 ac)	ac-ft	18	13	36	32	22	18	14	11	12	89	53	294
Treated Basin (443 ac)	ac-ft	21	16	42	38	25	22	17	13	14	104	62	345
Chloride Mass - Precipitation[d]													
Control Basin	grams	9,930	7,290	7,950	7,180	8,410	5,230	8,240	9,560	7,040	18,050	11,800	40,000
Treated Basin	grams	11,668	8,566	9,342	8,437	9,882	6,146	9,683	11,234	8,272	21,210	13,866	47,003

Appendix K. Values for Monthly Precipitation and Chloride Concentrations Used to Estimate Mass of Chloride for the Second Integration Period

Part 4 (October 2013-September 2014)

	Units	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	**Second Integration Period Total/ *Average***
Precipitation														
Average [a]	in	0.73	2.24	0.65	0.00	0.68	1.65	0.67	1.79	0.43	2.85	2.45	1.40	**60.93**
Chloride in Precipitation [b]														
Avg Adjusted Chloride	mg/L	*0.28*	*0.12*	*0.20*	*0.14*	*0.14*	*0.16*	*0.29*	*0.32*	*0.26*	*0.26*	*0.26*	*0.16*	***0.21***
Avg Adjusted Chloride	mg/ft^3	*7.98*	*3.43*	*5.69*	*3.84*	*3.84*	*4.56*	*8.19*	*8.93*	*7.36*	*7.36*	*7.36*	*4.45*	***5.92***
Water Volume – Precipitation [c]														
Control Basin (377 ac)	ac-ft	23	70	21	0	21	52	21	56	14	90	77	44	**1,914**
Treated Basin (443 ac)	ac-ft	27	83	24	0	25	61	25	66	16	105	90	52	**2,249**
Chloride Mass – Precipitation [d]														
Control Basin	gm	8,010	10,520	5,090	18	3,593	10,282	7,513	21,826	4,365	28,706	24,677	8,490	**493,289**
Treated Basin	gm	9,412	12,362	5,981	21	4,222	12,082	8,829	25,647	5,129	33,732	28,997	9,976	**579,648**

[a] Average precipitation based on sum of daily precipitation at the Upper, Middle and Lower gages

[b] Average of chloride concentration adjusted to volume measured by tipping bucket versus amount in collector. (Volume Weighted)

[c] Area of basin times average precipitation from three stations

[d] Average concentration of chloride times volume of water

Appendix L. Values for Monthly Precipitation and Chloride Concentrations Used to Estimate Mass of Chloride

Third Integration Period October 2014-September 2015

	Units	Oct-14	Nov-14	Dec-14	Jan-15	Feb-15	Mar-15	Apr-15	May-15	Jun-15	Jul-15	Aug-15	Sep-15	**Total/ *Average***
Precipitation														
Average [a]	in	1.19	1.05	1.85	1.53	0.88	1.88	0.52	3.79	2.59	5.30	0.94	0.70	**22.23**
Chloride in Precipitation [b]														
Avg Adjusted Chloride	mg/L	*0.18*	*0.18*	*0.11*	*0.11*	*0.18*	*0.19*	*0.20*	*0.20*	*0.17*	*0.17*	*0.24*	*0.28*	***0.18***
Avg Adjusted Chloride	mg/ft^3	*4.97*	*4.97*	*3.15*	*3.15*	*4.99*	*5.28*	*5.54*	*5.79*	*4.69*	*4.83*	*6.83*	*8.04*	***4.98***
Water Volume – Precipitation [c]														
Control Basin (377 ac)	ac-ft	37	33	58	48	28	59	16	119	82	167	29	22	**698**
Treated Basin (443 ac)	ac-ft	44	39	68	57	32	70	19	140	96	196	35	26	**821**
Chloride Mass – Precipitation [d]														
Control Basin	gm	8,113	7,161	7,991	6,604	5,987	13,615	3,908	30,022	16,644	35,052	8,736	7,705	**151,537**
Treated Basin	gm	9,533	8,415	9,390	7,760	7,035	15,998	4,592	35,278	19,558	41,188	10,266	9,053	**178,066**

[a] Average precipitation based on sum of daily precipitation at the Upper, Middle and Lower gages

[b] Average of chloride concentration adjusted to volume measured by tipping bucket versus amount in collector.

[c] Area of basin times average precipitation from three stations

[d] Average concentration of chloride times volume of water

Appendix M. Values for Monthly Precipitation and Chloride Concentrations Used to Estimate Mass of Chloride

Fourth Integration Period October 2015-September 2016

	Units	Oct-15	Nov-15	Dec-15	Jan-16	Feb-16	Mar-16	Apr-16	May-16	Jun-16	Jul-16	Aug-16	Sep-16	**Total/ *Average***
Precipitation														
Average [a]	in	3.72	2.13	1.29	1.55	0.80	0.03	2.37	1.41	0.59	0.62	4.40	0.96	**19.87**
Chloride in Precipitation [b]														
Avg Adjusted Chloride	mg/L	*0.24*	*0.13*	*0.14*	*0.15*	*0.19*	*0.19*	*0.33*	*0.17*	*0.32*	*0.37*	*0.24*	*0.24*	***0.23***
Avg Adjusted Chloride	mg/ft^3	*6.72*	*3.81*	*4.00*	*4.28*	*5.37*	*5.26*	*9.43*	*4.90*	*8.95*	*10.61*	*6.75*	*6.93*	***6.38***
Water Volume – Precipitation [c]														
Control Basin (377 ac)	ac-ft	117	67	40	49	25	1	74	44	18	19	138	30	**624**
Treated Basin (443 ac)	ac-ft	137	79	47	57	30	1	87	52	22	23	163	36	**734**
Chloride Mass – Precipitation [d]														
Control Basin	gm	34,207	11,119	7,048	9,050	5,900	240	30,550	9,440	7,180	8,970	40,700	9,120	**173,525**
Treated Basin	gm	40,196	13,066	8,282	10,634	6,933	282	35,898	11,093	8,437	10,540	47,825	10,717	**203,903**

[a] Average precipitation based on sum of daily precipitation at the Upper, Middle and Lower gages

[b] Average of chloride concentration adjusted to volume measured by tipping bucket versus amount in collector.

[c] Area of basin times average precipitation from three stations

[d] Average concentration of chloride times volume of water

Appendix N. Values for Monthly Precipitation and Chloride Concentrations Used to Estimate Mass of Chloride

Fifth Integration Period October 2016-September 2017

	Units	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep 17	**Total/ *Average***
Precipitation														
Average [a]	in	0.34	2.32	0.97	2.37	0.57	1.24	2.48	0.63	0.22	2.44	1.75	3.69	**19.0**
Chloride in Precipitation [b]														
Avg Adjusted Chloride	mg/L	*0.32*	*0.27*	*0.15*	*0.13*	*0.12*	*0.13*	*0.03*	*0.45*	*0.52*	*0.67*	*0.26*	*0.18*	***0.24***
Avg Adjusted Chloride	mg/ft^3	*9.00*	*7.56*	*4.27*	*3.69*	*3.48*	*3.62*	*0.94*	*12.69*	*14.68*	*18.93*	*7.40*	*5.01*	***6.90***
Water Volume – Precipitation [c]														
Control Basin (377 ac)	ac-ft	11	73	30	74	18	39	78	20	7	77	55	116	**598**
Treated Basin (443 ac)	ac-ft	13	86	36	87	21	46	92	23	8	90	65	136	**703**
Chloride Mass – Precipitation [d]														
Control Basin	gm	4,240	23,980	5,650	11,960	2,730	6,130	3,200	11,000	4,420	63,340	17,780	25,290	**179,720**
Treated Basin	gm	4,982	28,178	6,639	14,054	3,208	7,203	3,760	12,926	5,194	74,429	20,893	29,717	**211,183**

[a] Average precipitation based on sum of daily precipitation at the Upper, Middle and Lower gages

[b] Average of chloride concentration adjusted to volume measured by tipping bucket versus amount in collector.

[c] Area of basin times average precipitation from three stations

[d] Average concentration of chloride times volume of water

Appendix O. Values for Monthly Precipitation and Chloride Concentrations Used to Estimate Mass of Chloride

Sixth Integration Period Oct 2017-Sept 2018

(Part 1)

	Units	Oct-17	Nov-17	Dec-17	Jan-18	Feb-18	Mar-18	Apr-18	May-18	Jun-18	Jul-18	Aug-18	Sep-18
Precipitation													
Total of Average Daily[a]	in	1.37	0.29	0.08	0.34	0.86	0.39	0.06	1.25	0.45	6.54	2.86	2.13
Chloride in Precipitation[b]													
Avg Adjusted Chloride	mg/L	*0.32*	*0.33*	*0.33*	*0.32*	*0.31*	*0.25*	*0.23*	*0.23*	*0.23*	*0.23*	*0.23*	*0.23*
Avg Adjusted Chloride	mg/ft^3	*9.15*	*9.30*	*9.26*	*8.99*	*8.69*	*6.95*	*6.51*	*6.51*	*6.51*	*6.51*	*6.51*	*6.51*
Water Volume - Precipitation[c]													
Control Basin (377 ac)	ac-ft	43	9	2	11	27	12	2	39	14	205	90	67
Treated Basin (443 ac)	ac-ft	51	11	3	12	32	14	2	46	17	241	106	79
Chloride Mass - Precipitation[d]													
Control Basin	grams	17,170	3,690	950	4,120	10,210	3,710	490	11,100	4,010	58,300	25,510	19,010
Treated Basin	grams	20,176	4,336	1,116	4,841	11,997	4,359	576	13,043	4,712	68,506	29,976	22,338

[a] Average of daily from Lower, Middle & Upper gages

[b] Avg. of chloride concentration adjusted to volume measured by tipping bucket versus amount in collector.

[c] Area of basin times average precipitation from three stations

[d] Average daily concentration of chloride times daily volume of water

Appendix O. Values for Monthly Precipitation and Chloride Concentrations Used to Estimate Mass of Chloride

Sixth Integration Period Oct 2018-Sept 2019

(Part 2)

	Units	Oct-18	Nov-18	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Jun-19	Jul-19	Aug-19	Sep-19	Integration Period 6 Total/ *Average*
Precipitation														
Total of Average Daily[a]	in	4.78	0.50	0.71	1.41	1.39	3.44	1.58	1.05	0.53	1.92	2.79	1.50	**38.22**
Chloride in Precipitation[b]														
Avg Adjusted Chloride	mg/L	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.32	0.48	0.23	0.24	0.23	***0.24***
Avg Adjusted Chloride	mg/ft³	6.51	6.51	6.51	6.51	6.51	6.51	6.51	9.07	13.62	6.63	6.74	6.51	***6.90***
Water Volume - Precipitation[c]														
Control Basin (377 ac)	ac-ft	150	16	22	44	44	108	50	33	17	60	88	47	**1,201**
Treated Basin (443 ac)	ac-ft	176	19	26	52	51	127	59	39	20	71	103	56	**1,411**
Chloride Mass - Precipitation[d]														
Control Basin	grams	42,570	4,470	6,330	12,540	12,380	30,690	14,130	13,100	9,940	17,390	25,770	13,400	**360,980**
Treated Basin	grams	50,023	5,253	7,438	14,735	14,547	36,063	16,604	15,393	11,680	20,434	30,281	15,746	**424,175**

[a] Average of daily from Lower, Middle & Upper gages

[b] Avg. of chloride concentration adjusted to volume measured by tipping bucket versus amount in collector.

[c] Area of basin times average precipitation from three stations

[d] Average daily concentration of chloride times daily volume of water