Appendix A – Boca Maintenance Analysis Technical Report

Enclosure

BOCA MAINTENANCE ANALYSIS

Section 1: Modeling flood control restrictions and proposed temporary Water Control Manual Deviation

Section 2: Modeling maintenance operations and potential impacts to water supply

December 22, 2016

U.S. Department of the Interior
Bureau of Reclamation
Mid-Pacific Region
Lahontan Basin Area Office

TABLE OF CONTENTS

1 INTRODUCTION

The Lahontan Basin Area Office (LBAO) of the Bureau of Reclamation engaged Precision Water Resources Engineering (PWRE) to help assess the potential impacts to the Truckee system due to the Boca reservoir maintenance project, as a part of the Safety of Dams Evaluation undertaken by the Mid-Pacific Region, which is planned to occur between July 1st, 2018 and December 31st, 2018. This report and the presented analysis has been divided into two sections.

The first section focuses on the potential impacts to flood control and required changes to the standard Water Control Manual operations and procedures in order to limit the risk of impacting the maintenance project and other flood control operations in the basin.

The second section focuses on potential impacts to water supply in the basin due to the Boca maintenance project.

2 FLOOD ANALYSIS

2.1 INTRODUCTION TO FLOOD ANALYSIS

Maintenance is planned for the dam on Boca reservoir between July 1st, 2018 and December 31st, 2018. From July 1 to November 30, the reservoir's pool elevation will be limited 5,581 feet NAVD88 (5577.12 feet NGVD29, 18,079 acre-feet storage). On December 1, the limit will go up to 5,591 feet NAVD88 (5587.12 feet NGVD29, 25,204 acre-feet storage). As the common datum used within the RiverWare models of the Truckee river system as well as by the reservoir and system operators is the NGVD29, all elevations referred to throughout the rest of the report are in respect to that datum.

Modeling of the entire Truckee river system is necessary to identify the potential direct and indirect impacts of the limitations of the maintenance on Boca Dam and Reservoir. This Technical Memorandum first presents the methodology and results of the model runs, then discusses results and makes recommendations for temporary deviations from the WCM-based flood control operations during the maintenance period. In addition to identifying specific deviations from the WCM flood control operations that keep Boca's pool elevation below the maintenance-imposed limits during various severe flood scenarios, various likelihoods of such changes being utilized are estimated using a large range of historical hydrology sequences.

2.2 Modeling Approach and Methods

2.2.1 Model Selection and Versions

All models used within this study originated from the same daily timestep Truckee River Operating Agreement (TROA) Operations RiverWare model ("TROA Ops model"). This model is used by the Federal Water Master's office for management, and by USBR's Lahontan Basin Area Office for Newlands Project forecasted diversion. Due to continuous development of the Official TROA Ops model, at the onset of this study, the current version of the Official TROA Ops model was cloned and the models (herein the Boca Maintenance models) used for this study were developed separately from the Official model. The Official TROA Ops model from which the Boca Maintenance models diverged was dated April 22, 2016. Modeling assumptions are addressed in Section 2.2.3 which discuss the assumptions for the Baseline, No WCM Changes and WCM Changes model scenarios.

2.2.2 Types of Analysis

Two distinct types of modeling analyses were designed and completed for this study, a **pseudo-historic flood analysis** and a **probabilistic hydrologic operations analysis**. Both of these types of analysis are summarized below, and each type of analysis is more fully described and its results presented within their own subsequent sections.

2.2.2.1 Pseudo-Historic Flood Analysis

The first type of analysis, a **pseudo-historic flood analysis**, was conducted to purposefully stress the system with several extreme hydrologic conditions that represent non-sequential combinations of two years of high runoff and flood conditions observed in the historic record. Specifically, the reservoir system was evaluated with regards to its continued ability to mitigate potential flooding impacts along the Truckee River as well as the system's ability to maintain Boca Reservoir's pool elevation below the stage restriction dictated by the maintenance project.

Four sets of flood condition hydrologies were created by selectively combining several of the more extreme flood years in the observed record that experienced flood flow during the same time of year that the maintenance will occur. To further apply high runoff flooding stress within this analysis, the system was initialized with a "full" condition that is meant to represent how full the system could potentially be at the beginning of the Boca Maintenance Project. Preliminary sensitivity runs indicated that the impacts from these large flood events if the total system volume was low or mid-range were always lower than those of the full condition, and thus this analysis focuses on the full condition. These four "pseudo-historic" flood hydrologies are expected to reasonably represent extreme hydrologic conditions in regards to stressing the system's flood control ability.

2.2.2.2 Probabilistic Hydrologic Operations Analysis

The second type of analysis, a **probabilistic hydrologic operations analysis** was completed to estimate probabilities or likelihoods of certain events occurring or thresholds being reached, e.g., the probability of the Boca reservoir pool elevation exceeding the stage restriction during the maintenance period. The hydrologic conditions ("hydrologies"), used in this analysis consist of every 2-year sequence of observed historic hydrology (from 1956 forward, for instance 1956-57, 1957-58, etc.) in order to span, as much as possible, the entire range of possible hydrology that could occur during the modeled period in the future. Each historic hydrology is used to drive the model and each 2-year model run is referred to as a single trace. In order to generate distinct, potential near future outcomes, each probabilistic model run

is initialized from the current hydrologic conditions of the basin. In this analysis, the initial conditions are represented by the most likely end of water year 2016 (9/30/2016) conditions from the June 2016 TROA Scheduling Coordination Process model runs.

This type of probabilistic analysis is very similar to the current methodology used monthly as part of the TROA Scheduling Meetings and related materials, and also has many similarities to the widely accepted and utilized Ensemble Streamflow Prediction techniques that are regularly used for forecasting hydrologic and water supply conditions in many river basins across the United States. Each distinct observed hydrology used for a model trace is assumed to be equally likely to occur given a sufficient quantity of well distributed sets of potential hydrologic conditions.

By including a high number and large range of observed historic hydrologic conditions, it is very likely that the hydrologic conditions that will be observed during the 2018 Boca maintenance period will be captured within the range of this analysis. Nevertheless, it is possible that the hydro climatic conditions of 2017-2018 will be more extreme than anything observed during the past 60 years.

2.2.3 Description of Modeled Operational Scenarios

For each type of the flood analysis, three distinct sets of operational criteria and procedures were modeled. These three scenarios are described below. Section 2.3.5, "Flood Mitigation Strategies – Proposed Temporary Changes to the Water Control Manual", contains more information regarding the standard WCM operational procedures and the development and modeled performance of the proposed temporary changes to the WCM. All scenarios below assumed Martis Reservoir operated as described in the WCM, which is not necessarily how it has been operated in the recent past.

2.2.3.1 Baseline Scenario

The "**Baseline"** scenario represents the standard and current river and reservoir operational criteria and procedures as defined with the Truckee River Operating Agreement (TROA). The normal WCM procedures are modeled. As this scenario does not contain the restrictions to Boca Reservoir or the changes to the WCM, it represents a scenario in which the Boca Maintenance Project does not occur. Boca flood operations are modeled as follows:

- Stampede Elevation-Capacity, Elevation-Surface Area, Regulated Spill and Unregulated spill tables were updated based on the assumption that Stampede construction had been completed. These tables used the elevation datum NGVD29.
- "Scheduling" of water supply allowed under TROA was set to achieve the following goals for all parties, these scheduling changes were applied to the baseline model as well to avoid showing differences due to scheduling which is subjective.
    - Move and/or establish as much credit water as possible in reservoirs at the following priority order:
        1. Stampede
        2. Tahoe
        3. Prosser (except February through July when there is a high risk of spill)
        4. Boca
    - Exchanges were set up to move Fish credit water and Non Firm M&I Credit water from Stampede to Tahoe when possible to reduce the likelihood that

credit water would be subject to spill due to the reduced total storage capacity of Boca and Stampede.
    - Whenever possible move credit water from Boca to Stampede via exchange
    - Disable trade of credit water in Boca for Floriston Rate water in Stampede to avoid the effective displacement of the senior Floriston Rate water by the junior credit water.
    - Disable release from Stampede reservoir for the exclusive purpose of moving Floriston Rate water that was stored in Stampede downstream to Boca. In general Stampede releases are limited to the minimum and enhanced minimum flows prescribed in TROA as much as possible.
- Normal WCM procedures apply
- Flood space in Boca is subtracted from a maximum capacity of 40,868 acre-feet (5605 feet NGVD29)
- Flood space in Stampede is subtracted from a maximum capacity of 226,500 acre-feet (5949.31 feet NGVD29)
- Scheduling is set to reflect voluntary actions that are allowed within TROA, that would likely occur in reaction to a reduced Boca condition

2.2.3.2 No WCM Changes

The "**No WCM Changes"** scenario, represents the same standard and current operations criteria and procedures under TROA as the Baseline scenario, with the only differences being the Boca Reservoir stage restrictions and unavailability of the spillway due to the maintenance project. Specifically, Boca flood operations are modeled as follows:

- Same as Baseline scenario except:
- Time-varying maximum storage capacity on Boca Reservoir:
    - Before April 10, 2018 the maximum capacity is 40,868 acre-feet (5,605 feet NGVD29, the current capacity),
    - from April 10, 2018 through June 30, 2018 the maximum capacity gradually decreases from 40,868 acre-feet to 18,079 acre-feet (5,577.12 feet NGVD29 elevation),
    - from July 1, 2018 through November 30, 2018: 18,079 acre-feet,
    - from December 1, 2018 through December 31, 2018: 25,204 acre-feet (5,587.12 feet NGVD29), and
    - on January 1, 2019 the maximum capacity returns to the normal maximum of 40,868 acre-feet.
    - Releases are set so that the storage is equal to the maximum capacity specified above minus the flood space requirement per the WCM.
- During October and November 2018, the Boca flood space specified by the WCM is 8,000 acre-feet allowing a Boca storage of 10,079 acre-feet or 5,562.86 feet NGVD29 unless a flood condition existed. In the case of a flood, the reservoir would be allowed to temporarily store up to 18,079 acre-feet or 5,577.12 feet NGVD29.
- During December 2018, the Boca flood space specified by the WCM is 8,000 acre-feet allowing a Boca storage of 17,204 acre-feet or 5,575.75 feet NGVD29 unless a flood

condition existed. In the case of a flood, the reservoir would be allowed to temporarily store up to 25,204 acre-feet or 5,587.12 feet NGVD29.

- During October - December 2018, the Stampede flood space specified by the WCM is 22,000 acre-feet allowing a storage of 204,500 acre-feet (5942.77 feet NGVD29) unless a flood condition existed.

2.2.3.3 WCM Changes

The "**WCM Changes"** scenario, represents the same standard and current operations criteria and procedures under TROA as the Baseline and No WCM Changes scenarios, applies the Boca Reservoir stage restrictions, and additionally includes the proposed temporary changes to the WCM's flood operation procedures. The development of these changes is discussed in detail in Section 2.3.4 and 2.3.5 below. Specifically, Boca flood operations are modeled as follows:

- Same as the No WCM Changes scenario, except:
- Limit Stampede release as much as possible to prevent Boca storage encroaching into its modified flood space, even if this causes Stampede reservoir to exceed its current maximum capacity of 226,500 acre-feet.
- When storing flood water in the Little Truckee reservoirs, store as much in Stampede as possible instead of allocating the storage between Stampede and Boca as prescribed in the WCM.
- Of the 30,000 acre-feet of flood space that is specified for Boca and Stampede, reserve 11,500 acre-feet of flood space in Boca and the remaining 18,500 acre-feet in Stampede. This additional flood space in Boca will allow Boca to store flood water to control downstream flooding in excess of the flood water that Boca must store due to the limited release capacity due to the reduced elevation during maintenance.
    - During October and November 2018, the Boca flood space requirement is 11,500 acre-feet allowing a storage of 6,579 acre-feet or 5,554.61 feet NGVD29 unless a flood condition existed. In the case of a flood, the reservoir would be allowed to temporarily store up to 18,079 acre-feet or 5,577.12 feet NGVD29.
    - During December 2018, the Boca flood space requirement is 11,500 acre-feet allowing a storage of 13,704 acre-feet or 5,569.88 feet NGVD29 unless a flood condition existed. In the case of a flood, the reservoir would be allowed to temporarily store up to 25,204 acre-feet or 5,587.12 feet NGVD29.
    - During October - December 2018, the Stampede flood space is 18,500 acre-feet allowing a storage of 208,000 acre-feet (5943.83 feet NGVD29) unless a flood condition existed.
- In the event of a major flood in December 2018, the Boca reservoir outlet should be fully opened when (or before) the reservoir reaches an elevation of 5585.97 feet NGVD29, or 1.15 feet below the December stage restriction of 5587.12 feet NGVD29.

2.3 Pseudo-Historic Flood Analysis

2.3.1 Model Run Timeline

The timeline of the model runs completed during the pseudo-historic flood analysis is shown in Figure 1 below. Each modeled 2-year hydrologic flood sequence consists of two 15-month runs. The first year of each 2-year hydrologic flood sequence (described in depth below and in Figure 1) is used to drive the 15-month run of the TROA Ops model from October 1, 2017 through December 31, 2018. This model run contains the beginning of the Boca Maintenance Project period (which spans both model runs), with stage and spillway restrictions beginning on July 1, 2018, and potential drawdown to the restricted levels beginning as early as April 10, 2018, and thus contains the various differences in operations due to the Boca Reservoir stage restrictions and potential changes to the Truckee River WCM depending on model scenario. The modeled hydrologic conditions in the entire Truckee River Basin on September 30, 2017 are used to initialize the second model run of the trace, which is driven by the second year of each 2-year hydrologic flood sequence and runs from October 1, 2018 through December 31, 2019. The beginning of this model run occurs during the Boca maintenance period and thus contains the various differences in operations due to the Boca Reservoir stage restrictions and potential changes to the Truckee River WCM depending on model scenario. The Boca maintenance period and associated restrictions end on December 31, 2018, and normal TROA and WCM operations resume on January 1, 2019. The second-year model run continues for another year through December 31, 2019.

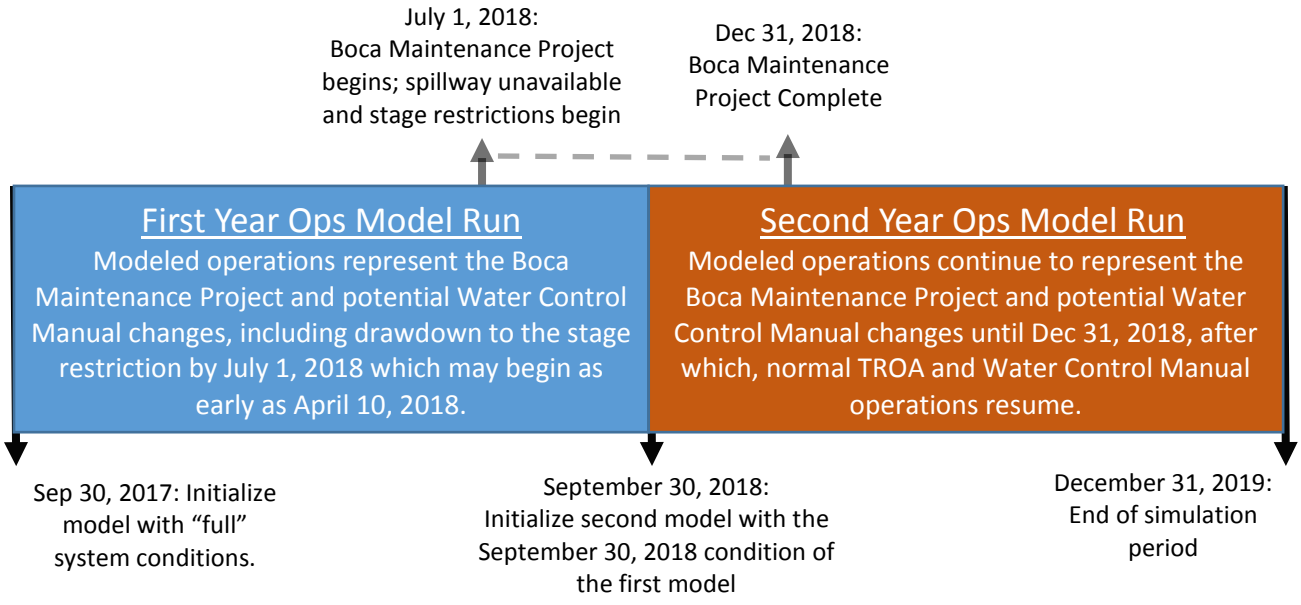


Figure 1: Model run timeline diagram for the pseudo-historic flood analysis.

2.3.2 Initialization

A hydrologically "full" system was selected for the initialization condition applied for September 30, 2017. This full initialization condition was created by first selecting a low probability of exceedance and thus a potentially high but reasonable hydrologic scenario for the end of WY 2016. Preliminary sensitivity runs indicated that there was no further impact from large flood events if the total system volume was low or mid-range as compared to the impacts of the full condition. At the time of creation

(late April 2016), the 20% chance of exceedance end of WY 2016 condition was used for creating this scenario. Next, the system was essentially "topped off" hydrologically by driving a one-year model run with water year 1952 hydrology, ending on September 30, 2017. Water year 1952 represents the year with the highest April to July runoff volume for the Truckee River Basin. The final full initialization condition, with a Little Truckee River Basin (combined Independence, Stampede, and Boca Reservoirs) storage volume of ~284,000 acre-feet, and represents all of the reservoirs filled to the allowed flood control levels.

2.3.3 Hydrology

To be modeled with the "full" basin initialization condition described above, a total of four 2-year flood hydrology sequences were created in order to stress the system with various types of flood hydrology, with each representing a different potential mode of failure. These four flood hydrology sequences were constructed by selecting and resequencing specific and notable years of record in terms of high snowmelt runoff conditions preceding the Boca maintenance period and high and extreme fall and winter flood magnitudes occurring during the maintenance period with the restrictions and modified operations in place. Each of these four flood hydrologies are described below.

- **Flood of Record**– 1952, 1997 – This sequence represents the highest April-July volume on record followed by the highest flood on record, the January 1997 flood, which is shifted to occur 2 weeks earlier so that it occurs during the maintenance period with restrictions still in place. This is a robust test of the altered system's resilience to an extreme flood occurring in December following a very wet year.
- **Back-to-back high inflow years** – 1982-1983 – This sequence represents the two highest water year volume years in the historical record and they happen to be back-to-back.
- **September-November stress** – 1952-1963 – As with the Flood of Record sequence, this represents the highest April-July volume on record to stress the system with volume immediately prior to the maintenance period. The beginning of water year 1963 contains the highest early fall flood on record for the Little Truckee River, occurring in the middle of October, which will test the system's ability to handle a significant flood potentially before the fall flood space is fully evacuated.
- **Large Second Year –** 1978-1982 – The fall and winter of water year 1982 contains multiple high magnitude flood events in November and December that will occur during the restricted maintenance period during the model runs. As the second year, 1982 also contains a large February flood event and sustained volume through the early spring to another peak in April, followed by a sustained, high volume spring runoff period. This will test how the system could potentially handle both high flow magnitudes and volumes following the end of the Boca maintenance period and the associated restrictions. Water year 1978 was selected as a preceding year, and represents a relatively typical above-average year.

To visualize the four flood hydrology sequences, Figure 2 shows the natural flow at Farad for each of the flood hydrology sequences overlying each of the individual 60 years of record used in the probabilistic analysis, and Figure 3 shows the total natural inflow to the Little Truckee River basin during the fall of the Boca maintenance period, when the stage restrictions coincide with flood space requirements.

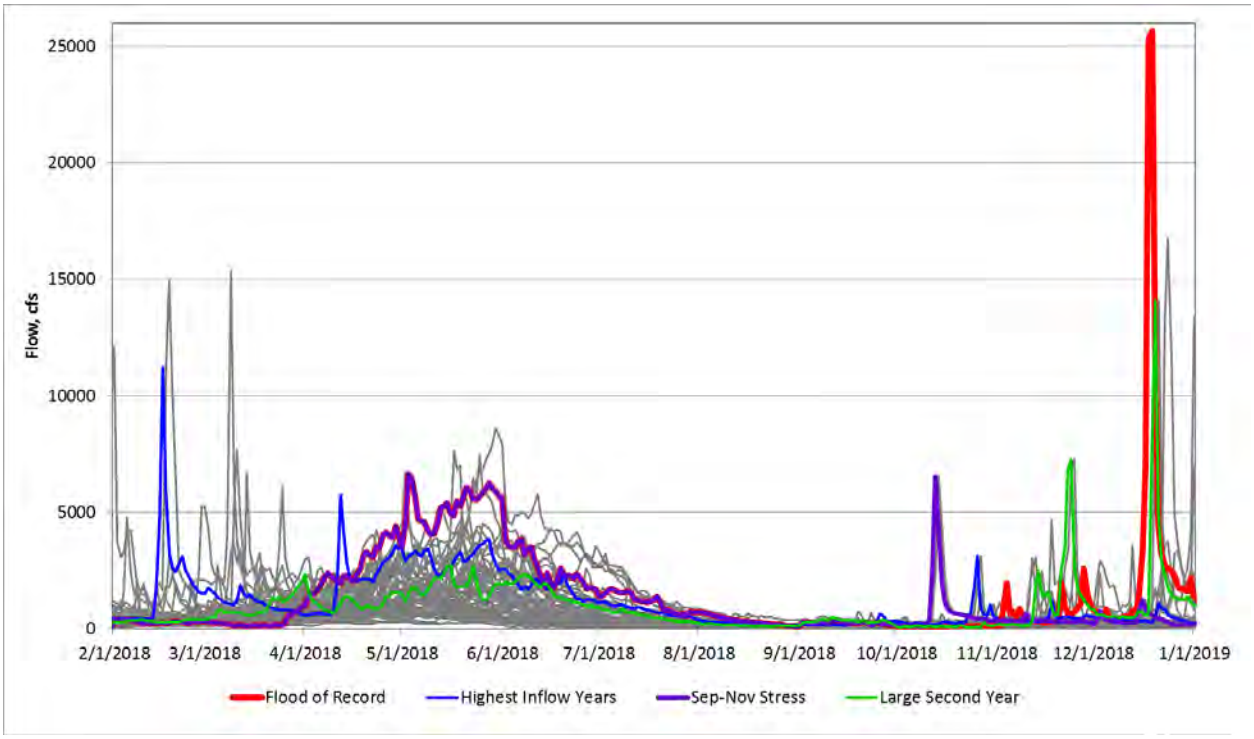


Figure 2: Daily natural flow of the Truckee River at Farad for the four pseudo-historic flood sequences, with 60 years (1956-2015) in the background.

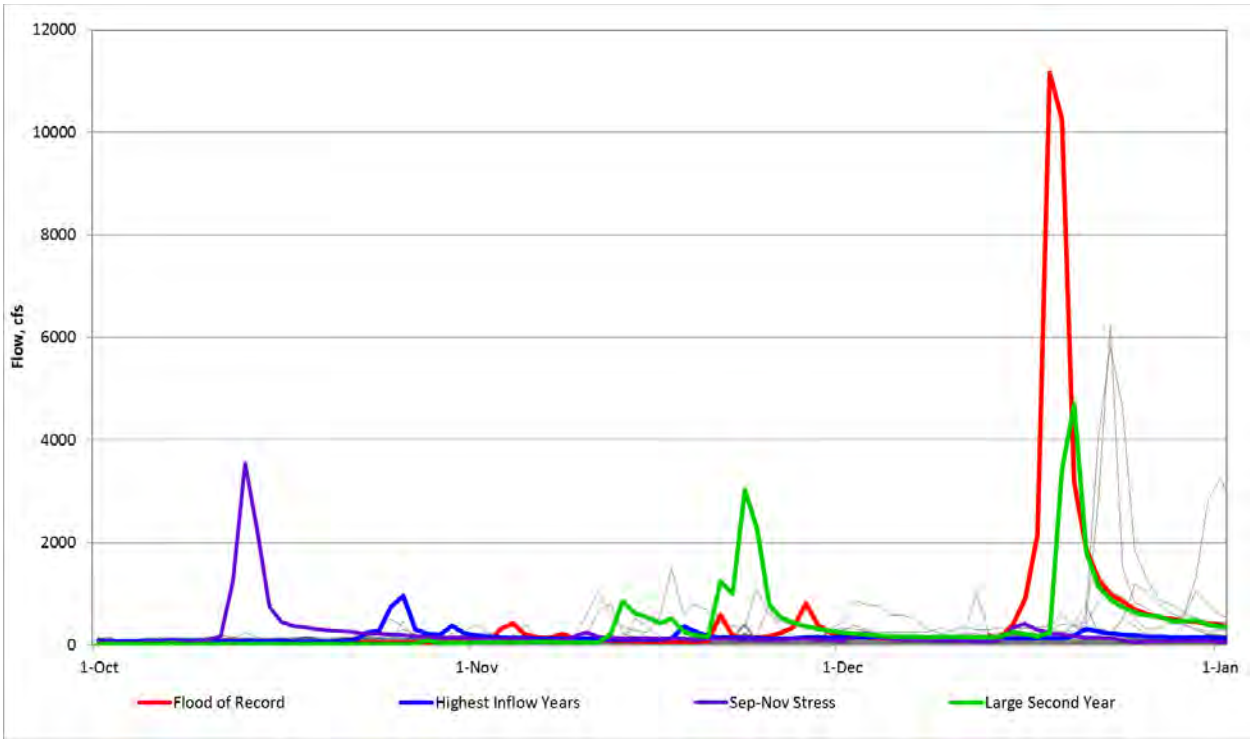


Figure 3: Daily natural inflow of the Little Truckee River basin during October – December of the Boca Maintenance Project time period for the four pseudo-historic flood sequences, with 60 years (1956-2015) in the background.

2.3.4 Results and Impacts

Modeling of the four flood hydrologies under the No WCM Changes operational scenario showed that the maximum allowable storage during the maintenance period was exceeded in three out of four of the scenarios, as shown in Figure 4. Of the sequences shown, the "Flood of Record" sequence (the largest flood in the historic record, January 1997, shifted 15 days earlier) has the highest Boca pool elevation (5,597.1 feet NGVD29).

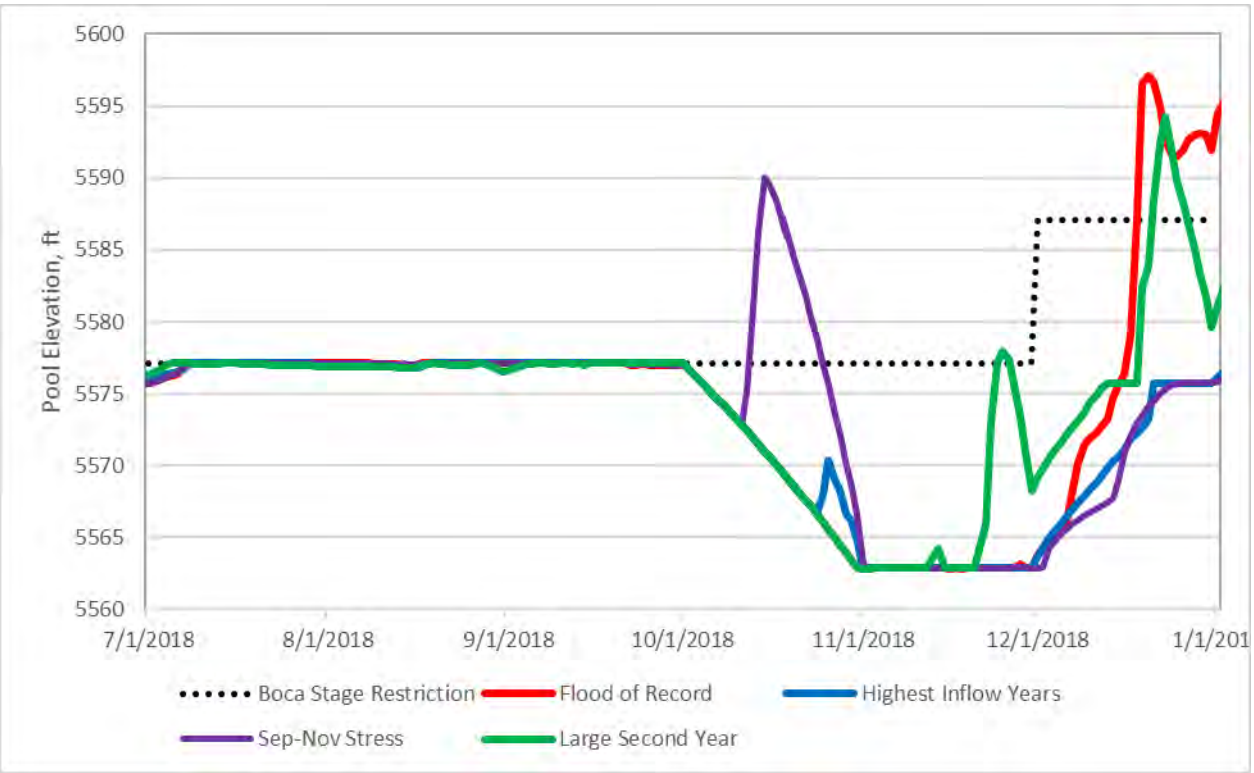


*Figure 4: Boca Pool Elevation with **No WCM Changes.***

A major impact of the Boca maintenance project is that the total Boca reservoir release capacity is significantly reduced. This is because during the maintenance period, Boca must maintain pool elevations that are below the spillway invert elevation of 5589 feet NGVD29 and thus there is no access to the spillway to release water. Therefore, the reservoir outlet works represents the only mechanism to release water while the maintenance project is underway. At the normal maximum storage capacity (5605 feet NGVD29, 40,868 acre-feet) the Boca release capacity is 9,247 cfs, however at the reduced December maximum storage capacity (5587.12 ft NGVD29, 25,204 acre-feet) the release capacity is only 1,138 cfs and the release capacity during summer-fall reduced condition (5577.12 feet NGVD29, 18,079 acre-feet) is only 1,067 cfs. This limited release capacity significantly limits Boca's ability to evacuate flood waters when needed. For the shifted 1997 flood sequence the total Little Truckee Inflow exceeds the Boca maximum release capacity for seven days between December 16 and December 22 for the No WCM Changes model runs, as shown in Table 1. Per the WCM, the releases from Boca are limited to reduce flows at Reno while proportionally storing into the flood space on Boca, Stampede, Prosser, and Martis reservoirs. This occurs on December 17 and 18. On December 18 the maximum storage capacity is reached at Boca and on December 19 at Stampede and the gates on both reservoirs are opened to reduce surcharge as much as possible. On December 19, after Boca reservoir has already slightly

exceeded its reduced maximum storage capacity of 25,204 acre-feet, the total inflow to Boca reservoir is 5,663 cfcs (2,654 cfs local inflow + 3,009 cfs Stampede release), however if Boca's total release capacity (assuming that there is no access to the spillway) at the reduced condition is only 1,138 cfs that means that Boca would have to store almost 9,000 acre-feet in just one day. This one day increase in storage would fill Boca reservoir to an elevation of almost 5598 feet NGVD29, which is 11 feet above the December stage restriction and 9 feet above the spillway invert.

The failure of Boca to maintain a level below that required by the maintenance project can be broken down into two modes. The first mode of failure occurs when the overall flood volume that must be stored in the Little Truckee Reservoirs is greater than the total flood space available as dictated by the WCM **plus** the total possible release from Boca. This failure mode is severely exacerbated during the Boca maintenance project as the total possible release from Boca is significantly reduced due to the reduced pool elevation being below the spillway elevation. The second mode of failure is a specific version of the first mode, concerned with only the portion of the flood volume which must be stored in Boca rather than in Stampede but is subject to the same significantly reduced Boca release capacity. To further elaborate, the second mode of failure represents failures where Boca will exceed the stage restriction even if there is no release from Stampede release.

To highlight the first failure mode, as shown in Table 1, the total Little Truckee inflow for December 16 through December 22, 2018 is 63,964 acre-feet. The total volume Boca can possibly release over the same period is only 15,541 acre-feet, as due to stage restriction, the release capacity is limited to 1,138 cfs which is the release capacity at the December stage restriction. Consequently, at least 48,424 acre-feet of flood water must be stored in Little Truckee reservoir. The flood space required by the WCM for Boca and Stampede combined is only 30,000 acre-feet, which is only 62% of the total volume that must be stored if the Boca restricted elevation is to be maintained.

The second failure mode is similar to the first, but narrows the focus to Boca reservoir alone. It is made apparent by comparing the local inflow to Boca reservoir to the release capacity of Boca reservoir. The amount by which the Boca local inflow exceeds the Boca release capacity is the flow rate that is necessarily stored in Boca. The local inflow on December 18 and 19, 3,005 and 2,654 cfs respectively, are the most stressing in this regard. If a constant release capacity of ~1,057 cfs (the release capacity at a pool elevation of 5575.76 feet, 17204 acre-feet storage, or the December maximum capacity of 25,204 minus the 8,000 acre-feet of required flood space) is assumed, the local inflow on December 18 and 19 exceeds the release capacity by 7,030 acre-feet without accounting for any release from Stampede. This volume then represents the upper limit of the volume that needs to be stored in Boca due to local inflow alone being in excess of the release capacity. The lower limit of how much needs to be stored in Boca due to limited release capacity would be if the reservoir could maintain the restricted elevation during the entire duration of the flood. The release capacity at the restricted elevation is 1,138 cfs, as shown in Table 1, if this release were maintained for the duration of the flood then the reservoir would need to store 6,710 acre-feet, however if Boca began at the restricted elevation and subsequently stored 6,710 acre-feet the restricted elevation would be exceeded by over 8 feet. Therefore, between 6,710 acre-feet and 7,030 acre-feet of flood space needs to be reserved in Boca exclusively for capturing the local inflow that exceeds the Boca release capacity at the restricted elevation, even without accounting for any release or spill from Stampede.

Table 1: Little Truckee River Water Balance for shifted 1997 flood hydrology during the No WCM Changes run. Values in red indicate that target values were exceeded. Values in purple assume the maximum release at the December stage restriction.

	Little Truckee Inflow	Boca Local Inflow	Stampede Release	Boca Release (1)	Boca Pool Elevation	Boca Storage	Stampede Storage	Boca Max Release (2)	Little Truckee Daily Storage	Lagged Flow at Reno
	cfs	cfs	cfs	cfs	feet NGVD29	acre-feet	acre-feet	cfs	cfs	cfs
16-Dec	1,245	450	797	1,059	5,576.34	17,573	204,500	1,061	184	3,117
17-Dec	2,375	880	45	0	5,579.12	19,404	207,379	1,082	1,292	5,459
18-Dec	11,404	3,005	45	79	5,587.24	25,293	223,101	1,138	10,266	8,481
19-Dec	10,728	2,654	3,009	1,757	5,596.56	33,037	232,460	1,138	9,590	14,083
20-Dec	3,386	822	3,100	3,679	5,597.10	33,514	231,531	1,138	2,247	15,185
21-Dec	1,839	421	3,055	3,692	5,596.61	33,082	228,853	1,138	701	11,992
22-Dec	1,272	291	2,170	3,161	5,594.99	31,688	227,216	1,138	134	8,682
Volume (acre-feet)	**63,964**			**26,631**				**15,541**	**48,424**	

(1): This Boca Release includes uncontrolled flow over the spillway once that elevation is reached.
(2): This Boca Maximum Release assumes that the Boca pool elevation is maintained at the maximum restricted elevation.

2.3.5 Flood Mitigation Strategies – Proposed Temporary Changes to the Water Control Manual

The results presented in section 2.3.4 above suggest:

1. The Little Truckee System needs to be able to store at least 48,500 acre-feet of flood waters.
2. At least 7,100 acre-feet of flood space needs to be reserved in Boca reservoir exclusively for storing local inflow to Boca reservoir that exceeds the release capacity of Boca reservoir at the maintenance condition. This flood space cannot be intentionally stored into for the purpose of flood control downstream per the WCM, however Boca will act as a detention basin storing the inflows in excess of the release capacity. Only the Boca flood space in excess of 7,100 acre-feet can be used for flood control per the WCM if Boca's restricted elevation is to be maintained.

To achieve these goals, the following changes to the WCM are recommended during the maintenance period:

- Limit Stampede release as much as possible to prevent Boca storage encroaching into its modified flood space, even if this causes Stampede reservoir to exceed its current maximum capacity of 226,500 acre-feet. To pass the hydrology from the 1997 flood as discussed above, this would potentially result in surcharging approximately 21,000 acre-feet. Given the planned increase to Stampede's surcharge storage space prior to the Boca maintenance period, it is assumed that this surcharge will not put Stampede reservoir in an unacceptable risk.

- When storing flood water in the Little Truckee reservoirs, store as much in Stampede as possible instead of allocating the storage between Stampede and Boca as prescribed in the WCM.
- Of the 30,000 acre-feet of flood space that is specified for Boca and Stampede, reserve 11,500 acre-feet of flood space in Boca and the remaining 18,500 acre-feet in Stampede. This additional flood space in Boca will allow Boca to store flood water to control downstream flooding in excess of the flood water that Boca must store due to the limited release capacity due to the reduced elevation during maintenance.
- In the event of a major flood in December 2018, the Boca reservoir outlet should be fully opened when (or before) the reservoir reaches an elevation of 5585.97 feet NGVD29, or 1.15 feet below the December stage restriction of 5587.12 feet NGVD29.

By adopting the recommended changes, the model simulations show that the restricted Boca elevation can be maintained in each of the flood hydrology scenarios as shown in Figure 5. For this condition the maximum elevation of Boca reservoir in the 1997 flood scenario is 5,587.12 feet NGVD (25,204 acre-feet storage) and Stampede's maximum storage is 247,383 acre-feet (pool elevation of 5955.18 feet NGVD29) which represents a surcharge volume of 20,883 acre-feet. Figure 6 shows the Stampede reservoir storage during the Boca maintenance period for all of the flood hydrology traces under both the No WCM Changes and WCM Changes scenarios. Figure 7 shows the flow of the Truckee River at Reno during the Boca drawdown and maintenance period for all flood hydrology traces under the Baseline and WCM Changes scenarios. Of particular note is that under the Baseline (no maintenance) scenario the flow at Reno peaks at 19,061 cfs during the flood of record. During the same flood under the WCM Changes scenario with the Boca maintenance project, the flow of Reno only reaches 14,455 cfs, showing that the reduced storage conditions of Boca during the maintenance project would potentially have positive consequences regarding peak flood levels in the Truckee River.

During the earlier analysis of the proposed changes to the WCM there was an initial recommended change which was: *Increase Boca releases to maintain Boca's specified flood space immediately and allowing flows in Reno to exceed or further exceed 6,000 cfs if necessary.* This change, when included, eliminated the need for implementation of the third change described above that dictates reserving 11,500 acre-feet of space in Boca and 18,500 acre-feet in Stampede. However, during stakeholder review of the analysis results and findings, it became apparent that this originally recommended change was not desirable, thus the third recommended change above was implemented.

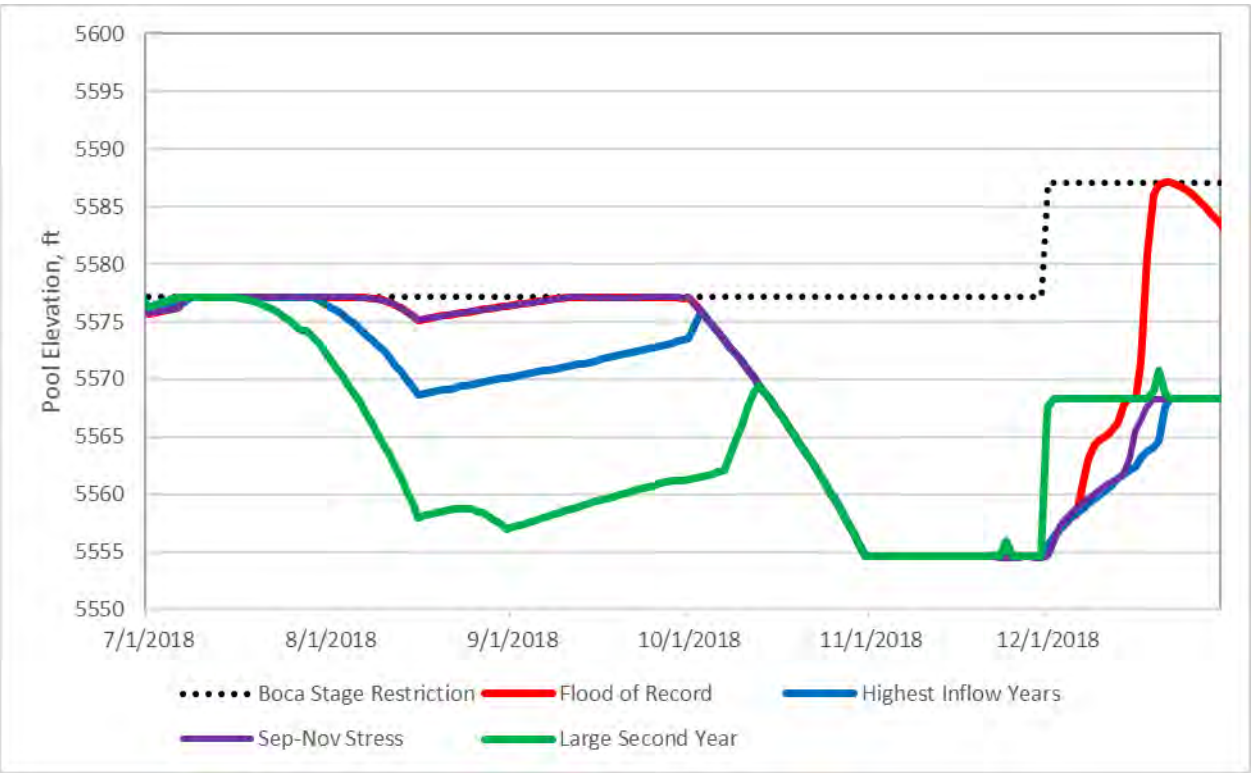


Figure 5: Boca Pool elevation for flood scenarios with recommended changes to the WCM.

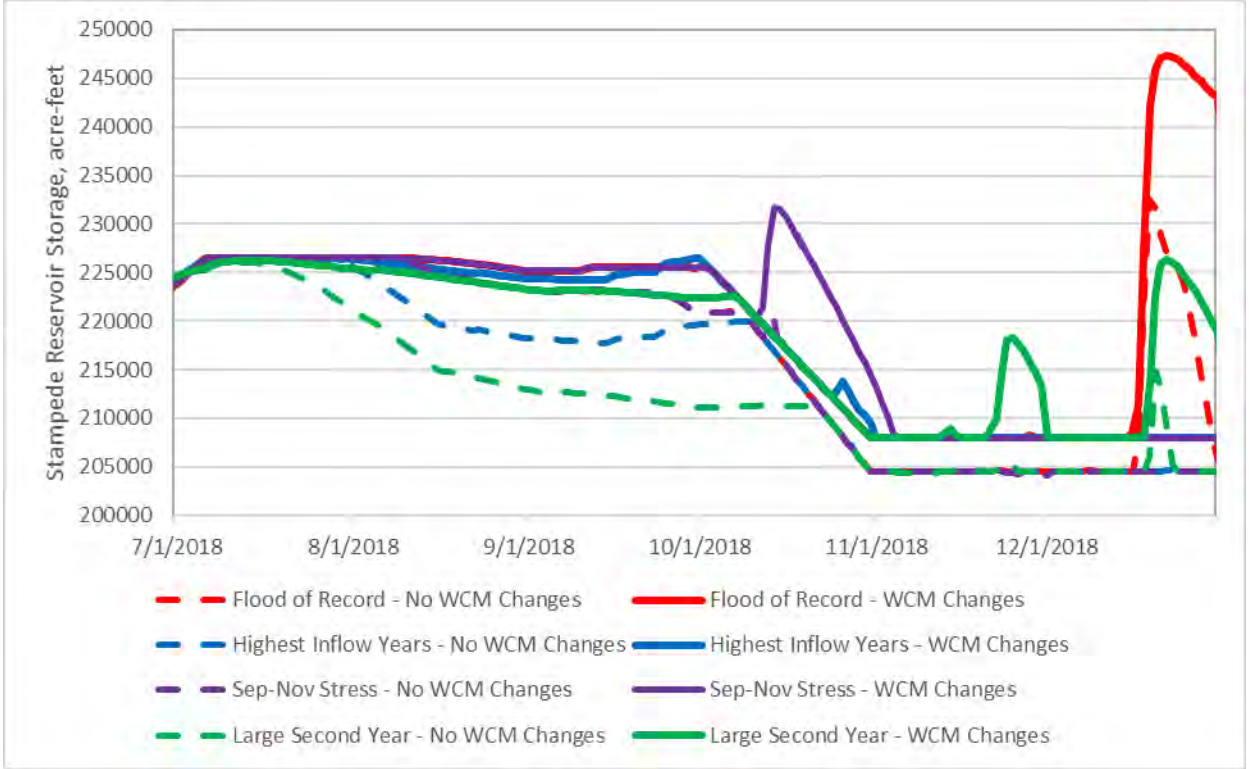


*Figure 6: Stampede storage for all flood hydrologies under **No WCM Changes** and **WCM Changes** scenarios.*

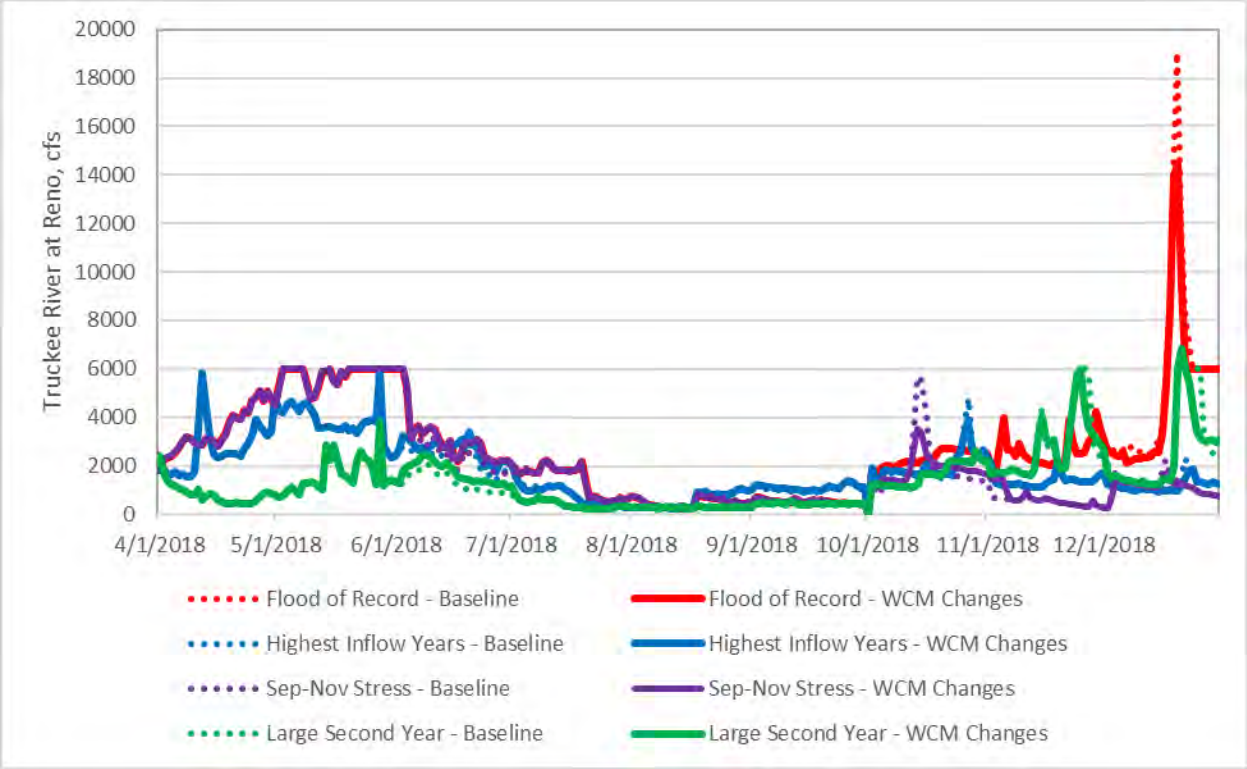


*Figure 7: Flow of the Truckee River at Reno for all flood hydrologies under **Baseline** and **WCM Changes** scenarios.*

2.3.6 Independent Flood Mitigation Strategy Analysis

Per stakeholder suggestion, additional model runs were made to analyze the effectiveness of each of the three recommended changes to the WCM individually. The results are illustrated in Figure 8, Figure 9, and Figure 10 below. The analysis shows that each of the WCM changes, when implemented independently, result in the Boca Reservoir water surface elevation exceeding the maintenance stage restriction in 3 of the 4 flood hydrology scenarios, the Flood of Record scenario, the Sept-Nov Stress scenario, and the Large Second Year scenario. The results for the Highest Inflow Years scenario, which does not include any significant fall and winter flood events, did not exceed the maintenance stage restriction under any conditions and thus are not shown in a figure. Furthermore, the maximum water surface elevation for each of the WCM changes runs, when applied independently is very similar, and not substantially improved from the No WCM Changes scenario. This indicates clearly that each of the recommended changes are insufficient if applied individually. However, when applied in combination the changes accomplish the necessary reduction in peak storage in Boca Reservoir during the simulated flooding scenarios.

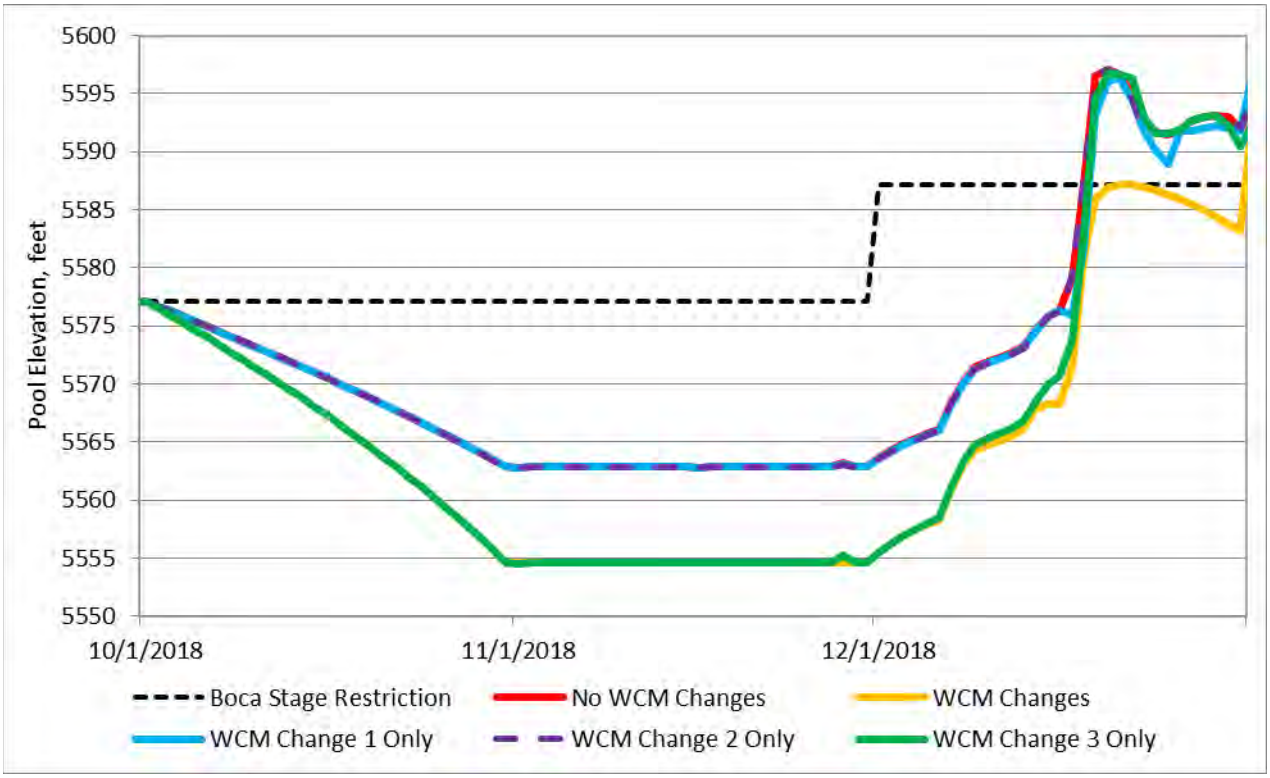


*Figure 8: Boca pool elevation with recommended WCM changes applied individually under the **Flood of Record** flood hydrology scenario.*

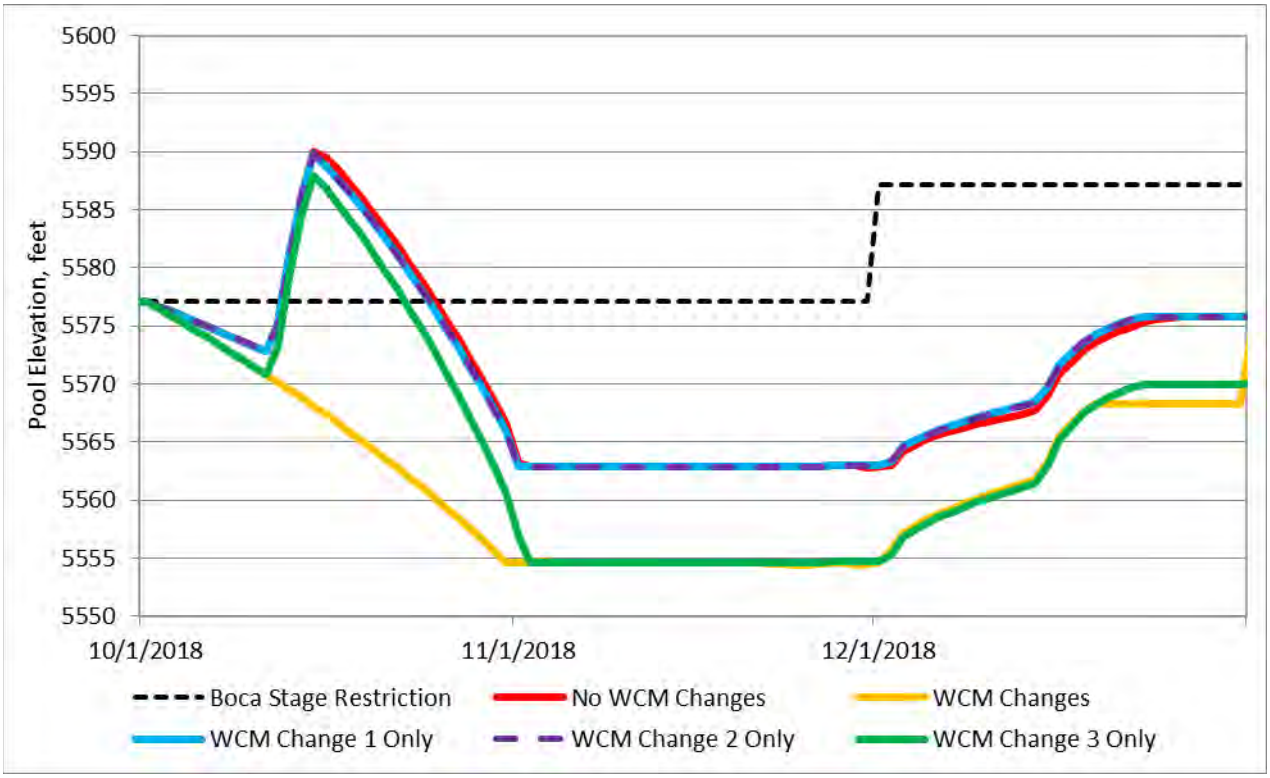


*Figure 9: Boca pool elevation with recommended WCM changes applied individually under the **Sep-Nov Stress** flood hydrology scenario.*

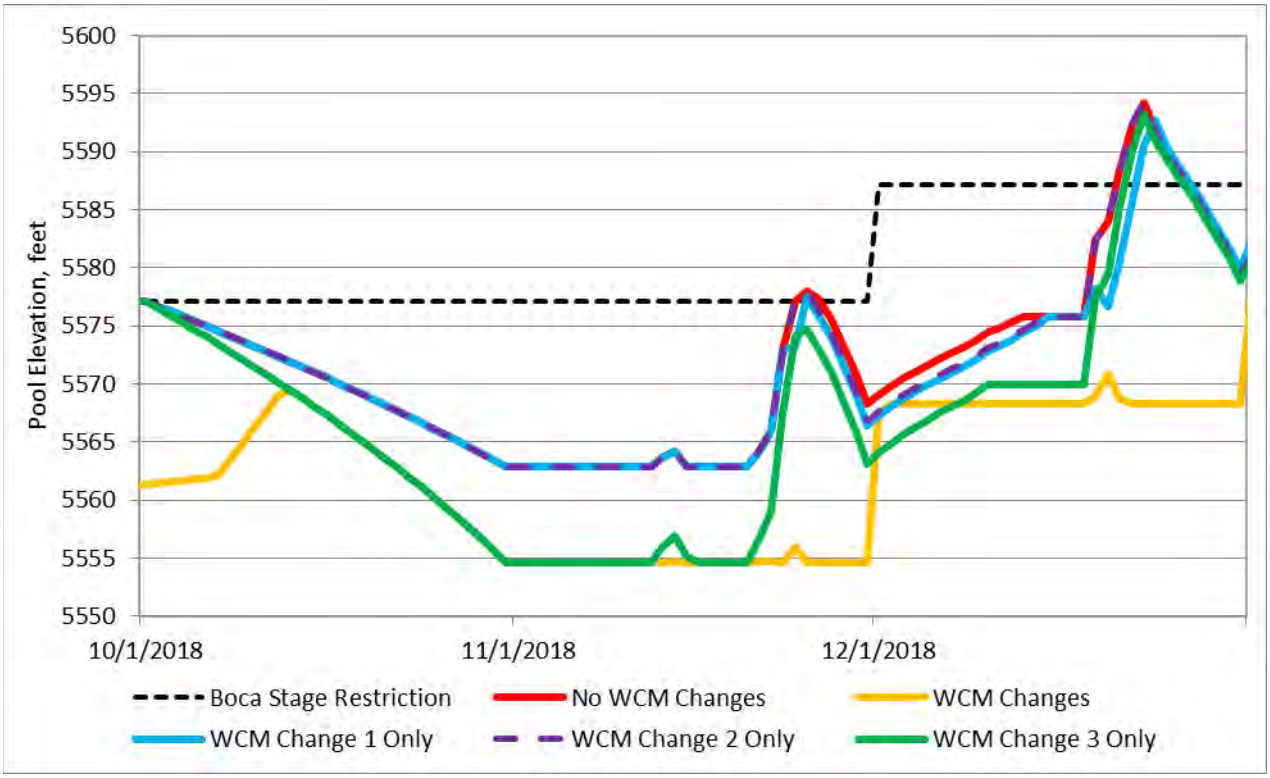


*Figure 10: Boca pool elevation with recommended WCM changes applied individually under the **Large Second Year** flood hydrology scenario.*

2.4 PROBABILISTIC HYDROLOGIC OPERATIONS ANALYSIS

Though changes to the WCM due to the Boca reservoir maintenance have been identified and proposed, it is only under the most severe hydrologic conditions (floods) that these changes will actually need to be enacted. In order to quantify the likelihood that the proposed changes to the water control manual will be needed, a probabilistic analysis was conducted. Using historical hydrologic sequences and current reservoir storage conditions, the probability that the future hydrologic conditions will warrant implementing the proposed changes to the standard WCM operations was explored.

2.4.1 Model Run Timeline

The timeline of the model runs completed during the probabilistic analysis is shown in Figure 11 below. This timeline is similar to that of the pseudo-historic flood analysis, however the model runs in this analysis begin on October 1, 2016 (rather than 2017 as in the previously discussed flood runs). The reason for this difference is that the first year of this probabilistic analysis represents an initialization year to prime the basin with potential initial hydrologic conditions before entering the year containing the Boca Maintenance Project.

Each model trace, consisting of two 15-month runs, begins on October 1, 2016 from an identical initialization condition (described below). The first year of each 2-year hydrologic sequence (described below) is used to drive the 15-month run of the TROA Ops model through December 31, 2017. The year 2017 model run of each trace uses the same TROA and normal WCM operational procedures and criteria, representing normal system operations as the Boca maintenance and associated operational changes do not occur in this period. The hydrologic conditions in the entire Truckee River Basin on September 30, 2017 are used to initialize the second model run of the trace, which is driven by the second year of each 2-year hydrologic sequence. This model run contains the Boca Maintenance Project period, with stage and spillway restrictions beginning on July 1, 2018, and the potential drawdown to the restricted levels beginning as early as April 10, 2018 (which is only required if Boca is previously above that level), and thus contains the various differences in operations due to the Boca Reservoir stage restrictions and potential changes to the Truckee River WCM depending on model scenario. The end of the Boca maintenance period corresponds with the end of the second model year run.

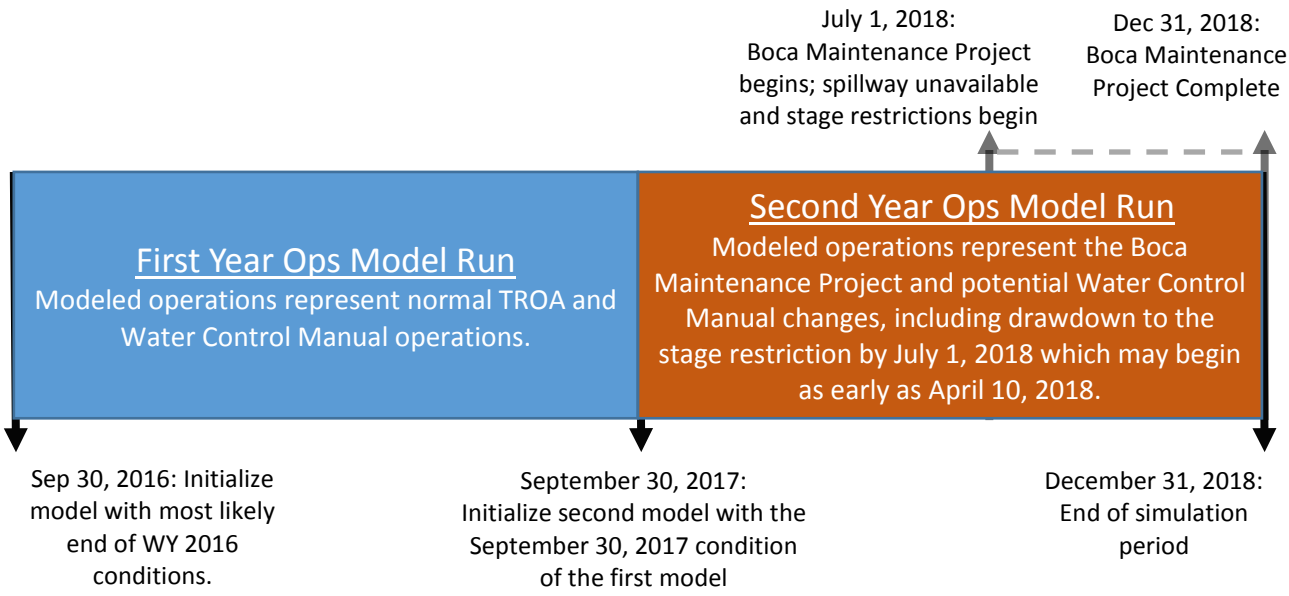


Figure 11: Model run timeline diagram for the probabilistic hydrologic operation analysis.

2.4.2 Initialization

The initial conditions used in this probabilistic analysis are the most likely basin-wide hydrologic conditions, including reservoir and account storage levels and various other hydrologic parameters, that will be present on September 30, 2016. This initialization condition was taken from the most likely outcome of the June 2016 TROA Scheduling Coordination Process modeling work. The relative range of these outcomes is shown in Figure 12 below.

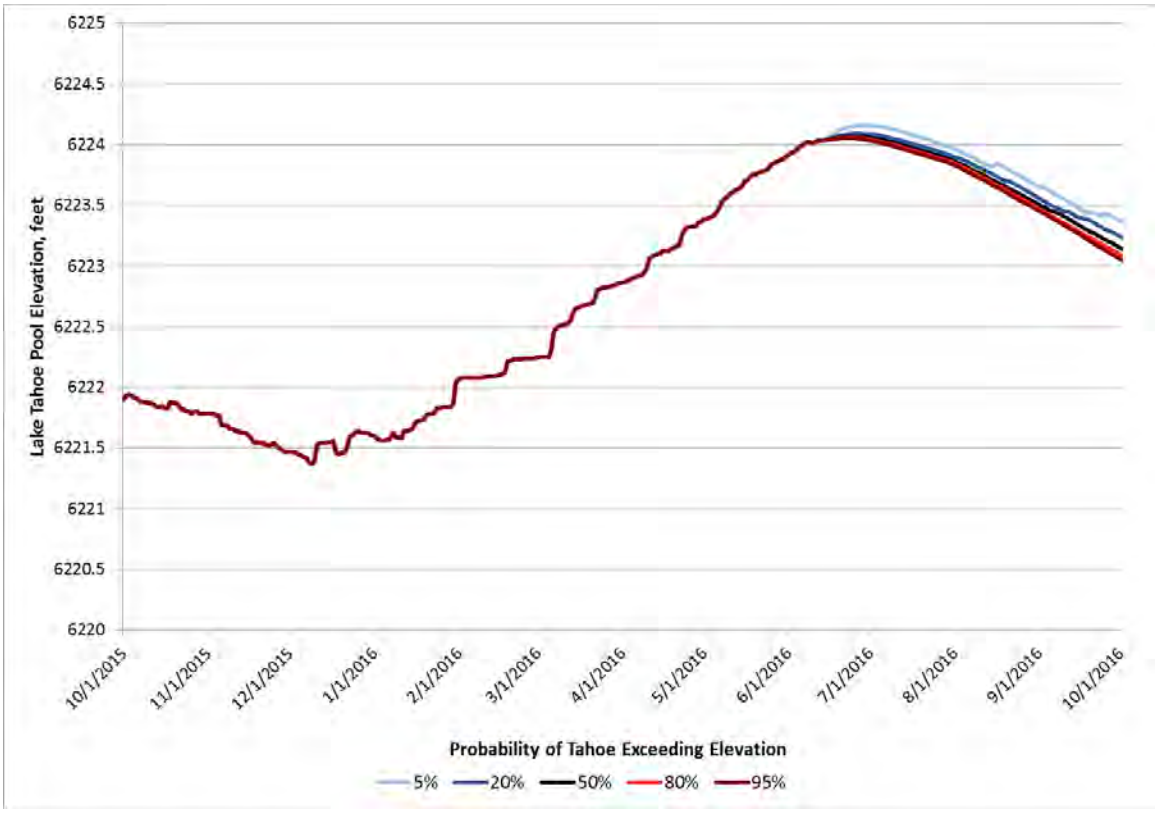


Figure 12: Plot showing the relatively narrow range of potential end of WY2016 Lake Tahoe pool elevations by exceedance probability, from the June 2016 TROA Scheduling Coordination Process.

2.4.3 Hydrology

Due to the limited scope of this analysis and the capability of the preexisting technical tools, only 59 hydrology sequences were used for the probabilistic analysis despite the historical record being 115 years. The hydrology selected for the probabilistic analysis includes each 2-year period of 60 consequent years beginning in October 1954 and ending in December of 2014. Except for the first and last water years, each year is included in the analysis twice, once as pre-maintenance year, 2017, and once as the year in which the Boca Maintenance Project occurs, 2018. In effect, each 2-year hydrologic trace is overlapped by the subsequent trace, and thus, a total of 59 2-year hydrologic sequences are analyzed: 10/1954-12/1956, 10/1955-12/1957, …, 10/2012-12/2014. These 60 individual years, from WY 1955 – WY 2014, contain the three of the four wettest hydrologic years of the entire 115-year (1901-2015) period of available record and 8 of the 10 driest hydrologic years of record in terms of total water year natural flow volume of the Truckee River at Farad.

One of the 59 traces was altered temporally for the purposes of this study. The water year 1996 hydrology contains the flood of record. Historically, this flood occurred between approximately December 31, 1996 and January 4, 1997, however for use in this analysis this flood was shifted back in time by two weeks to occur between December 17-21, 1996. This shift was applied to place the flood of record into the Boca maintenance period when the stage restrictions would still be in effect.

The large range of differences in hydrologies is apparent in the following figure. Assuming these 59 2-yr hydrology traces would be repeated starting on October 1, 2016, Figure 13 shows all 59 2-year hydrology traces of the daily natural flow of the Truckee River at Farad.

It is noted that a major assumption of this probabilistic analysis is that the 59 2-year hydrology traces are representative of a realistic and probable range of hydrologic conditions for the Truckee Basin. However, no statements or results of this analysis are meant to imply that future hydrology will always fall with the range, pattern, or frequency suggested by the historic distribution, and unforeseen and extreme events may always occur.

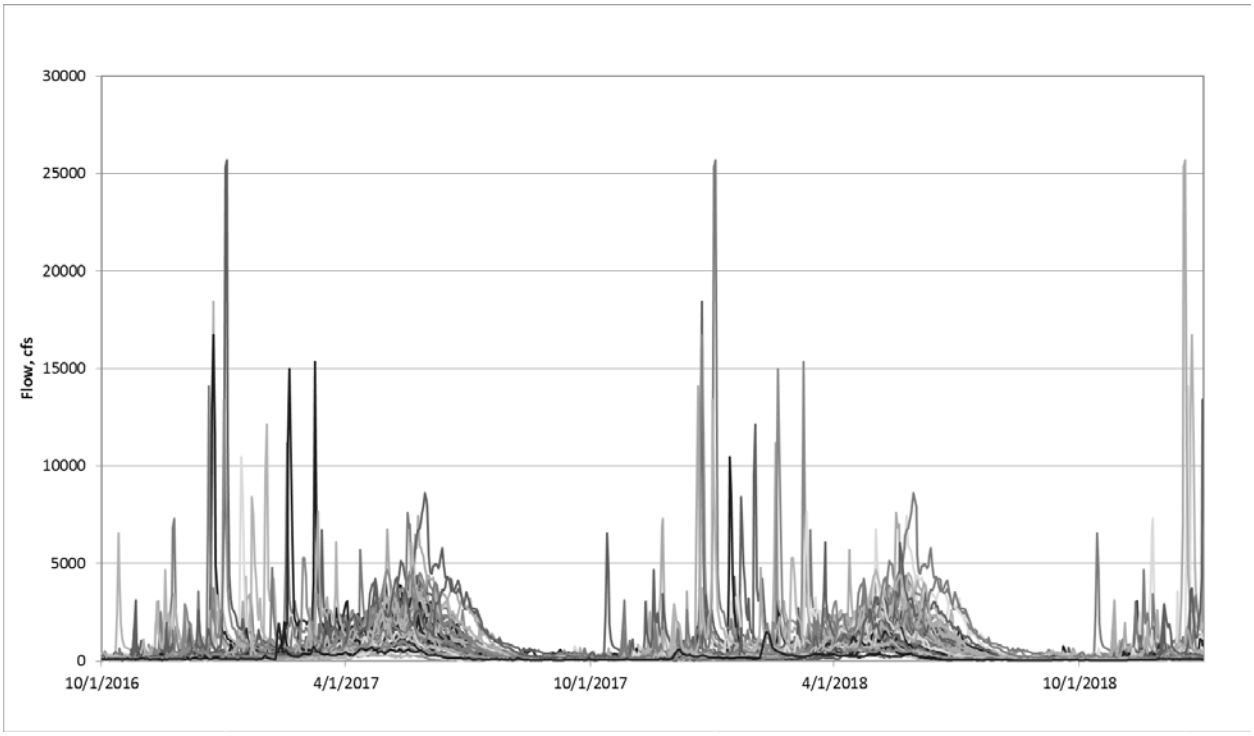


Figure 13: Daily natural flow of the Truckee River at Farad for all 59 2-year hydrology traces, assumed for WY 2017-2018.

2.4.4 Results

2.4.4.1 Baseline Scenario Results

Notable results from the probabilistic analysis of the Baseline scenario model runs are described below. Figure 14 shows the full range of Boca Reservoir pool elevations under the Baseline scenario along with selected probabilistic results in terms of probabilities of exceedance.

- ***23 (39%) of the 59 total traces show Boca Reservoir's pool elevation not exceeding the 5577.12 feet NGVD29 stage restriction throughout the maintenance period***. This is notable as this scenario does not have the stage restriction, drawdown, or any other operational changes in place, but would not exceed the stage restrictions or cause altered operations during the Boca maintenance period whatsoever.
- ***The 23 traces that do not exceed the restriction include 6 of the most recent 8 2-year hydrology sequences (2006-2007, 2007-2008, …, 2013-2014).*** Since 2006, the only two traces that would exceed the restriction under the Baseline, no maintenance scenario are 2010-2011 and 2011-2012.
- The median condition of all 59 traces exceeds the WCM initially, but then goes below the 5577.12 feet Boca pool elevation restriction in the beginning of August 2018 and remains below it for the rest of the maintenance period.
- The 25% exceedance Boca elevation value remains well above the Boca stage restriction elevation of 5577.12 feet during the entire maintenance period.

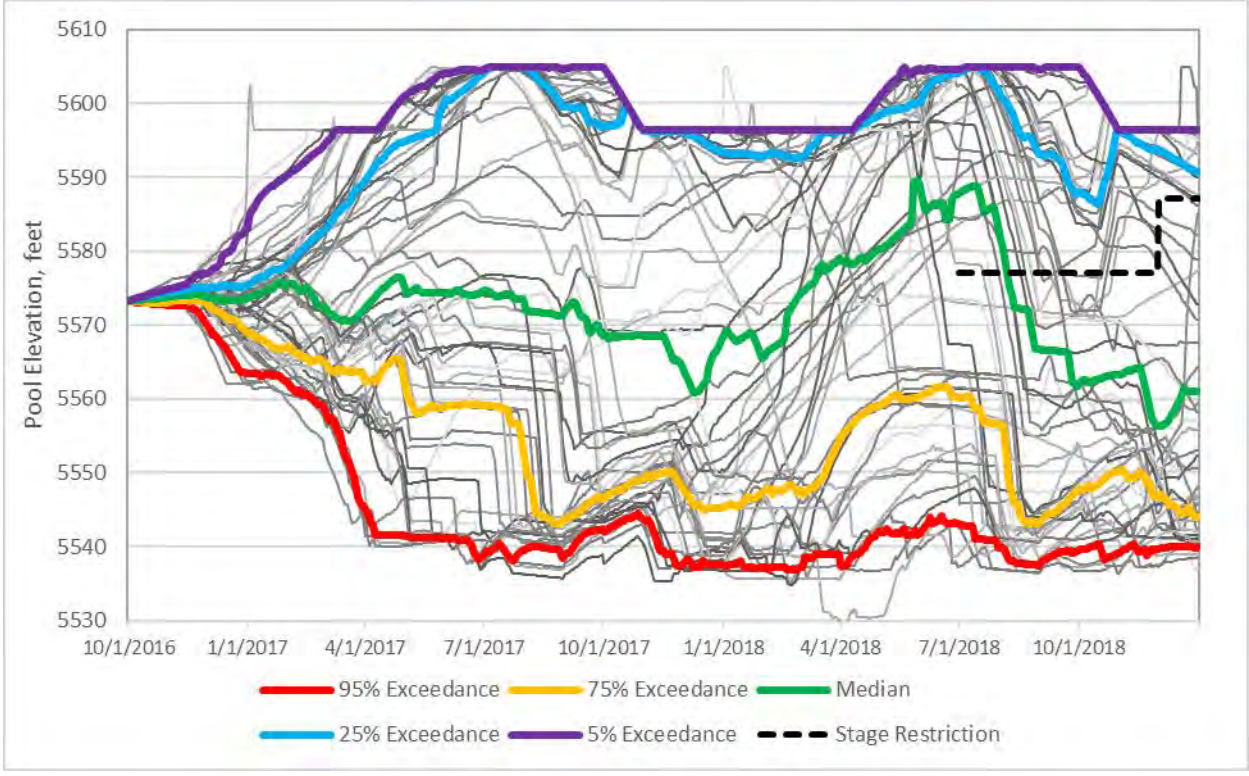


Figure 14: Probabilistic results for Boca Reservoir pool elevation under the Baseline scenario.

2.4.4.2 No WCM Changes Scenario Results

Figure 15 and Figure 16 show the full range of Boca and Stampede Reservoir pool elevations under the No WCM Changes Scenario along with selected probabilistic results in terms of probabilities of exceedance. These runs used the same No WCM Changes Scenario assumptions listed in Section 2.3.

- ***In all 59 model runs, Boca is able to be drawn down to the 5577.12 feet NGVD29 Boca stage restrictions by July 1.*** In all traces except for one, the 1982-1983 hydrology (which also represents one of the flood sequences), Boca is able to be drawn down to the restriction according to the drawdown schedule. However even in the 1982-1983 trace it is still ultimately able to evacuate the large volume of water necessary to meet the 5577.12 feet restriction by July 1, although it causes the Truckee River at Reno gage to exceed 6,000 cfs for a period of four days.
- ***Boca's Pool Elevation exceeds the stage-restrictions in only one trace, but it does so significantly.*** With the Boca construction restrictions in place, but with no changes to the normal WCM operating procedures, only one of the 59 total 2-year hydrology sequences exceeds the Boca stage restriction. Not surprisingly, this occurs in the 1995-1996 hydrology trace. This trace exceeds both the 5577.12 feet NGVD29 restriction and the relaxed December restriction for temporary storage up to 5587.12 feet NGVD29 for flood mitigation. The peak Boca elevation during this flood reaches 5597.1 feet and remains above or very near the 5587.12 feet restriction for at least 14 days (through the end of the maintenance period).
- ***Stampede surcharges during the Boca exceedance.*** During the Boca stage restriction exceedance, Stampede surcharges over its maximum capacity of 226,500 acre-feet (5949.3 feet NGVD29) by 5,942 acre-feet (1.7 ft) to 232,442 acre-feet (5951 feet NGVD29). However, this amount of surcharge is nearly identical to that of the Baseline scenario model run of this same hydrology trace. Thus, there is no additional impact to Stampede due to the Boca stage-restrictions in this situation.

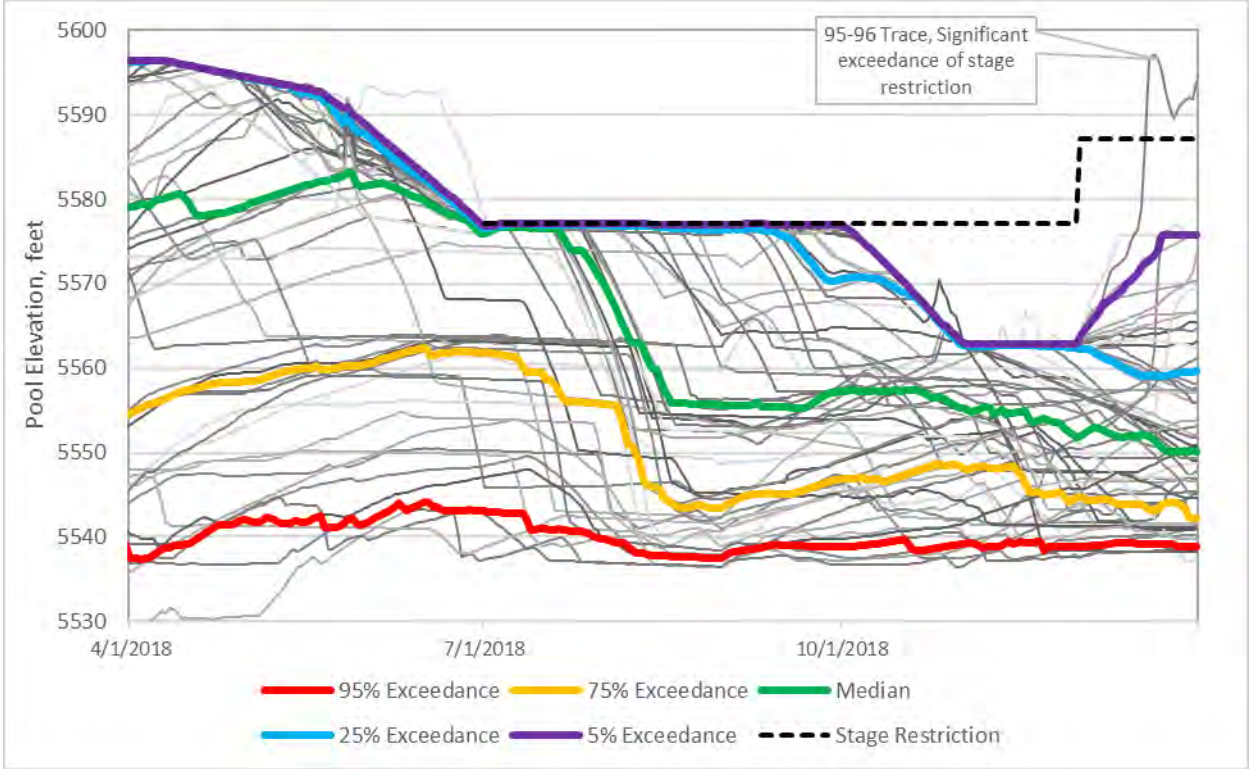


*Figure 15: Probabilistic results for Boca Reservoir pool elevation during the maintenance period under the **No WCM Changes** scenario.*

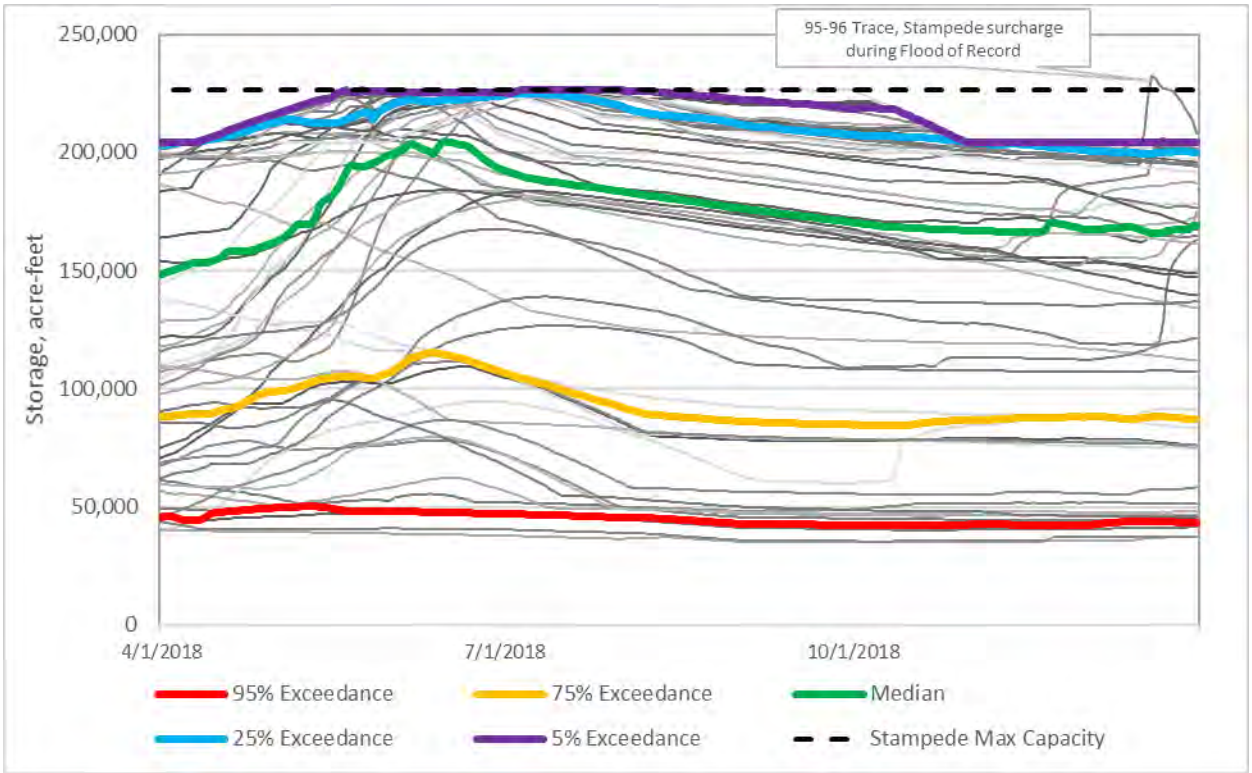


*Figure 16: Probabilistic results for Stampede Reservoir storage during the maintenance period under the **No WCM Changes** scenario.*

2.4.4.3 WCM Changes Scenario Results

Figure 17 and Figure 18 show the full range of Boca and Stampede Reservoir pool elevations under the proposed temporary WCM Changes Scenario along with selected probabilistic results in terms of probabilities of exceedance. These runs used the same WCM Changes Scenario assumptions listed in Sections 2.2.3.3 and 2.3.5.

- ***In 58 of the 59 model runs, Boca is able to be drawn down to the 5577.12 feet NGVD29 Boca stage restrictions by July 1.*** In the 1982-1983 trace, the drawdown is not able to reach the maintenance restriction of 5577.12 feet until July 18. The 1983 spring runoff is one of the largest on record and follows the year 1982 which is also very large, including several large fall and winter events. If a very large spring runoff like this were to occur during the spring of 2018 it would be very apparent relatively early in the spring, giving time for additional considerations to be made. While the model was unable to meet the July 1 Boca stage restriction using the standard operations logic and procedures used for all traces, it is possible to reach 5577.12 feet by July 1 if several custom modeling logic changes are made. For instance, allowing Stampede to remain in surcharge for a longer time, allowing for reduced Stampede outflow levels in coordination with the reduced Boca release capacity to allow Boca to draw down to and maintain the restricted elevation.
- ***No traces exceed the Boca stage restrictions other than the drawdown issue in single trace discussed above.*** The proposed temporary changes to the WCM successfully prevent Boca from exceeding the stage restriction during all fall or early winter flood events present in the hydrology traces used, however;
- ***Stampede surcharges during the flood of record to protect Boca.*** During the 95-96 trace containing the shifted flood of record, Stampede surcharges over its maximum capacity of 226,500 acre-feet (5949.3 feet NGVD29) by 20,858 acre-feet (5.9 ft) to 247,358 acre-feet (5955.2 feet NGVD29). This represents an additional ~15,000 acre-feet in surcharge versus the "No WCM Changes" scenario. This additional surcharge in Stampede is required to maintain the Boca elevation below the stage restriction.
- One of the 59 traces, requires use of Boca's temporary storage for flood mitigation of up to 5587.12 feet NGVD29 in December. In the 1995-1996 trace Boca reaches an elevation of 5587.12 feet for a period of 2 days before receding.
- There are no notable differences in the flood operations of Martis and Prosser Reservoirs between the scenarios. For all traces, the maximum storage in Martis is below 12,000 acre-feet, well below the maximum capacity of 20,400 acre-feet. Under all scenarios, Prosser nears its full storage of 29,840 acre-feet in approximately 25% of years during the spring runoff period.

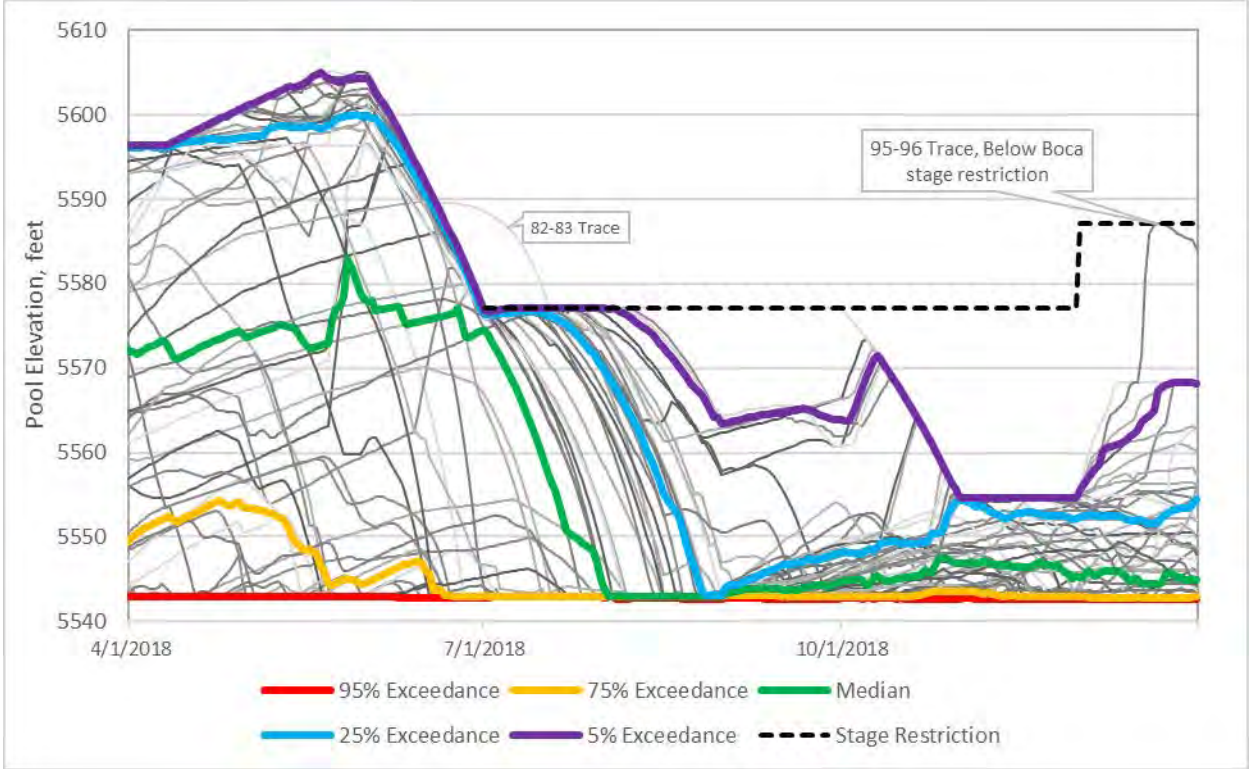


*Figure 17: Probabilistic results for Boca Reservoir pool elevation during the maintenance period under the **WCM Changes** scenario.*

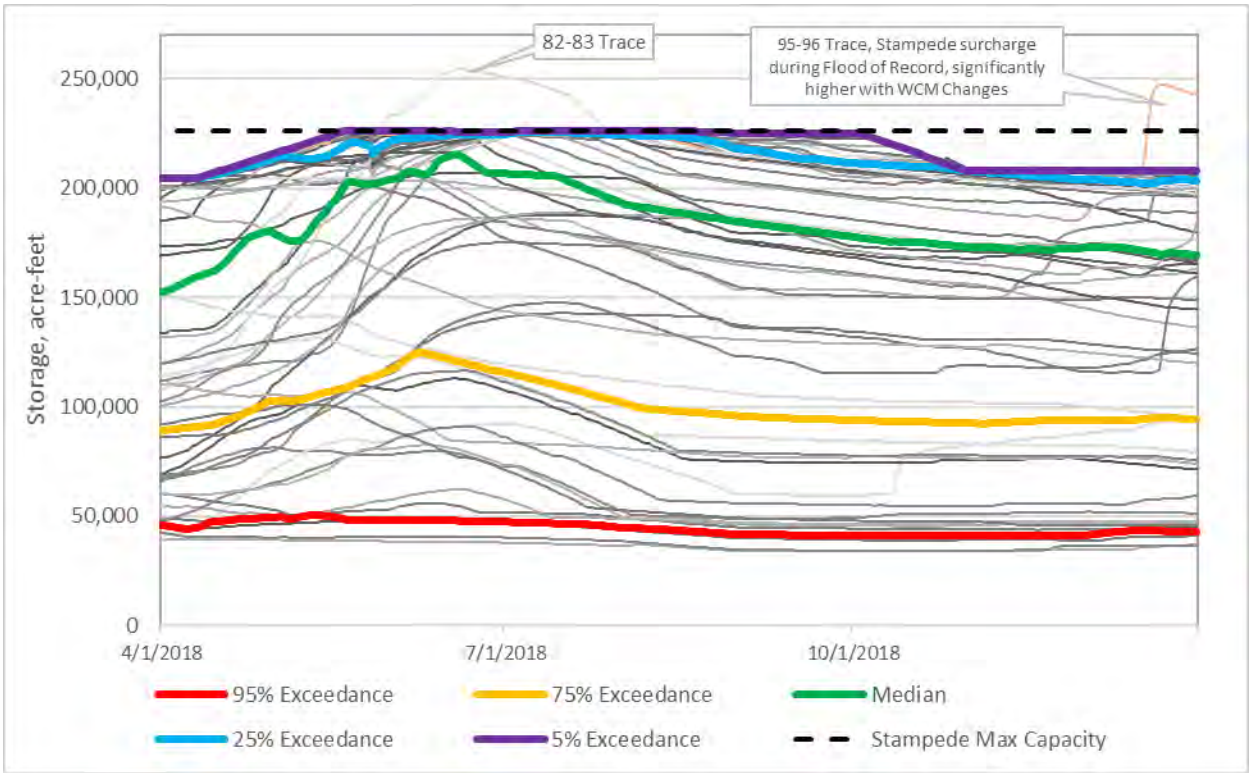


*Figure 18: Probabilistic results for Stampede Reservoir storage during the maintenance period under the **WCM Changes** scenario.*

2.4.5 Further Discussion of Probabilistic Flood Analysis Results

From this probabilistic analysis, several key overall results are recognized:

- With the Boca stage restrictions and planned drawdown schedule in place, it is unlikely that the Boca restrictions would be exceeded. The "No WCM Changes" scenario modeling shows that only 1 out of the 59 hydrology traces would exceed the Boca stage restriction of 5577.12 feet NGVD29 (albeit significantly to 5597.1 feet). Furthermore, just one additional trace would use the allowable temporary flood storage of up to 5587.12 feet NGVD29 in Boca during December.
- The proposed temporary changes to the WCM successfully mitigate the single exceedance of the Boca restrictions that is observed in one out of the 59 2-year hydrology sequences, during the temporally shifted flood of record. In order to limit Boca's rise during this flood, the proposed changes to the WCM operational procedures would cause a surcharge in Stampede of 5.9 feet above the normal maximum elevation to a pool elevation of 5955.2 feet NGVD29. The maximum surcharge volume would be approximately 21,000 acre-feet.
- Interestingly, this is approximately the same Stampede surcharge volume that occurs during the flood of record in the pseudo-historic flood analysis, which has a significantly larger volume runoff year preceding the maintenance period. This indicates that the proposed changes to the WCM during the restricted Boca period would be effective in mitigating a very large runoff year preceding an extreme flood in the late fall/early winter period.
- Under the Baseline scenario results, there is approximately a 39% (23 of all 59 traces) likelihood that the Boca Maintenance Project and associated operational restrictions and changes would have very minimal possible effects on reservoir operations. These 23 traces meeting this condition include 6 of the most recent 8 hydrology traces, beginning in 2006.

Outside of the Little Truckee River Basin:

- Figure 19 and Figure 20 show that the maximum flood flows of the Truckee River at Reno during large events may actually be lower if they occurred during the Boca maintenance period with the WCM Changes in place than if maintenance was not occurring. This is a reasonable finding, due to the reduced storage conditions (i.e., the reservoirs have more empty space) and increased flood space requirements during the period. This is apparent in both the "No WCM Changes" and "WCM Changes" scenarios.
- There are no notable differences in the flood operations of Martis and Prosser Reservoirs between all of the scenarios. For all traces, the maximum storage in Martis is below 12,000 acre-feet, well below the maximum capacity of 20,400 acre-feet. Under all scenarios, Prosser nears its full storage of 29,840 acre-feet in approximately 25% of years during the spring runoff period.

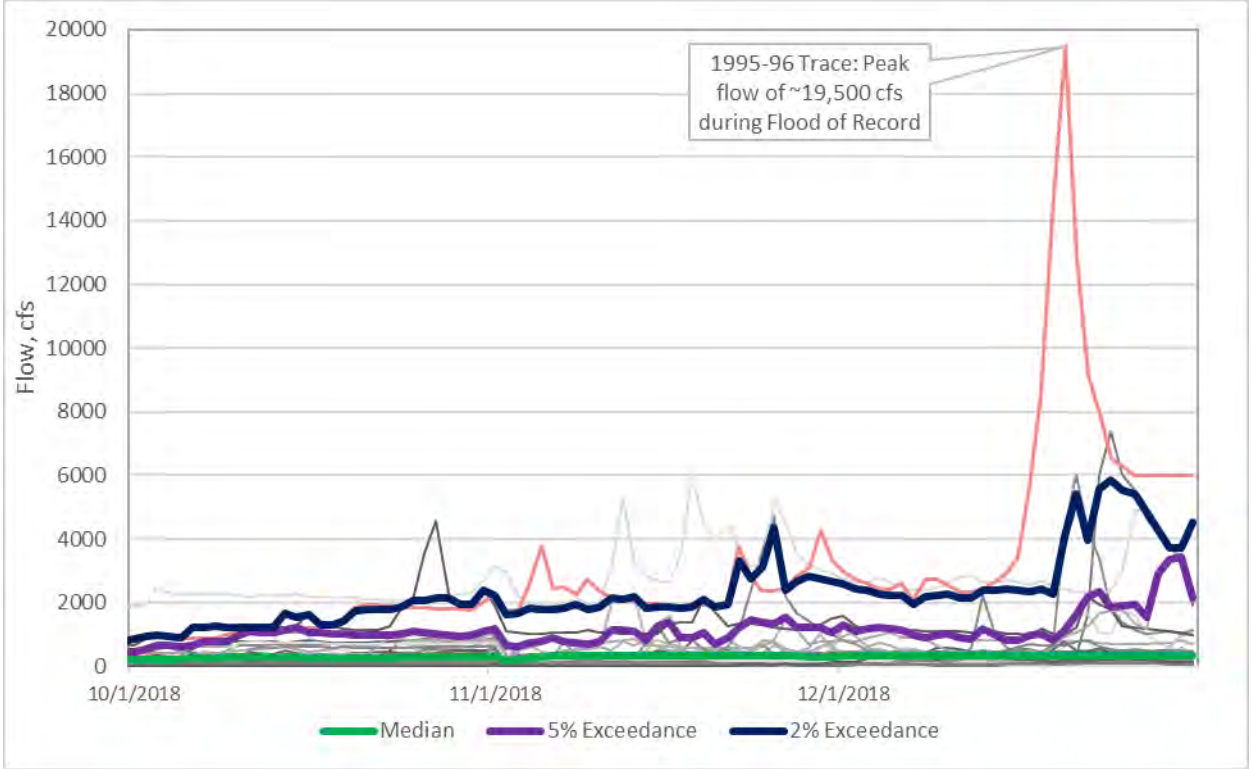


*Figure 19: Truckee River at Reno flow in the fall of the Boca maintenance period in the **Baseline**, no maintenance, scenario.*

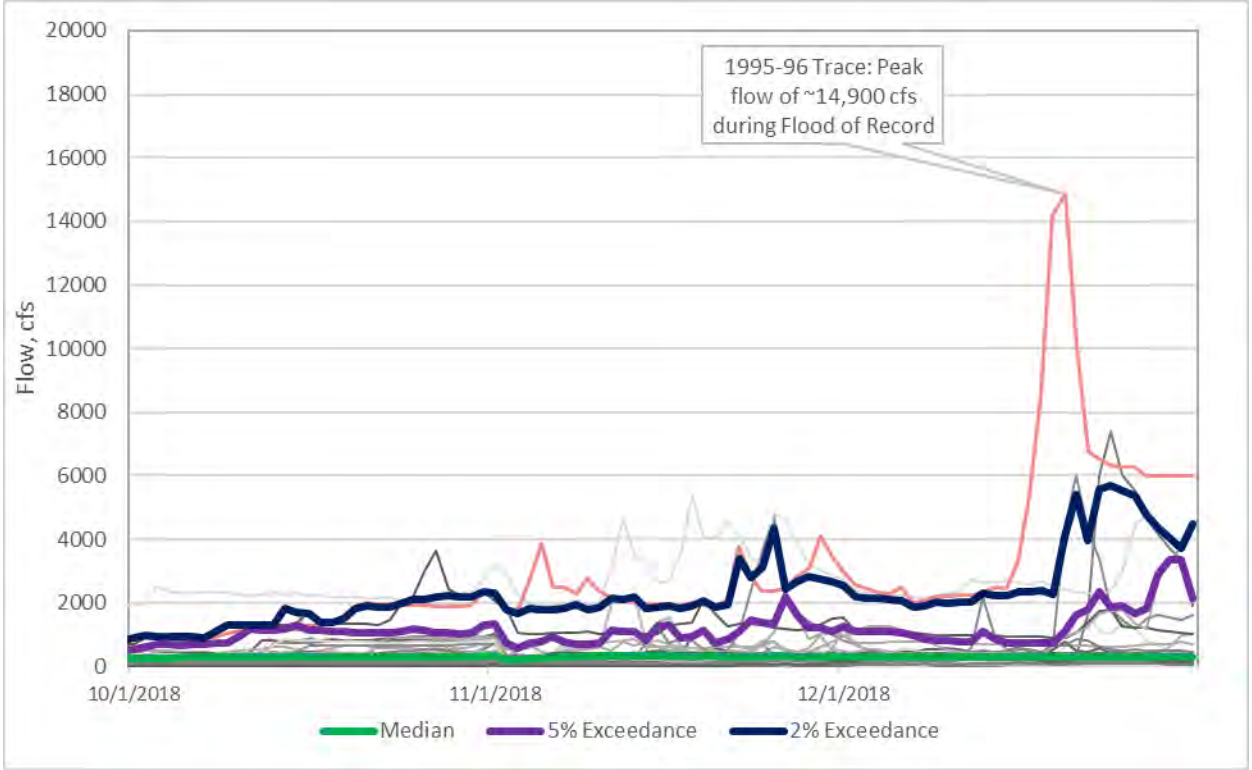


*Figure 20: Truckee River at Reno flow in the fall of the Boca maintenance period in the **WCM Changes** scenario.*

2.5 Conclusions and Recommendations of the Flood Control Analysis

Two complementary analyses were performed to determine the impacts to Boca reservoir and the Truckee system due to a significant maintenance project scheduled to be performed on Boca's dam in late 2018. The first analysis involved generating four pseudo-historic flood hydrologies to drive model runs to assess the ability of the system to safely manage these floods with a reduced capacity to store flood waters in Boca reservoir. From this analysis, three recommended deviations to the flood operations prescribed in the WCM are proposed that will allow the system to safely manage these floods. The second analysis was to drive the model with 59 historical hydrology sets in order to estimate the likelihood that the deviations to the WCM will be utilized, and to confirm their effectiveness in mitigating problems under a wide range of hydrologic conditions.

Results from modeling each of the four constructed flood scenarios showed that the restrictions on Boca Reservoir during the maintenance period were exceeded in three out of the four of the scenarios: The ***Flood of Record (1952-1997)***, ***September-November Stress (1952-1963)***, and ***Large Second Year (1978-1982)***. The only scenario that did not cause Boca to exceed the maintenance restrictions is the ***Back-to-Back High Inflow Years (1982-1983)***. This scenario contains very high snowmelt runoff volumes, however, it does not contain significant fall floods within the maintenance period. By analyzing the modes of failure for the flood scenarios, proposed temporary changes to the Water Control Manual were designed that would effectively mitigate the floods and prevent the Boca restrictions from being exceeded.

Based on the results of this analysis, the following recommendations are submitted:

Prior to the maintenance period, Boca Reservoir should be steadily drawn down from the normal maximum capacity of 40,868 acre-feet (5,605 feet NGVD29) on May 31, 2018 to a reduced maximum capacity of 18,079 acre-feet (5,577.12 feet NGVD29) by July 1, 2018; this drawdown operation could be adjusted if necessary. There is rarely a water supply demand for release of stored water prior to July 1 so any water that needs to be released during June 2018 to draw Boca down for maintenance is likely to be labeled as spill. However, in some conditions there may be a demand for the all or part of the releases in June, so it may be advantageous to store water in April and May only to evacuate it in June. These considerations would need to be reevaluated as well in the Spring of 2018 when the snowpack and likely runoff is less uncertain.

The following temporary changes to the WCM should be adopted from June 30, 2018 to December 31, 2018:

1. Limit Stampede release as much as possible to prevent Boca storage encroaching into its modified flood space, even if this causes Stampede reservoir to exceed its current maximum capacity of 226,500 acre-feet. Given the planned increase to Stampede's surcharge storage space prior to the Boca maintenance period, it is assumed that this surcharge will not put Stampede reservoir in an unacceptable risk.
2. When storing flood water in the Little Truckee reservoirs, store as much in Stampede as possible instead of allocating the storage between Stampede and Boca as prescribed in the WCM.
3. Of the 30,000 acre-feet of flood space that is specified for Boca and Stampede, reserve 11,500 acre-feet of flood space in Boca and the remaining 18,500 acre-feet in Stampede. This additional flood space in Boca will allow Boca to store flood water to control downstream flooding in

excess of the flood water that Boca must store due to the limited release capacity due to the reduced elevation during maintenance.

4. In the event of a major flood in December 2018, the Boca reservoir outlet should be fully opened when (or before) the reservoir reaches an elevation of 5585.97 feet NGVD29, or 1.15 feet below the December stage restriction of 5587.12 feet NGVD29.

With the proposed temporary WCM changes in place, the modeling simulations show that the Boca stage restrictions can be maintained in all of the pseudo-historic flood hydrology scenarios. Under these conditions, the maximum elevation of Boca reservoir in the 1997 Flood of Record scenario is 5,587.12 feet NGVD29 (25,204 acre-feet storage) and Stampede's maximum storage is 247,383 acre-feet (pool elevation of 5955.2 feet NGVD29) which is a surcharge of 20,883 acre-feet.

The subsequent probabilistic analysis to estimate the likelihood of utilizing the proposed deviations from the WCM, allowed for evaluation and comparison between each of the three operational scenarios: ***Baseline*** (no Boca maintenance), ***No WCM Changes***, and ***WCM Changes***. Major conclusions resulting from the probabilistic analysis presented within this report include:

- With the Boca stage-restrictions and planned drawdown schedule in place, it is unlikely that the Boca restrictions would be exceeded. Only one of 59 historic hydrology traces showed Boca exceeding the stage restriction during the maintenance period. But, without the proposed WCM changes in place, this flood would cause the Boca pool elevation to reach 5597.1 feet NGVD29, significantly exceeding the 5577.12 feet NGVD29 restriction and even exceeding the allowable temporary flood storage up to 5587.12 feet NGVD in December.
- Just one of the 59 traces with the proposed WCM changes in place was not able to draw Boca down to the 5577.12 feet NGVD29 restriction by July 1. In the 1982-1983 trace, the drawdown is not able to reach the maintenance restriction until July 18.
- The proposed temporary deviations from the WCM flood operation would allow the system to successfully mitigate the impacts of the flood on Boca. But, in order to limit Boca's rise during this flood, the proposed changes would cause a surcharge volume of approximately 21,000 acre-feet in Stampede.
- In most flooding situations, the flows at Reno would be reduced in the maintenance or unaffected, due to the reduced Boca storage conditions and significantly limited release capacity of Boca reservoir at the restricted elevation.
- Both the Flood of Record pseudo-historic flood hydrology sequence and the 1995-1996 historic trace contained the same flood. However, the pseudo-historic trace preceded the flood with a very high runoff year filling the whole system. The modeling shows that essentially the same Stampede surcharge volume was required to protect Boca during the flood in both cases. This indicates that the required flood space during the restricted Boca maintenance period would likely be successful in mitigating a very large runoff year preceding an extreme flood, and that the storage condition of the system entering into the maintenance period has little impact on the system's resilience to floods.

- In the normal and unaltered operations of the Baseline scenario, 23 of the 59 traces showed Boca's pool elevation never going above the stage restriction during the July-December time period. These 23 traces meeting this condition include 6 of the most recent 8 hydrology traces.

Future modeling will be conducted in early spring of the construction year (2018), incorporating the real-time hydrology and reservoir conditions, to validate that these proposed deviations are addressing the flood management goal.

3 WATER SUPPLY ANALYSIS

3.1 INTRODUCTION TO WATER SUPPLY ANALYSIS

During the majority of the maintenance period (July 1st, 2018 and December 31st, 2018), the reservoir's pool elevation will be limited to 5577.12 feet NGVD29 (18,079 acre-feet). During December the reservoir will be allowed to temporarily fill up to 5587.12 feet NGVD29 (25,204 acre-feet) if needed for flood control purposes. If Boca's pool elevation directly preceding the maintenance period is higher than the restriction, the reservoir must be drawn down to 5577.12 feet NGVD29 by July 1. The maximum potential pool elevation in the beginning of June 2018 would be at Boca's maximum capacity of 5605 feet NGVD29 (40,868 acre-feet), and thus the maximum potential reservoir drawdown would be 27.9 feet (22,800 acre-feet). The effects of this potential drawdown may be further amplified by the fact that the drawdown period and the beginning of maintenance restriction corresponds with the spring snowmelt runoff, a time period during which the reservoir is typically storing water that is used to meet demands later in the summer when flows naturally subside. The impacts to water supply are heavily dependent on the hydrology of the Truckee River basin preceding, during, and following the Boca maintenance project, and the range of potential hydrologic conditions are wide. The impacts to various stakeholders within the basin are likely to vary significantly between parties and may impact each party differently depending on the hydrology observed.

Modeling the entire Truckee river system is necessary to identify the potential direct and indirect impacts of the limitations of the maintenance on Boca Dam and Reservoir. This Technical Memorandum presents the methodology and results of the modeling analysis with respect to both likelihoods and potential magnitude of water supply impacts. It then goes on to discuss potential strategies that may minimize the impacts of the project on water supply. However, many factors should be taken into consideration in selecting a strategy, as the most appropriate strategy may vary significantly depending on both the hydrologic conditions observed and the objectives with respect to individual stakeholder parties, as differing strategies have the potential to decrease potential impacts to certain stakeholder parties while increasing impacts to others. Ideally, a strategy would not be decided upon until the maintenance period is closer so that the potential impacts are less uncertain.

3.2 Modeling Approach and Methods

3.2.1 Model Selection and Versions

All models used within this study originated from the same daily timestep Truckee River Operating Agreement (TROA) Operations RiverWare model ("TROA Ops model"), as described in section 2.2.1.

3.2.2 Types of Analysis

A probabilistic hydrology operations analysis was conducted to allow for quantification of both likelihoods and the range of magnitudes of potential water supply impacts across the wide range of potential hydrologic conditions that are possible preceding, during, and following the Boca maintenance period. The hydrologic sequences ("hydrologies") used in this analysis consist of 59 3-year sequences of observed historical hydrology in order to span the entire range of possible hydrology, insofar as practicable, that could occur during the modeled period in the future. Three years of hydrology is necessary to access the potential impacts that reduced storage in during the maintenance year (year 2) will have on water supply in the following year (year 3). By driving the analysis with this large number of potential historical hydrology sequences, the objective is to create a distribution of results that are representative of the range of magnitudes and distribution of hydrologic conditions possible. Also by using a wide range of hydrologic conditions, the goal is to capture the potential variability in how potential water supply impacts may be distributed between multiple stakeholder parties who may be affected differently as their water supply sources and uses are dependent on varying conditions. To generate distinct, potential near future outcomes, each model run is initialized from the current hydrologic conditions of the basin. In this analysis, the initial conditions are represented by the most likely end of water year 2016 (9/30/2016) conditions from the June 2016 TROA Scheduling Coordination Process model runs.

However, it is possible that the hydro climatic conditions of 2017-2019 will differ than anything observed during the past ~60 years, not only in magnitudes (i.e., total runoff volumes), but also in the year to year variability. Due to uncertainty in this type of analysis and special operations that would be appropriate for extreme events for the purpose of this study results will be discussed as a function of the "maximum probable impact" which shall be defined as the 5% exceedance impact to a particular quantity. With 59-traces the maximum probable impact corresponds roughly with the trace containing the third greatest impact. This maximum probable impact may be discussed as an adverse maximum probable impacts (i.e. less water in storage) or a beneficial maximum probable impacts (i.e. more water in storage).

3.2.3 Model Initialization

As discussed in section 2.4.2, the initial conditions used in this probabilistic analysis are the most likely basin-wide hydrologic conditions, including reservoir and account storage levels and various other hydrologic parameters, that will be present on September 30, 2016. This initialization condition was taken from the most likely outcome of the June 2016 TROA Scheduling Coordination Process modeling work, with uncertainty remaining in the hydrologic conditions of the Truckee River Basin through September. Statistics generated from the same TROA modeling work show an 80 percent chance of the end of WY 2016 Lake Tahoe pool elevation falling between 6223.09 and 6223.33 feet LTGD (Lake Tahoe Gage Datum), with the most likely value used for initialization is 6223.12 feet LTGD. In historical context,

this most likely end of WY 2016 combined Little Truckee Storage falls below approximately 67% of the historic September 30th volumes (1971-2015).

3.2.4 Hydrology Sequences

The hydrology sequences selected for the probabilistic analysis includes each 3-year period beginning in October 1954 and ending in December of 2015, resulting in 59 3-year sequence model traces within 61 individual years of hydrologic data. The historical ordering of each 3-year hydrologic sequence was maintained in order to maintain the observed hydrologic year-to-year patterns. With the exception of the first and last sequences, each year's hydrology is included in the analysis three times, once as pre-maintenance year, 2017, once as the year in which the Boca Maintenance Project occurs, 2018, and once as the year following the maintenance, 2019. In effect, each 3-year hydrologic trace is overlapped by the subsequent trace, and thus, a total of 59 3-year hydrologic sequences are analyzed: 10/1954-12/1957, 10/1955-12/1958, …, 10/2011-12/2014, and 10/2012-12/2015.

These 61 years between WY 1955 – WY 2015 are representative of the range of historical hydrologic conditions. This time period contain three of the four wettest hydrologic years of the entire 115-year (1901-2015) period of available record, and 8 of the 10 driest hydrologic years of record in terms of total water year natural flow volume of the Truckee River at Farad.

Figure 21 shows all 59 3-year hydrology traces of the daily natural flow of the Truckee River at Farad. Further illustrating the range. Figure 22 shows the range of variability of water year natural flow volume of the Truckee River at Farad of each 3-year hydrology sequence.

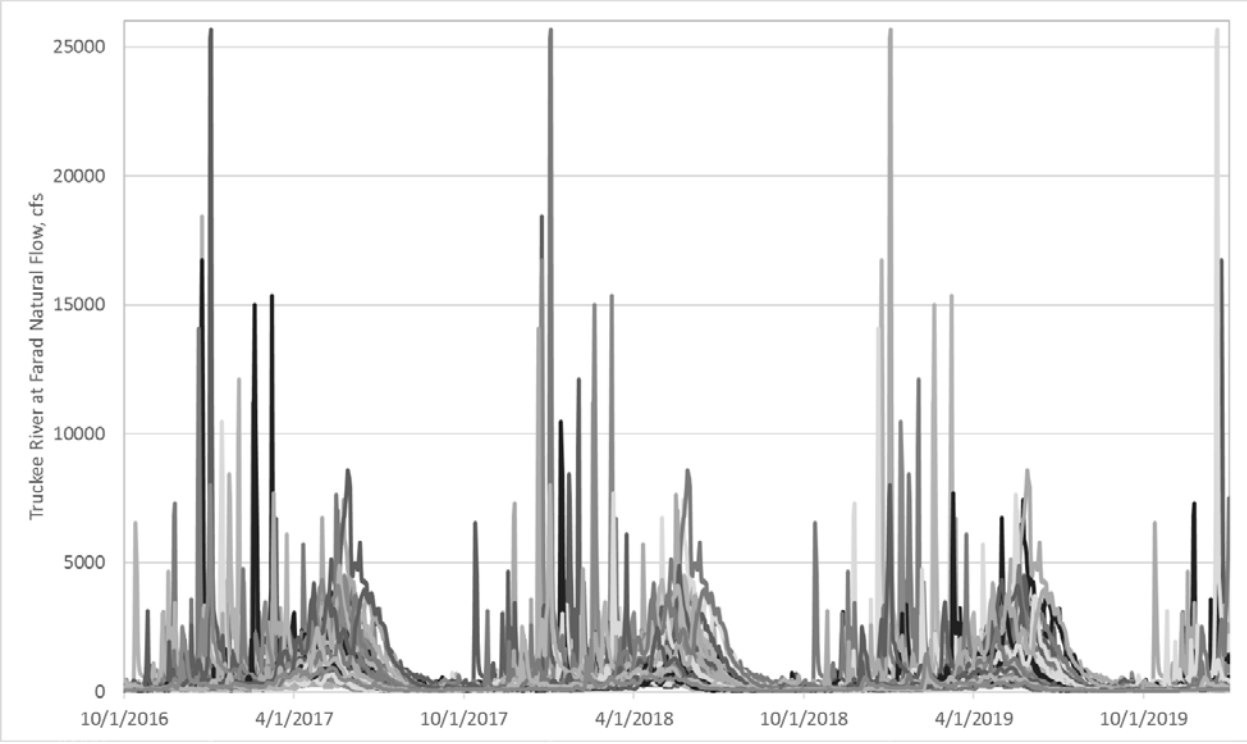


Figure 21: Daily natural flow of the Truckee River at Farad for all 59 3-year hydrology traces.

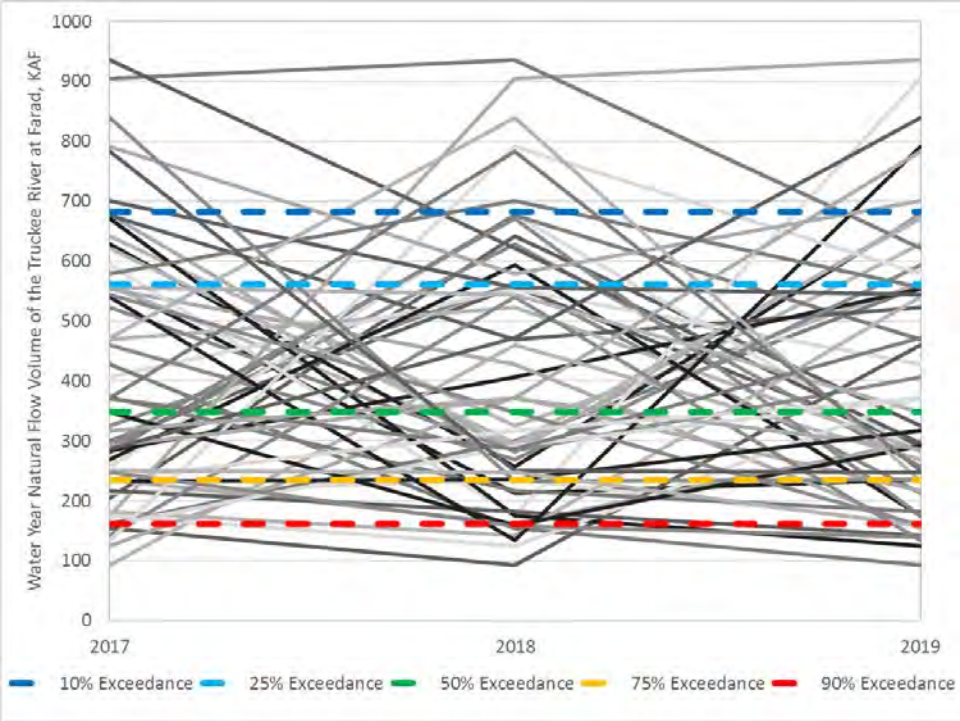


Figure 22: Annual water year volumes of Truckee River at Farad for each 3-year hydrology sequence.

3.2.5 Model Run Timeline and Operational Scenarios

The timeline of the model runs completed during the probabilistic analysis is shown in Table 2 below. Each model trace begins on October 1, 2016 from the identical initialization condition described above. The first 18 months of each 3-year hydrologic sequence, from October 2016 through September 2017, uses the same TROA operational procedures and criteria for each scenario, representing normal system operations as the Boca maintenance and associated operational changes do not occur in this period. Beginning in October 2017 operations are adapted in preparation for the Boca Maintenance with begins in July 2018. These adapted operations last through the end of the maintenance period on Dec 31, 2018, different operations are applied under each scenario, which are described further below. Following the maintenance period, from January 1, 2019 through the end of the model trace on Dec 31, 2019, the normal (no maintenance) operations are resumed.

Two distinct sets of operational criteria and procedures were modeled. The operational scenarios only differ from October 2017 through December 2019 in preparation for and during the Boca maintenance period, and thus are the same for the time periods preceding and following the maintenance period. To create valid comparisons between scenarios, and due to the wide range of scheduling flexibility of various parties, the scheduling in all scenarios (including the Baseline) is set to reflect voluntary actions that are allowed within TROA and that would likely occur in reaction to a reduced Boca condition. The parties were not consulted to compile these voluntary actions and thus their actual reactions to a reduced Boca condition may differ from the reactions that were assumed.

The two scenarios are described below and the specific operations at Boca are described further in the following section. The timelines and differences between the scenarios are shown in Table 2.

- The "**Baseline"** (no Boca maintenance) scenario represents the standard and current river and reservoir operational criteria and procedures as defined with the Truckee River Operating Agreement (TROA), which went into full effect in December 2015. This scenario does not contain the restrictions to Boca Reservoir associated with the maintenance and is the same as the Baseline condition for the Flood Analysis as described in Section 2.2.3.1.

- The "**Maintenance"** scenario, represents the same standard and current operations criteria and procedures under TROA as the Base scenario, with the difference being that the Boca maintenance project and associated operations are modeled during the maintenance period. The maintenance operations include the potential pre-maintenance drawdown to the maintenance elevation of 5577.12 feet NGVD29 and the enforcement of the Boca Reservoir stage restrictions and unavailability of the spillway during to the maintenance period. The flood operations during maintenance include the recommended changes to the WCM as discussed within Section 2.3.5 above. After consulting the U.S. District Court Water Master's office who oversee operations of the Truckee River reservoirs, operational strategies were implemented that attempt to minimize the impacts of the maintenance project. The strategies that were applied are described below.

Table 2: Operational Scenarios for the Boca maintenance water supply model runs.

Operational Scenario	Preceding Period	Preparation for Maintenance	Boca Maintenance Period	Following Year
Date Range	10/1/2016-9/30/2017	10/1/2017-7/1/2018	7/1/2018-12/31/2018	1/1/2019-12/31/2019
Period Length	12 months	9 months	6 months	12 months
Baseline	Normal operations	Normal operations	Normal operations (no maintenance)	Normal operations
Maintenance	Normal operations	Operations in anticipation of Boca Maintenance	Boca Maintenance Operations	Normal operations

3.2.6 Description of Normal and Maintenance Boca Reservoir Operations

Boca reservoir operations for the Normal and Maintenance scenarios are described in the following sub-sections 3.2.6.1 and 3.2.6.2.

3.2.6.1 Normal Boca Reservoir Operations

The general operational objective of Boca reservoir is to fill the reservoir during the spring runoff period and deliver the stored water to users through various pathways during the summer months when river flows begin to naturally decline. Under normal operations, Boca's maximum elevation is 5605 feet NGVD29 (40,868 acre-feet) beginning in May or June and lasting through September. During October-

April of each year the Truckee River Water Control Manual requires that Boca must have at least 8,000 acre-feet of storage space available for flood control purposes, which dictates an elevation of 5596.4 feet NGVD29 (32,868 acre-feet). Thus, at the beginning of October of each year, if the reservoir is higher than the required elevation, water must be evacuated to create the required flood storage space. This space must be maintained throughout the fall and winter except in the case of temporary storage during flood operations when it is used to mitigate downstream flooding as described in Section 7-05 of the Water Control Manual. In the spring, depending on snowmelt runoff forecasts, the reservoir may begin gradually filling as early as April 10 or as late as June 1, and may fill completely as early as May 20 or as late as July 5, when there is sufficient runoff volume available.

3.2.6.2 Boca Reservoir Operations during the Maintenance Project

During the Boca maintenance project, the reservoir will be limited to an elevation of 5577.12 feet NGVD29 (18,079 acre-feet) of storage from July 1-September 30. If Boca's elevation is above the restriction prior to the maintenance period, it would have to be drawn down by July 1 as described in Sections 2.1 and 3.1 . Due to the required flood space during the previous winter and spring, the maximum possible elevation of Boca on May 31 would be 5,605 feet NGVD29, and thus the maximum potential drawdown would be 27.9 feet or about 22,800 acre-feet. Depending on runoff, the required drawdown would be made gradually between June 1 and June 30 of 2018. Inopportunely, this period corresponds directly with the time period when Boca would be filling under normal operations, and thus there will also be potential impacts due to an inability to store runoff that normally would have been captured. This potential would only be realized if the runoff is sufficient to fill the reservoir to storage levels exceeding the maintenance condition. The 5577.12 feet NGVD29 restricted elevation would be maintained through September 30. Beginning on October 1, the 11,500 acre-feet of required flood space (the normal flood space requirement is 8,000 acre-feet, additional flood space is required due to reduced release capacity during the maintenance condition, see Section 2.2.3.3) would have to be maintained below 5577.12 feet NGVD29, and thus the reservoir would potentially have to be drawn down further to a maximum elevation of 5554.6 feet NGVD29 (6,579 acre-feet). Beginning on December 1, the flood space would have to be maintained below a relaxed 5587.12 feet NGVD29 (25,204 acre-feet) restriction, leading to a maximum elevation of 5569.9 feet NGVD29 (13,704 acre-feet), and thus the reservoir would potentially be able to begin filling given high enough flows, although this is generally a period of lower flows. Beginning on January 1, 2019, the maintenance period would come to an end, and the reservoir would conceivably be allowed to fill to the normal flood control level of 5596.4 feet NGVD29 (32,868 acre-feet) again given sufficient inflows. Figure 23 highlights the differences between the normal reservoir operation goals and the restricted operations during the Boca reservoir drawdown and normal filling season prior to the maintenance period (April 1, 2018 to August 1, 2018). These operational differences are due to the proposed changes to the WCM that are described in Section 2.2.3.3. Additional changes to normal operational criteria that was developed to reduce impacts to water supply are described in Sections 3.2.7, 3.3.2.3, and 3.3.3.3.

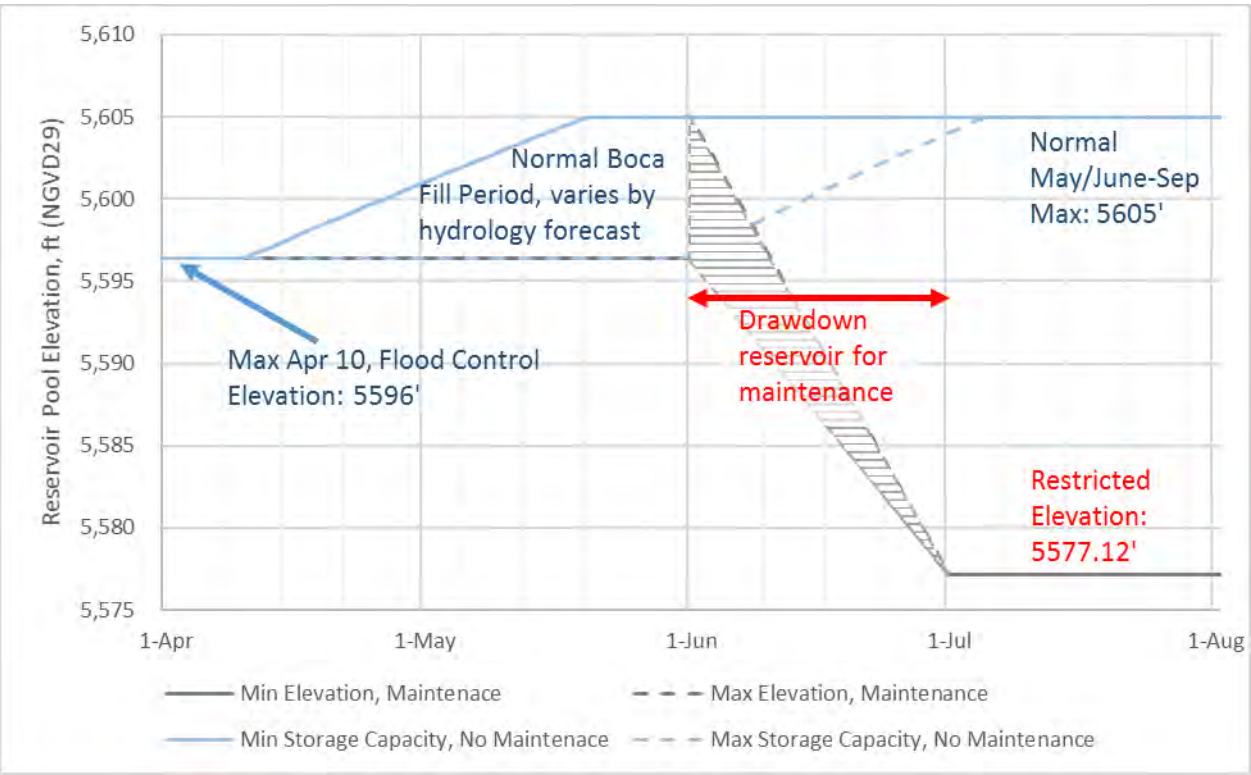


Figure 23: Diagram highlighting the differences between normal and maintenance operations during the potential Boca drawdown period, April to July, 2018.

3.2.7 Description of Modeled Maintenance Strategy

This analysis focus on strategies to reduce the impact to Floriston Rate water and reduce potential spill of credit water, which is discussed in more detail in Section 3.3.2.3.

3.3 RESULTS

In order to assess any potential impact on water supply due to the proposed changes for WCM deviation, the following sections describe the results of the model scenarios.

3.3.1 Potential Boca Reservoir Conditions Near Beginning of Maintenance, May 2018

To reduce the potential for water supply impacts, the drawdown for Boca maintenance operations could potentially begin as early as October 1, 2017. In anticipation of the reduced condition in Boca, operations would be coordinated in the winter and spring prior to the maintenance to minimize the storage in Boca and maximize storage in other Truckee River Basin reservoirs, primarily Stampede. The results from the probabilistic analysis of all 59 model traces for Boca reservoir pool elevations between October 1, 2016 and May 31, 2018 are shown in Figure 24 and in Table 3 below. There is approximately a 53 percent chance that the elevation of Boca will be above 5577.12 feet NGVD29 on May 31, 2018. There is approximately a 2 percent chance that the reservoir would be at the full flood control pool elevation of 5605 feet NGVD29.

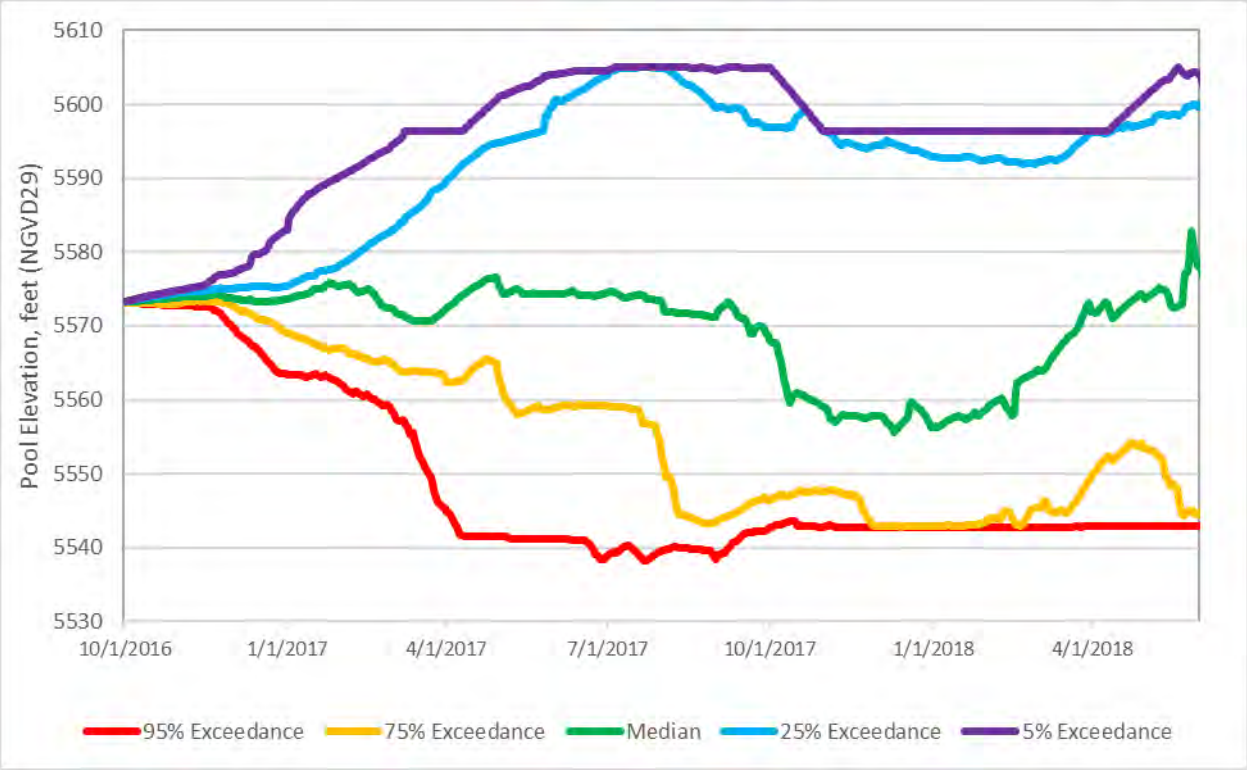


Figure 24: Probabilistic results of Boca reservoir elevation between October 1, 2016 and May 31, 2018.

Table 3: Probabilistic results of Boca reservoir elevation on May 31, 2018.

	Boca Reservoir Pool Elevation on May 31, 2018								
Probability of Exceedance (%)	**2%**	**5%**	**10%**	**25%**	**50%**	**75%**	**90%**	**95%**	**98%**
Pool Elevation, ft	5604.7	5604.2	5604.0	5599.7	5578.1	5544.5	5542.9	5542.9	5542.8

3.3.2 Floriston Rate Water Supply Impacts

Water stored in the Little Truckee reservoir system under the Boca storage license, known as "Floriston Rate water" or "FR water", is used for meeting target flows at the Farad gage near the California-Nevada border (USGS gage 10346000). This target is specified by the Truckee River Agreement and is known as the FR target. Natural inflows, if available, are used in a priority order, to meet the FR targets. Releases from stored water in Boca reservoir and Tahoe reservoir are used to supplement the natural inflow to the basin when necessary to meet these FR targets. The FR water is used to meet demands of many downstream users including: the Truckee Meadows Water Authority (TMWA), agriculture, diversions through the Truckee Canal for the Newlands Project, and to meet rights held by the Pyramid Lake Paiute Tribe (PLPT) and others that are permitted for instream flow. Any effect to the ability to meet these FR targets will result in an increased demand shortage to one or more of the parties listed above. Analysis was conducted to determine the effect to meeting the FR flow targets during the maintenance year (WY2018) and the following year (WY2019). The effect to carry over FR storage at the end of WY2019 will also be discussed as this may affect the ability to meet the FR target in years following WY2019.

The demand for releasing stored FR water to meet the Floriston Rate very often occurs around July 1, as this date corresponds with the approximate time when the natural inflow to the Truckee River Basin (upstream of the Farad Gage) typically recedes below 500 cfs (the summer FR target). Because of this, the peak storage for the Truckee River basin is very often around July 1 as well. For the maintenance condition, Boca storage will need to be at or below 18,079 acre-feet by July 1, which is almost 23,000 acre-feet less than the usual maximum capacity of 40,868 acre-feet and this reduced level needs to be achieved at the time of the year when Boca reservoir is typically the fullest. In many hydrology sequences, Stampede reservoir is not full and much of the water that would typically be stored in Boca can be stored in Stampede without adversely affecting other parties.

The FR target for each month is summarized in Table 4. The annual total of the FR target is between 296 KAF and 332 KAF depending on the Lake Tahoe pool elevation.

To analyze the impact of the planned Boca maintenance to the system's ability to meet the FR target, the water year cumulative volume of FR water at the Farad gage across the 59 hydrology sequences were compared between a maintenance and a no maintenance (baseline) scenario. The impacts for maintenance and the no maintenance runs are summarized in Table 5. The maintenance strategies that were analyzed as part of the maintenance condition are discussed in more detail in Section 3.3.2.3.

Table 4: Monthly Floriston Rate flow Target, the Low, Normal or High target is selected based on the Tahoe pool elevation

	Low cfs	Normal cfs	High cfs
Jan	300	350	400
Feb	300	350	400
Mar	300	350	500
Apr	500	500	500
May	500	500	500
Jun	500	500	500
Jul	500	500	500
Aug	500	500	500
Sep	500	500	500
Oct	400	400	400
Nov	300	350	400
Dec	300	350	400
Annual Volume (acre-feet)	**295,938**	**310,914**	**332,038**

3.3.2.1 Impact to FR Demands

In general, the maintenance to Boca reservoir's dam has a 24% likelihood of adversely affecting the FR deliveries between WY 2018 and WY 2019. The maximum probable impact over 2018-2019 is 7,800 acre-feet. This amounts to as much as ten less days of making the Floriston Rate target over the two years due to the dam maintenance.

Table 5: Comparison of water year Floriston Rate volume of deliveries impact.

	2018-2019, Cumulative Impact	
	Magnitude (acre-feet)	**% Of Baseline Average**
Maximum Probable Adverse Impact*	-7800	-1.5%
Median Impact*	0	0.0%
Maximum Probable Beneficial Impact*	4400	0.8%
Probability of Negative Impact	24%	N/A
Probability of No Impact**	46%	N/A
Probability of Positive Impact	31%	N/A

*Negative values are averse to the party; positive values are beneficial to the party

**No impact is defined as impacts less than +/-100 acre-feet

The majority of the effect is seen in WY2019 when the carryover storage is reduced because of the maintenance. This effect is most likely if the WY2018 hydrology is sufficient to meet the FR target through the fall of WY2018 when the maintenance occurs and the WY 2019 hydrology is relatively small. Without the maintenance, the potential additional carryover storage in Boca reservoir could allow the FR target to be met longer in WY2019. One of the strategies to avoid spilling FR water when Boca is drawn down for maintenance in summer 2018 is to use Boca storage to meet the Floriston Rate as much as possible in the previous spring and winter, even if the pool elevation of Lake Tahoe is less than 6225.5 feet LTGD and Lake Tahoe would typically be used to meet the Floriston Rate, as prescribed by the Truckee River Agreement. This strategy may reduce the amount of water that is released from Lake Tahoe if goes under the rim in 2018 and reduce the period of time that the Floriston Rate target is met in 2018, however this will also leave more carryover storage in Lake Tahoe which will become available when the Pool Elevation next rises above the rim.

3.3.2.2 Impact to FR end of water year storage

Any FR water that remains in storage at the end of 2019 may be used to supplement meeting the FR target through the winter and the during the next summer. Under the baseline condition the average carryover FR water in Boca and Stampede for the end of WY2019 was 6,900 acre-feet, with some traces showing a carryover as high as 33,900 acre-feet. For the maintenance condition the average carryover for WY2019 is reduced slightly to 6,300 acre-feet and the maximum carry over is reduced to 32,000 acre-feet. Analysis shows that there is approximately a 20% probability of adversely impacting the total FR water carryover storage (including water in Lake Tahoe) for the end of WY 2019, this reduced storage is most likely to impact the ability to meet the FR demand for WY 2020 as discussed in Section 3.3.2.1. The impacts to FR carry over storage are summarized in Table 6.

Table 6: FR carry over storage impacts.

	November 1, 2019 Storage Impacts (all FR water) (acre-feet)***	***November 1, 2019 Storage Impacts*** (Boca and Stampede) (acre-feet)***
Maximum Probable Adverse Impact*	-5400	-1000
Median Impact*	0	0
Maximum Probable Beneficial Impact*	11200	400
Probability of Negative Impact**	20%	31%
Probability of No Impact**	34%	51%
Probability of Positive Impact**	46%	19%

*Negative values are averse to the party; positive values are beneficial to the party

**No impact is defined as impacts less than +/-100 acre-ft

*** November 1 storage was used to show the impact to storage after the reservoir(s) have drawn down to the winter carryover level

Figure 25 shows the daily exceedance of total FR storage in Boca and Stampede reservoirs. The blue line represents the level that 10% of the traces exceeded on each day, the green lines represent the level that 50% of the traces exceed on a given day, and the yellow lines represent the level that was exceeded by 90% of the traces. In the dry condition (yellow), the baseline and maintenance storages are nearly the same, because even the reduced storage capacity of Boca reservoir is sufficient to store the available inflow. In the median condition (green), we see that the maintenance causes lower storage during the summer of 2018 until the minimum storage is reached earlier in September 2018 indicating that either the FR target was not met earlier due to the maintenance, or Tahoe was used to meet the FR target earlier than in the baseline case. After the minimum storage is achieved in fall 2018 the storage is unaffected by the maintenance for the fall of 2018 and all of 2019. For the 10% exceedance traces (blue), the pooled storage is predominately effected during the fall and winter of 2018, but it is able to refill in the spring of 2019 after the maintenance is completed. Traces in Figure 25 should not be interpreted as actual years since the hydrology often varies significantly from year to year.

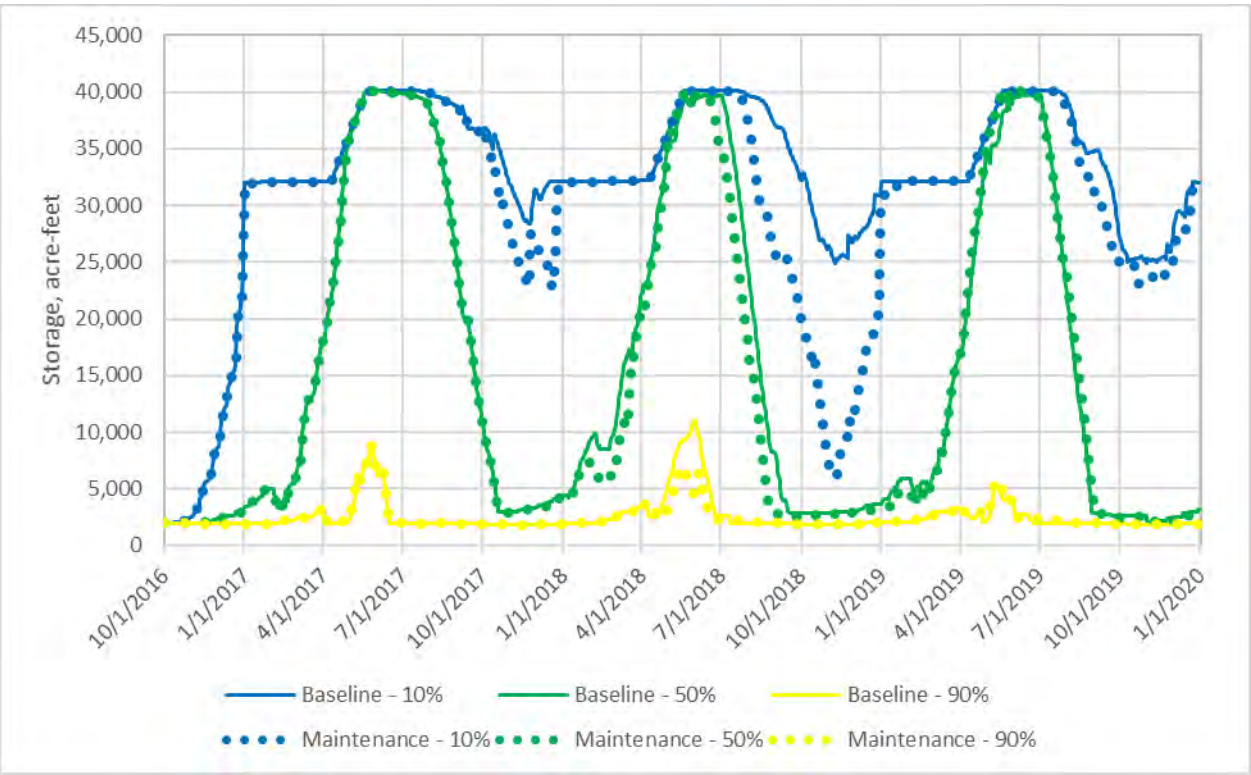


Figure 25: Daily exceedance plot of the total FR storage in Boca and Stampede reservoirs in the baseline runs (solid lines) and the maintenance runs (dotted lines).

3.3.2.3 FR water supply maintenance strategies

To mitigate the impacts to meeting FR demands and to FR carryover storages six general strategies were developed after consultation with the US District Court Water Master's Office (Water Master's Office). Some of these strategies represent deviations from the active policy, but were recommended by the Water Master's Office in response to the reduced storage condition in Boca reservoir and to avoid undue impact to senior water rights. These strategies all have the same general goal which is reducing the storage in Boca as much as possible when storage in other reservoirs (primarily Stampede) can be increased. This will reduce the likelihood that the water will need to be evacuated without a demand during the summer of 2018 to achieve the maintenance elevation of 5577.12 feet NGVD29 in Boca by July 1, 2018.

1. For WY 2018, when meeting demands with stored FR water, use water stored in Boca before using water in Stampede. This is opposite of the normal order of use of stored FR water.
2. For WY 2018, when meeting demands with stored FR water, use water stored in Boca before using water stored in Tahoe even if the Tahoe pool elevation is less than the threshold when Tahoe is typically used to meet the Floriston Rate (6225.5 feet LTGD). Note that this is a deviation from the standard operations prescribed by the Truckee River Agreement and was recommended by the Water Master's Office.
3. Whenever possible, move water that is stored in Boca to Stampede via exchange of inflow pass-through, or Fish Water releases. This applies to credit water, FR water and Fish water.
4. Reduce the Stampede releases to 30 cfs whenever possible. This release is less than the minimum required by TROA in a non-drought year (45 cfs), and it would require approval from

California Department of Water Resources to reduce these minimum releases. These flows are significantly lower than the flows desired by California Department of Water Resources. The environmental impact of the reduced flows from Stampede will primarily impact fishing in the Little Truckee river between Stampede and Boca reservoirs.

5. If there is sufficient inflow to fill both Boca and Stampede in 2018 allow the reservoirs to fill as normal until May 31, 2018 before drawing Boca down to the maintenance level by July 1, 2018. Occasionally there will be a demand for FR and/or FishW releases in June as the natural flow declines which may allow the water stored in April and May to be released to meet a demand instead of being released when there is no demand downstream.
6. Whenever there is a demand to release stored FR water from the Little Truckee and there is space in Prosser, store the inflow to Prosser to increase the demand on FR storage in the Little Truckee.

These strategies will help minimize the effect of the Boca maintenance to FR users downstream. These strategies should reduce the likelihood of spilling other parties water such as the Pyramid Lake Paiute Tribe (PLPT or Fish) and TMWA. When the storage condition is limited, operations to favor one party are likely to adversely affect another. For the scope of this analysis, emphasis was placed on mitigating the effect on FR because it holds the senior storage right in the Little Truckee Reservoir system.

3.3.3 PLPT Water Supply Impacts

Pyramid Lake Paiute Tribe operates the water that is stored under licenses/permits held by Reclamation in Stampede Reservoir, the water stored in Prosser Reservoir that is not needed for the Tahoe Prosser Exchange, and has the ability to credit store water in certain circumstances. This water is released to benefit endangered species of fish including the Lahontan Cutthroat Trout and the Cui-ui. To achieve these goals water stored in Stampede and Prosser reservoirs is released to maintain flow targets, known as “Flow Regimes”, at the Truckee River at Nixon stream gage (USGS ID 10351700). There are six different Flow Regimes which prescribe flows of varying magnitude as shown in Figure 26.

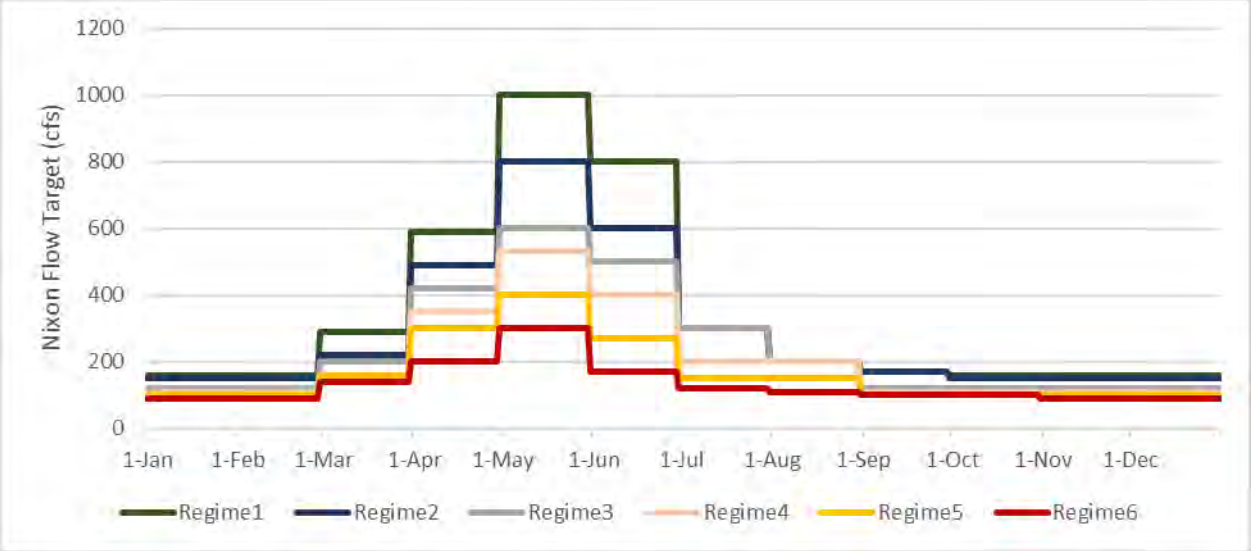


Figure 26: Flow Regime Targets for various times of the year

The primary source of PLPT storage is the water stored in Stampede reservoir in accordance with the priority date. Because the PLPT storage permit is junior to the FR storage permit and both permits can be stored in either Stampede or Boca, PLPT cannot begin storing water under these permits until the FR permit is satisfied. Figure 27 shows the normal total storage capacity of Boca and Stampede in blue and the total storage capacity in the maintenance condition in grey. The area between the dashed and sold lines of the same color in Figure 27 show the range of allowed storage capacities considering the WCM.

During normal operations, the total maximum storage capacity of Boca and Stampede increase by a total of 30,000 acre-feet during the storage season. However, in the maintenance case the total maximum capacity can only increase by 7,200 acre-feet during the storage season. Boca is entitled to store up to 8,000 acre-feet alone under its FR storage license, however with a maximum combined summer storage capacity of only 7,200 acre-feet, the net effect is reducing the maximum amount that can be stored under the both the Boca and Stampede permits by 22,800 acre-feet. The maximum effect would only occur if both reservoirs would have been able to fill completely if there were no maintenance. It is possible that this water could be stored before July 1, however it would need to be evacuated prior to July 1 during a time of the year where there is not historically not a large demand downstream. If the water is stored prior to May 31 when the drawdown begins, it could be released to prolong the peak of the natural hydrograph particularly if the natural hydrograph peaks early. If the water must be evacuated without a downstream demand it will still flow to Pyramid Lake and benefit the lake level and species in Pyramid Lake, in this case the primary effect is that the PLPT loses the control of the timing of the releases and potentially loses carryover storage to supplement flows in later years.

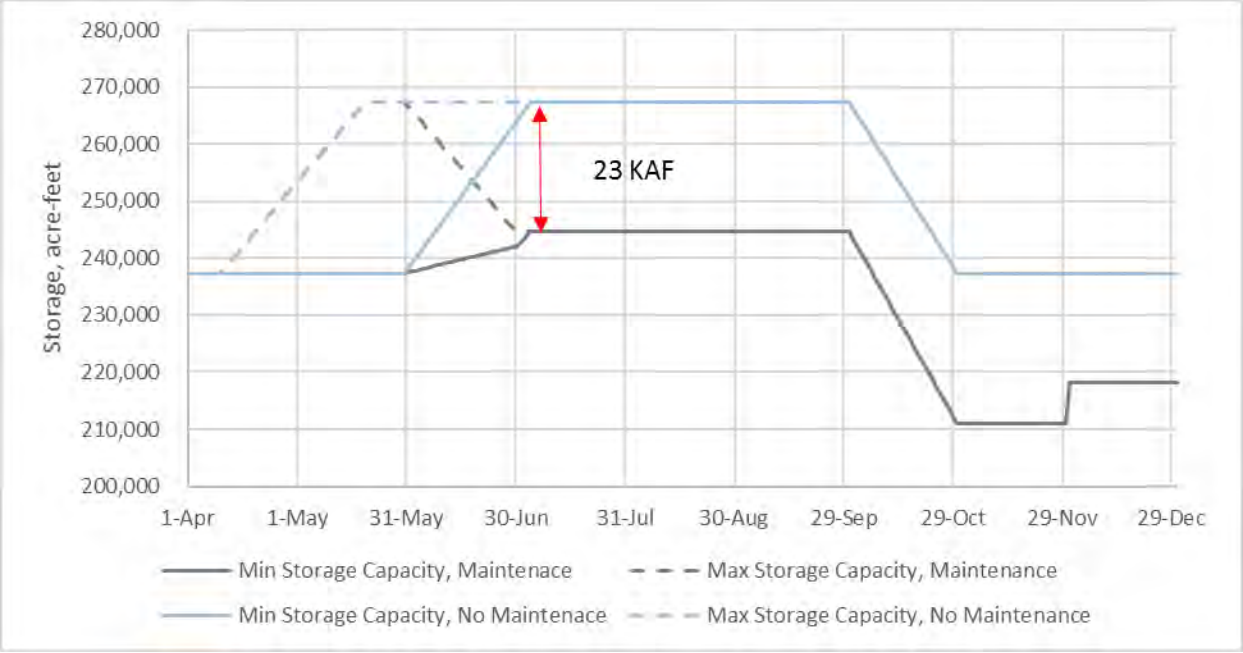


Figure 27: Stampede and Boca combined storage capacity. Max and min storage capacity are based on the range specified by the Snow Melt Parameter in the WCM.

3.3.3.1 Impact to PLPT Demands

To analyze the impact of the planned Boca maintenance to the system's ability to meet the flow regime targets, the water year cumulative volume of water at the Nixon Gage, across the 59 hydrologic traces, were compared between the maintenance and baseline scenario. The impacts of the strategies, discussed in Section 3.3.2.3, on PLPT demands are also summarized.

In general, as shown in Table 7, the maintenance to Boca reservoir's dam has a 36% likelihood of adversely affecting the number of days that the Flow Regime targets are met and a 7% likelihood of positively affecting the number of days that the Flow Regime Target is met. The maximum probable impact to the number of days that the Flow Regime Target is missed is 9 additional days that the targets are not met.

Table 7: Comparison of the impact of the Boca maintenance to the frequency that the PLPT Flow Regime targets at Nixon are met, values are in number of days.

	WY2018-2019 Days of Missed Flow Target Impacts
Maximum Probable Adverse Impact*	-9
Median Impact*	0
Maximum Probable Beneficial Impact*	1
Probability of Negative Impact	36%
Probability of No Impact**	58%
Probability of Positive Impact	7%

*Negative values are averse to the party; positive values are beneficial to the party

**No impact is defined as impacts less than +/-1 day

If storage in the Little Truckee reservoirs is limited due to the maintenance on Boca dam, any water that would have been stored as FishW would be permitted to flow to Pyramid Lake. Table 8 indicates that overall the Boca maintenance has a 37 percent probability of reducing the volume of water the flows over the Nixon gage in 2018 and 2019, but there is a 54 percent chance of increasing the water that flows over the Nixon gage. The magnitude of the maximum probable adverse and beneficial impacts are similar: -8,600 AF and +17,100 AF, respectively. These maximum probable impacts are roughly 2 percent of the forecasted average flow over the Nixon gage during the same period. These impacts are summarized in Table 8.

Table 8: Comparison of water year Nixon Flow volume.

	2018-2019, Cumulative Impact	
	Magnitude (acre-feet)	**% Of Baseline Average**
5% Exceedance Impact*	-8600	-1.1%
Median Impact*	300	0.0%
95% Exceedance Impact*	17100	2.2%
Probability of Negative Impact	37%	N/A
Probability of No Impact	8%	N/A
Probability of Positive Impact	54%	N/A

*Negative values are averse to the party; positive values are beneficial to the party

**No impact is defined as impacts less than +/-100 acre-feet

3.3.3.2 Impact to PLPT end of water year storage

Any category of PLPT water that remains in storage in any reservoir at the end of the water year may be used to supplement meeting the Flow Regime targets through the winter and the during the next summer. The March 1 Stampede PLPT storage is one of the metrics used to determine the Flow Regime for the year so reduced storage has the potential to reduce the Flow Target for the next year. This occurred in 20 percent of the traces with a maximum increase in Flow Regime of 2, corresponding to a reduction of the flow targets per Figure 26.

The end of water year 2019 PLPT total storage has a 66% chance of being adversely impacted, as shown in Table 9. The maximum probable adverse impact for the WY 2019 carryover is 21,900 acre-feet, while the maximum probable beneficial impact is 2,300 acre-feet.

Table 9: PLPT carry over storage impacts.

	November 1, 2019 Storage Impacts (acre-feet)***	***Percent of Baseline Average***
Maximum Probable Adverse Impact*	-21900	-15.2%
Median Impact*	-1700	-1.2%
Maximum Probable Beneficial Impact*	2300	1.6%
Probability of Negative Impact**	66%	N/A
Probability of No Impact**	12%	N/A
Probability of Positive Impact**	22%	N/A

*Negative values are averse to the party; positive values are beneficial to the party

**No impact is defined as impacts less than +/-100 ft

*** November 1 storage was used to show the impact to storage after the reservoir(s) have drawn down to the winter carryover level

Figure 28 shows the daily exceedance of total PLPT storage in the system. The blue line represents the level that 10% of the traces exceeded on a given day, the green lines represent the level that 50% of the traces exceeded on a given day, and the yellow lines represent the level that was exceeded by 90% of the traces. The impacts are most significant in the wettest traces (blue), which show the total PLPT storage being significantly less in the maintenance condition than the baseline condition between June 2018 and June 2019. After June 2019, most of the wetter traces are able to recover to the baseline condition. The median traces (green) remain diverged from the baseline condition for October 2018 through April 2019, however these traces generally converge to the baseline condition by the winter of 2019. Traces in Figure 28 should not be interpreted as actual years since the hydrology varies significantly from year to year.

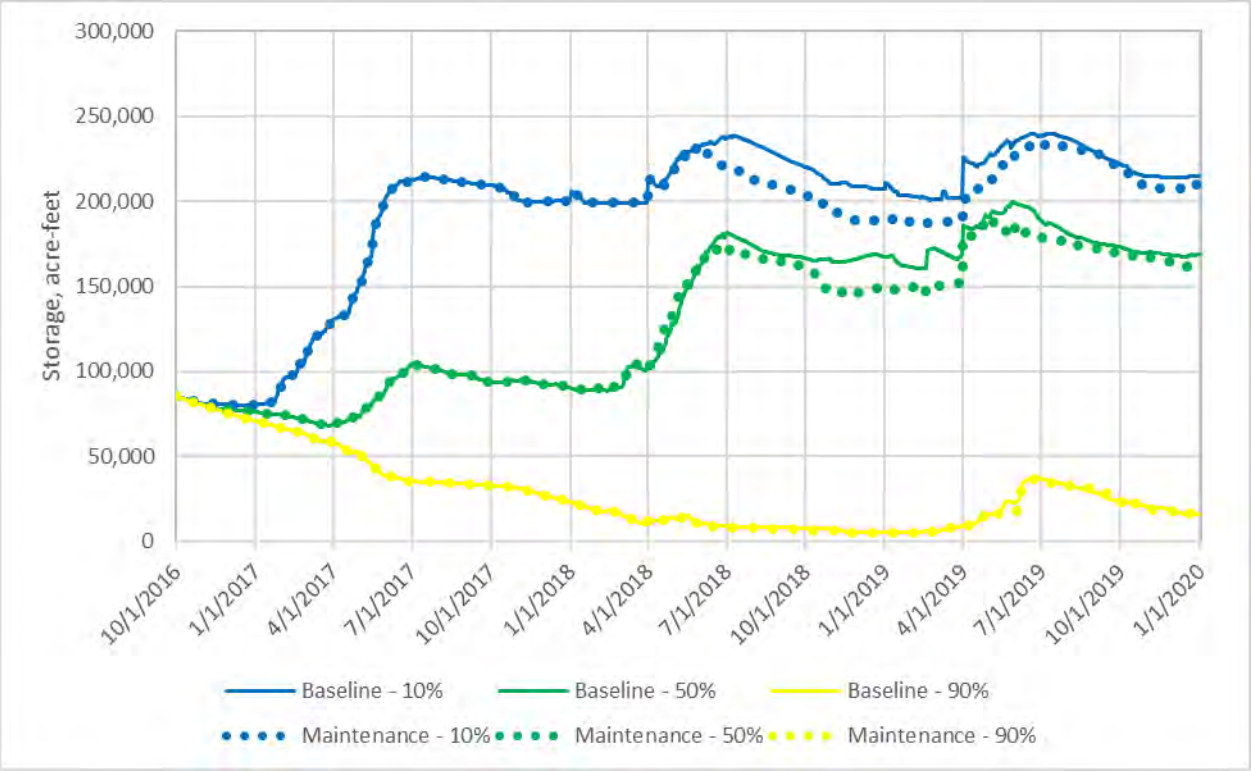


Figure 28: Daily exceedance plot of the total PLPT storage in the baseline runs (solid lines) and the maintenance runs (dotted lines).

3.3.3.3 PLPT Maintenance Strategies

Because the Stampede storage water rights (used for Fish Water) for the Little Truckee reservoirs are the junior water rights in the system, the impacts of reduced storage capacity are most likely to fall on the PLPT. However, the PLPT storage in Little Truckee reservoirs is used primarily to (1) benefit the cui-ui and Lahontan cutthroat trout in the lower Truckee River and, (2) supplement flow rates in the lower river near the Nixon gage, and (3) improve the lake levels in Pyramid Lake. With this in mind, any water that could have been stored in the Little Truckee but for the maintenance to Boca dam can be protected all the way to Pyramid Lake to serve as a beneficial use to the fishes.

1. Allow Boca and Stampede to fill as normal in the summer of WY 2018 until June 1, 2018 then draw Boca down to the restricted level over the month of June to achieve the restricted elevation by July 1. The Boca and Stampede combined system storage under this scenario is shown in Figure 27. Very likely any water that is stored above the Boca maintenance level will not be released to a downstream demand before it is evacuated in June 2018. So, storing it is counter-intuitive, however in certain situations the water evacuated in June 2018 to achieve the maintenance level may be needed to meet a downstream Fish demand so it should be stored for those cases.
2. Increase the Flow Regime targets for June and potentially May to provide a use for the water that needs to be evacuated to achieve the Boca restricted elevation. This extra water may provide a biological benefit to species. This was not included in the modeling, but could be considered if the hydrologic conditions between now and the maintenance period support it.

3. Consider delaying the beginning of the Boca storage restriction maintenance until August 1, 2018. Because there is often no demand for releasing stored water until July 1, water release prior to July 1 is less likely to meet a demand. If the restriction did not begin until August 1, then the some or all of the water that needs to be evacuated to meet the restricted Boca elevation could also be used to meet a demand. This was not included in the modeling, but could be considered if the hydrologic conditions between now and the maintenance period support it.

3.3.4 TMWA Water Supply Impacts

Truckee Meadows Water Authority (TMWA) provides potable water to the Truckee Meadows area which includes over 385,000 residents in Reno, Sparks, Washoe County and surrounding areas. TMWA owns and operates the surface water storage in Donner and Independence lakes. Under TROA, TMWA is allowed to exercise their surface water rights by diversion to storage in Lake Tahoe, Prosser Reservoir, Boca Reservoir, Stampede Reservoir, Donner Lake, and Independence Lake. This diversion to storage (commonly known as a "holdback") allows TMWA to establish credit water that can be used to meet TMWA's surface water demand in the event of a drought. TMWA's current surface water storage water rights are sufficient to meet their current demand even in extreme drought conditions (conditions significantly worse than the current drought condition). When the Floriston Rate target is being met, see Section 0, TMWA has sufficient water rights to meet their demand with direct surface water diversions. When the Floriston Rate is not being met, drought reserves are used to supplement the available surface water.

3.3.4.1 Modeling Assumptions

For the sake of this modeling exercise we have assumed that TMWA would first use ground water to supplement the available surface water. If the ground water annual volume is depleted or the maximum pumping rate is insufficient to meet the demand, then TMWA will release water from its drought reserves upstream.

3.3.4.2 Impact to TMWA Demands

As noted above, TMWA is very unlikely to experience a shortage in the near future. With this in mind the impact of the Boca maintenance to TMWA's drought reserves will be fully described in Section 3.3.4.3: Impact to TMWA end of water year storage.

3.3.4.3 Impact to TMWA end of water year storage

During a drought year TMWA is able to store as much credit water as their permits and available water allow to meet their demands that year and if the drought continues and there is no limit on the total credit water that they can have in storage at a given time. However, in the first non-drought year the credit water above a base amount specified in TROA will convert to Fish credit water. The drought situation is critical to TMWA's operational criteria and is driven largely by releases of Floriston Rate water from Boca reservoir. It is conceivable that the maintenance to Boca reservoir would affect the drought designation in 2018 and/or 2019. Since the 2016 conditions are a drought the hydrologic, conditions would need to improve to come out of the drought designation. Based on Figure 29, for 2017 there is about a 54 percent chance of it still being a drought while in 2018 the likelihood of drought decreases to 39 percent and in 2019 the probability to drought decreases slightly to 37 percent. If the

drought ends, any impact to TMWA's surface water is much less likely to affect their ability to meet customer demands. The Boca maintenance did not affect the drought designation for any of the traces.

At the end of water year 2019, TMWA total storage has a 25 percent chance of being adversely affected and a 51 percent likelihood of being beneficially affected, as shown in Table 10.

Figure 30 shows the daily exceedance of total TMWA storage in the system. The abrupt drop in storage on April 1, 2018 in the 10% (blue) and 50% (green) exceedance traces correspond to the conversion of TMWA credit water to Fish credit water. Any difference in storage before April 1, 2018 due to the maintenance will not have a lasting effect to TMWA because storage lost due to the maintenance would have converted to Fish credit water on April 1, 2019 regardless of the maintenance.

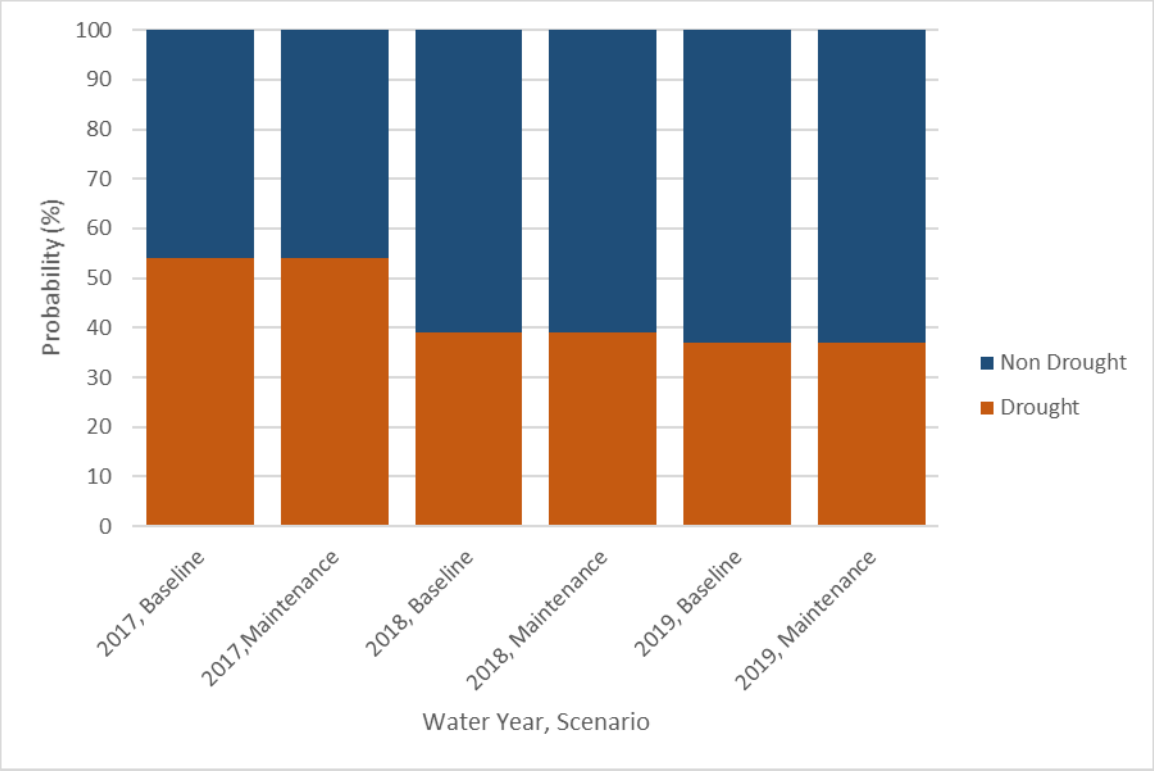


Figure 29: Probability of drought based on year and scenario

Table 10: TMWA carry over storage impacts.

	November 1, 2019 Storage Impacts (acre-feet)***	***Percent of Baseline Average***
Maximum Probable Adverse Impact*	-1300	-2.5%
Median Impact*	100	0.2%
Maximum Probable Beneficial Impact*	4400	8.4%
Probability of Negative Impact**	25%	N/A
Probability of No Impact**	24%	N/A
Probability of Positive Impact**	51%	N/A

*Negative values are averse to the party; positive values are beneficial to the party
**No impact is defined as impacts less than +/-100 ft
*** November 1 storage was used to show the impact to storage after the reservoir(s) have drawn down to the winter carryover level

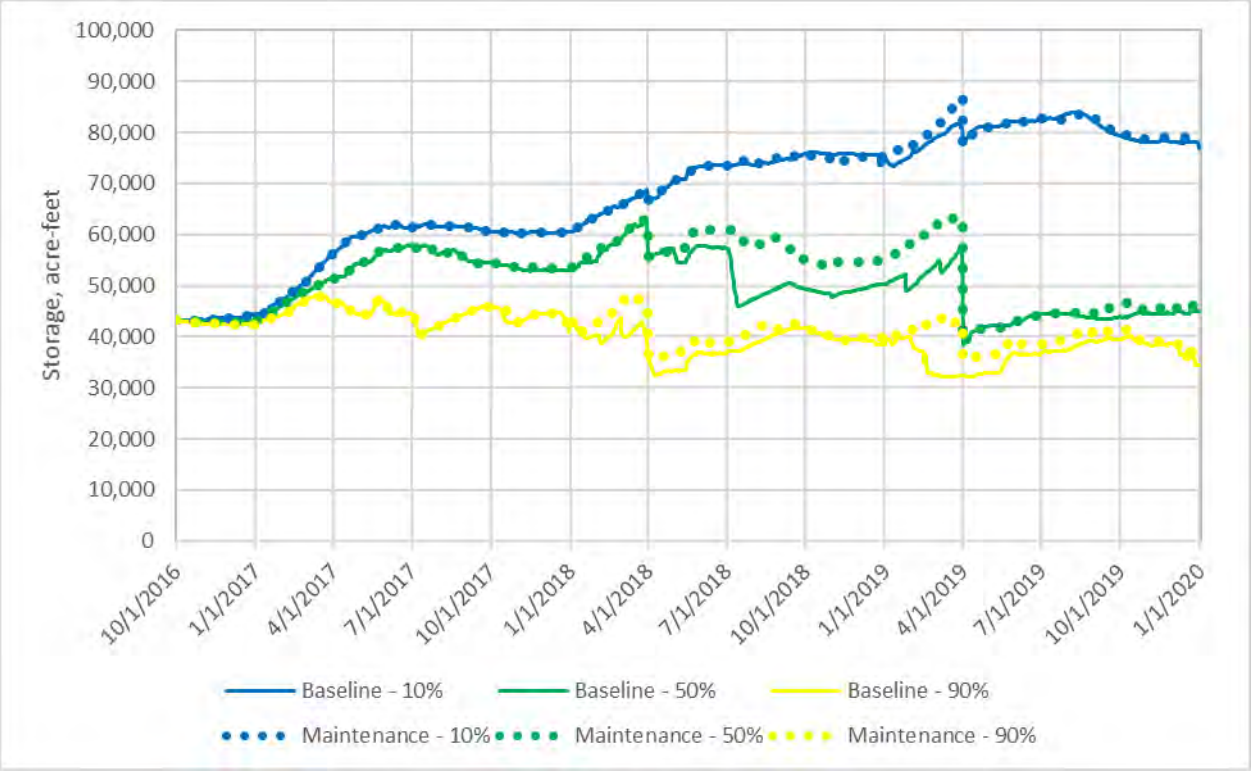


Figure 30: Daily exceedance plot of the total TMWA storage in the baseline runs (solid lines) and the maintenance runs (dotted lines).

3.3.5 Newlands Project Water Supply Impacts

The Newlands project includes the Truckee Canal and Lahontan reservoir. Lahontan reservoir captures water from the Carson River and its storage is supplemented with diversion from the Truckee River via the Truckee Canal. Diversion through the Truckee Canal are managed to meet storage target in Lahontan reservoir that are determined by the Operating Criteria and Procedures (OCAP) and other operating constraints. Diversions are also made from the Truckee Canal upstream of Lahontan reservoir to serve agricultural and municipal demands in the Truckee Division with an annual demand of approximately 10,500 acre-feet. Releases from Lahontan reservoir serve agricultural demands in the area of Fallon, NV which have an annual demand of approximately 290,000 acre-feet. The Truckee Canal diverts Floriston Rate water from the Truckee river, however diversions are most significant during high runoff when the natural flow at Farad exceeds the Floriston Rate target.

3.3.5.1 Impact to Newlands Project Water Supply

Impacts to the Truckee Canal diversions may either impact diversions to the Truckee division (which diverts from the Truckee Canal) or Lahontan Storage. Impacts to Lahontan storage may impact the ability to meet demands that year or in a subsequent year. As shown in Table 11, the probability of having an adverse impact to the Truckee Canal diversions is about 29 percent and there is about a 25 percent probability that the maintenance will increase the diversions through the canal. The maximum probable adverse impact to cumulative Truckee canal diversions over WY2018 and 2019 is only 2,900 acre feet which is 1.6% of the average annual diversion over the same period.

Table 11: Water supply impacts to Truckee Canal diversions.

	2018-2019, Cumulative Impact	
	Magnitude (acre-feet)	**% Of Baseline Average**
Maximum Probable Adverse Impact*	-2900	-1.6%
Median Impact*	0	0.0%
Maximum Probable Beneficial Impact*	4000	2.2%
Probability of Negative Impact	29%	N/A
Probability of No Impact	46%	N/A
Probability of Positive Impact	25%	N/A

*Negative values are averse to the party; positive values are beneficial to the party

**No impact is defined as impacts less than +/-100 acre-feet

Adverse water supply impacts to the Carson and Truckee divisions are unlikely to occur, 15% and 7% respectively. The maximum probable impacts to either division is also small amounting to less than 1% of the annual demand in either case.

In summary, the Boca maintenance is unlikely to have a significant impact to diversions through the Truckee Canal.

3.3.5.2 Impact to Newlands Project end of water year storage

The Newlands Project stores water in Lahontan reservoir to meet demands in the Carson Division that year and uses carryover storage to meet demands in the next water year. Any impact to the end of water year 2019 storage may impact the deliveries in WY2020, a water year after 2020 or have no impact on deliveries. Table 12 summarizes the impacts to the Lahontan end of water year storage for water year 2019. There is a 7 percent likelihood that the storage at the end of WY2019 is adversely impacted by the Boca maintenance, and the maximum probable adverse impact to WY 2019 storage is only 200 acre-feet, which only 0.3 percent of the baseline average end of water year 2019 storage. There is also a 7 percent probability that the maintenance would increase the storage in Lahontan reservoir at the end of WY2019, but the maximum probable beneficial impact is only 1,500 acre-feet which is 1.7% of the baseline average November 15, 2019 storage. Figure 31 shows the daily exceedance of Lahontan storage.

Table 12: Impacts to end of water year Lahontan Storage, all values in acre-feet.

	November 15, 2019 Storage Impacts***	***Percent of Baseline Average***
5% Exceedance Impact*	-200	-0.3%
Median Impact*	0	0.0%
95% Exceedance Impact*	1500	1.7%
Probability of Negative Impact**	7%	N/A
Probability of No Impact**	86%	N/A
Probability of Positive Impact**	7%	N/A

*Negative values are averse to the party; positive values are beneficial to the party

**No impact is defined as impacts less than +/-100 ft

*** November 15 storage was used to show the impact to storage after the irrigation season ends.

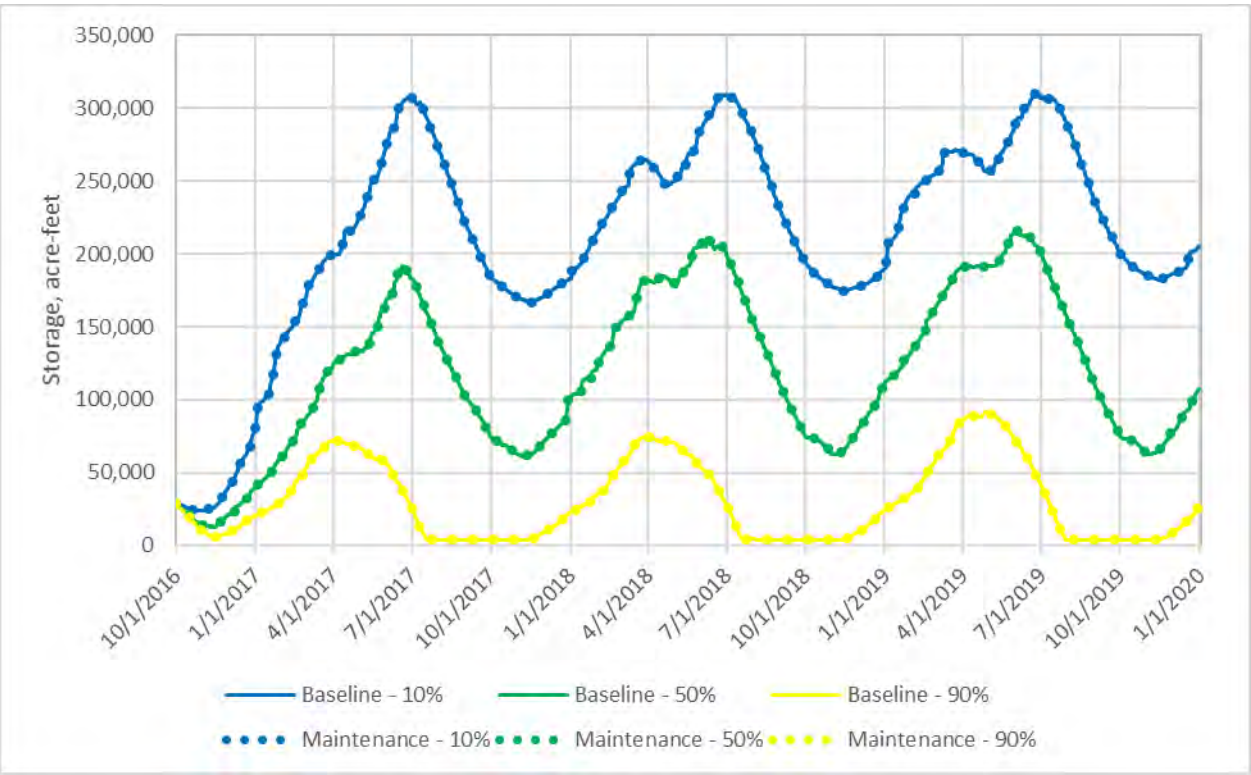


Figure 31: Daily exceedance plot of the Lahontan reservoir storage in the baseline runs (solid lines) and the maintenance runs (dotted lines).

3.3.6 California Water Supply Impacts

California Department of Water Resources (CA DWR) has the ability to store credit water under TROA. This water credit water is called Joint Program Fish Credit water (JPF Credit) and can be established in coordination with PLPT when there is Floriston Rate water in the Truckee River downstream of the Truckee Canal that exceeds the Flow Regime targets (see Section 3.3.3). Water established in this method is divided 50/50 between Fish Credit water that PLPT has full control over and JPF Credit water that CA DWR has control over with the caveat that any JPF Credit water that reaches the Truckee River at Farad gage must flow on to Pyramid Lake.

Currently there is no JPF Credit water in storage and it is unlikely that any will be stored by the end of WY 2016. However, the maintenance on Boca reservoir could either adversely affect the ability to store JPF Credit water or cause all or a portion of the JPF Credit water that is stored between now and summer 2018 to vacate the reservoir.

3.3.6.1 Impact to CA DWR Demands

Any JPF Credit water that CA DWR is able to store is used by moving it from one reservoir to another via exchange to better meet the flow targets in the reaches downstream of each reservoir. Because the desired releases from these reservoirs is still in development by CA DWR, and comparison of how well flow targets are achieved in the maintenance condition relative to the baseline condition is somewhat ill-defined; there was no analysis conducted comparing how the CA DWR flow targets are met in the baseline and maintenance scenarios.

Releases from Stampede reservoir are of particular interest to CA DWR as the Little Truckee River between Stampede and Boca reservoir is an active fly fishing location. One of the strategies to mitigate the effect to meeting Floriston Rate demands is to limit the release from Stampede reservoir to 30 cfs as often as possible see Section 3.3.2.3 item 4. Maintenance on Boca reservoir will also likely prevent or severely limit the recreational activity, predominately water skiing, on Boca reservoir during the maintenance period and the period leading up to the maintenance period.

3.3.6.2 Impact to CA DWR end of water year storage

In the baseline condition, CA DWR may establish as much as 17,000 acre-feet by the end of WY 2019, with an average storage of 4,300 acre-feet at the end of WY2019. Table 13 summarizes the potential impact of the Boca maintenance to the end of water year 2019 storage of JPF Credit water for water year 2019.

Table 13: Impact to end of water year JPF Credit water.

	November 1, 2019 Storage Impacts (acre-feet)***	***Percent of Baseline Average***
Maximum Probable Adverse Impact*	-1500	-35.0%
Median Impact*	600	13.4%
Maximum Probable Beneficial Impact*	6300	147.1%
Probability of Negative Impact**	12%	N/A
Probability of No Impact**	24%	N/A
Probability of Positive Impact**	64%	N/A

*Negative values are averse to the party; positive values are beneficial to the party

**No impact is defined as impacts less than +/-100 ft

*** November 1 storage was used to show the impact to storage after the reservoir(s) have drawn down to the winter carryover level

Figure 32 shows the daily exceedance of total CA DWR storage in the system. The maintenance traces begin to diverge from the baseline traces after the maintenance is complete at the end of December 2019. This effect could be explained by the extra storage space in Boca reservoir that becomes available after the maintenance is complete, this storage capacity could be used to store project water that would have displaced CA DWR water or could be used to store new CA DWR water directly.

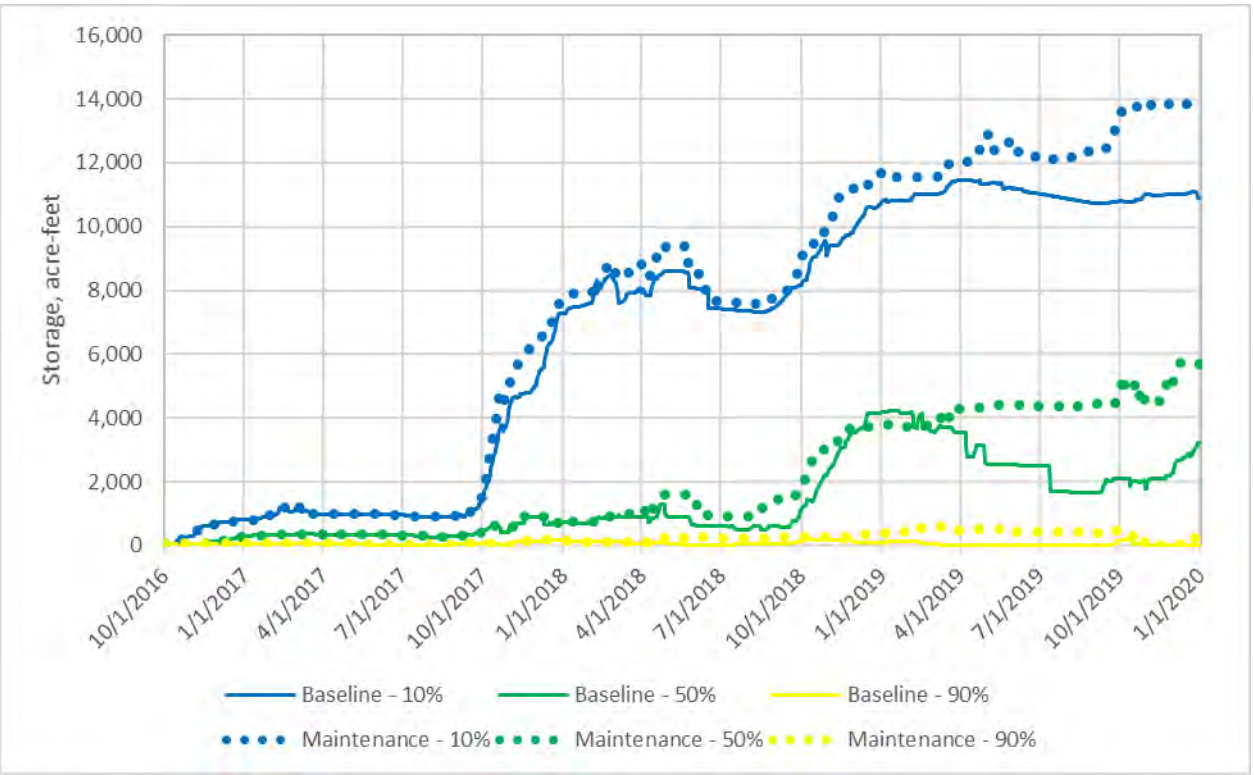


Figure 32: Daily exceedance plot of the total CA DWR storage in the baseline runs (solid lines) and the maintenance runs (dotted lines).

3.4 Conclusions and Recommendations of the Water Supply Analysis

3.4.1 Conclusions

Maintenance to the dam at Boca reservoir will limit the maximum storage capacity of water in the Boca-Stampede Reservoir system. After consultation with the U.S. District Court Water Master's office who oversees operations of the Truckee River Basin reservoirs, strategies were developed and tested to reduce the impact of this maintenance on water supply for water years 2018 and 2019**.** Concerning the impact to the various parties' abilities to meet demands, the most significantly impacted parties are Floriston Rate users and supply for Fish targets which together comprise the majority of the stored water in Boca and Stampede. The deliveries to Floriston Rate users have a 24 percent likelihood of being adversely affected by as much as -7,800 AF over 2018 and 2019 which is approximately 1.5 percent of the demand over the same period. The frequency of achieving the PLPT/Fish flow targets has a 36 percent likelihood of being adversely impacted by the Boca maintenance with the maximum probable impact of 9 fewer days in which the flow targets are met. Deliveries to TMWA are extremely unlikely to be affected by the Boca maintenance because of the reliability of TMWA drought storage which includes significant storage in Donner and Independence reservoirs, as well as storage in Stampede that is protected from spill per TROA. Deliveries to the Newlands Project's Truckee and Carson divisions have 7 and 15 percent likelihood of being adversely impacted, respectively, however the maximum probable adverse impact is on the order of one percent of the demand over the same period. Maintenance would likely necessitate reduced releases from Stampede reservoir which would be averse to the recreational activities, primarily fishing, that occur on the Little Truckee River between Boca and Stampede reservoir.

Analysis was also conducted to assess the impact to the end of water year 2019 storage for each party. Impacts to storage may also impact deliveries in years following WY 2019. Impact to deliveries in the future are only likely to occur if a particular party's storage license is not able to be satisfied in the following year, and would be fully depleted in WY 2020. The party with the greatest potential impact to WY 2019 carry over storage was PLPT which has a 66 percent likelihood of an adverse impact to WY 2019 storage and a maximum probable adverse impact of 21,900 acre-feet. Though it is important to note that for PLPT, unlike all other parties, any water that is referred to here as an impact, did get delivered to its appropriate destination (Pyramid Lake), just not with the same timing. The second most significantly impacted party is FR which has a 20 percent likelihood of adverse impact with a maximum probable adverse impact of 5,400 AF to total FR storage (including storage in Lake Tahoe). The third greatest impacts are to TMWA storage, which has a 25 percent probability of having an impacted WY 2019 carryover storage with a maximum probable adverse impact of 1,300 acre-feet. The fourth most significant potential impact to WY 2019 carry over storage is for CA DWR which has a 12 percent likelihood of adverse impact and a maximum probable adverse impact of 1,500 acre-feet, however there is a 64 percent probability that CA DWR storage would be positively impacted by the maintenance by up to 6,300 acre-feet. The least impacted party in terms of WY2019 carryover storage is the Newlands Project which has a 7 percent probability of adverse effect and a maximum probable adverse impact of 200 acre-feet, only 0.3% of the average baseline storage.

3.4.2 Recommendations

In order to reduce the impact of the Boca maintenance on meeting the Floriston Rate demands and thus decrease the impact of Floriston Rate users (including all other parties), it is recommended that the water supply maintenance strategies outlined in Section 3.3.2.3 be implemented.

Additional analysis should be conducted to analyze the potential strategies to reduce impacts to PLPT carry over storage, some of which are outlined in Section 3.3.3.3. This analysis would be most effective if conducted in the beginning of WY 2018 to remove the uncertainty in the condition of the system going into maintenance. Future modeling will be conducted in early spring of the construction year (2018), incorporating the real-time hydrology and reservoir conditions, to validate that these proposed deviations are addressing the water supply goal.

Appendix B – Boca Reservoir Potential Reservoir Restriction Analysis

RECLAMATION

Managing Water in the West

BOCA RESERVOIR POTENTIAL RESERVOIR RESTRICTION ANALYSIS

July 2017
Updated February 2018

U.S. Department of the Interior
Bureau of Reclamation
Mid-Pacific Region
Lahontan Basin Area Office

Introduction

This document, developed jointly by Precision Water Resources Engineering (PWRE) and the Bureau of Reclamation staff in the Lahontan Basin Area Office, summarizes the hydrologic analysis used to support the alternatives considered in the Environmental Assessment process for Reclamation's Boca Reservoir Safety of Dams Modification Project. Boca Reservoir is managed in conjunction with Lake Tahoe to meet the Floriston Rates on the Truckee River. Floriston Rates provide water to serve municipal and industrial (M&I) use in Truckee Meadows, agricultural water rights, hydropower generation, environmental needs and flows in the River. Releases are made from Boca Reservoir and Lake Tahoe storage as necessary to meet water rights when unregulated flows are insufficient to serve those rights, and to meet dam safety or flood control requirements. There is no minimum reservoir release for Boca Reservoir.

PWRE contracted with the Lahontan Basin Area Office of the Bureau of Reclamation (USBR) to generate two model runs of the "Pre-Water Rights Solver" version of the TROA Planning Model in support of an analysis of the impacts resulting from the enforcement of a reduced water surface elevation limit on Boca Reservoir. LBAO staff and PWRE staff prepared this Technical Report. The model runs are summarized as:

1. Current Boca Storage, Increasing Basin Demand Levels to future "robust" scenario, and Historic Hydrology. Robust demand level is as developed for the Truckee Basin Study.
2. Restricted Boca Storage level at 5579 feet (NAVD88) (about 5575.12 NGVD29), Increasing Basin Demand Levels to future "robust" scenario, and Historic Hydrology.

The model is run 51 years into the future (WY 2016 – WY 2066).

This modeling is redo of the modeling conducted in April 2015, results of which were used in the Economic Benefit Analysis (2016), with a different Restricted Boca Storage level, at 5582.9 feet (NAVD88) (about 5579.0 NGVD29). Diversion of Truckee River water to the Truckee Canal was limited to a maximum of 300 cfs in all simulations[1].

Hydrology

Both scenarios that were analyzed in this exercise were driven by the same hydrology set. The hydrology comes from the TCDAT dataset that was used for the TROA EIS/EIR. This originally monthly TCDAT data was disaggregated to daily flows by Stetson Engineers in 2012 and has been widely accepted by stakeholders in the Basin. The TCDAT dataset spans from October 1st, 1900 to September 30th, 2000. Because only 51 years of data were needed for this analysis, the most recent 51 years, WY 1950 through WY 2000, from this data set were used to drive the model runs.

The demand data used in the model represents future demand levels for the next 50 years under "robust" scenario considered in the Truckee Basin Study (2015).

[1] A letter from Reclamation to TCID on 10/31/2016 ("Amendment to the March 14, 2008 Special Written Notice") removed earlier diversion restrictions and allowed a diversion based on the stage in the canal which could occassionally be more than 300 cfs.

Table 1: Storage in upstream reservoir including Prosser, Boca, Stampede, Independence, and Donner.

	Total Upstream Storage		
	Baseline Magnitude (acre-feet)	**Future Magnitude (acre-feet)**	**Difference (Impact)**
Annual Maximum	284,040	263,186	-20,854
Annual Minimum	78,674	95,276	16,602
Annual Average	219,173	209,819	-9,354

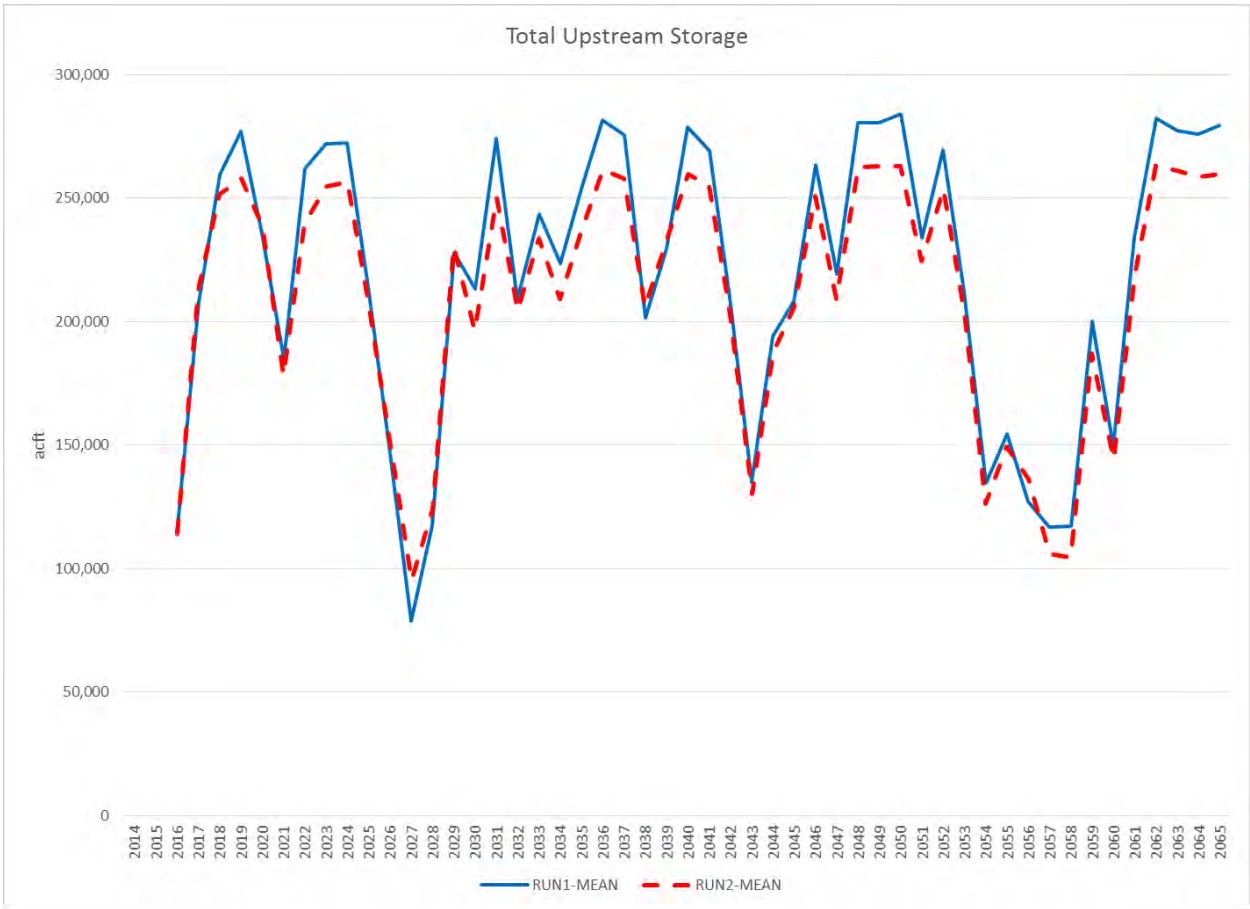


Figure 1 storage in upstream reservoir including Prosser, Boca, Stampede, Independence, and Donner.

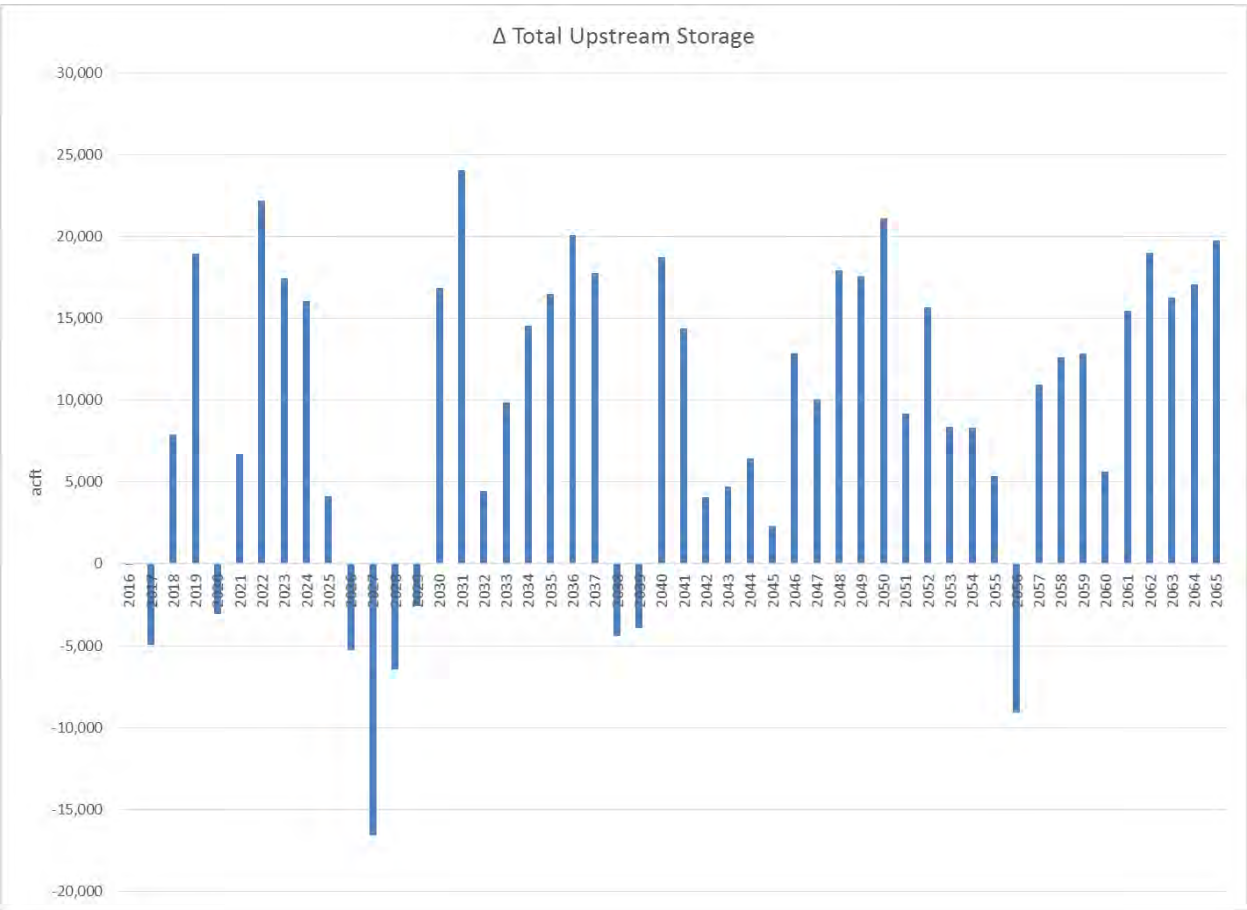


Figure 2: the difference in total upstream storage between the baseline and the limited Boca scenarios

Table 2: Releases of Floriston Rates water from upstream reservoirs.

	Floriston Rates (FR) Deliveries		
	Baseline Magnitude (acre-feet)	**Future Magnitude (acre-feet)**	**Difference (Impact)**
Annual Maximum	332,826	332,826	0
Annual Minimum	126,935	126,753	-182
Annual Average	300,710	297,324	-3,387

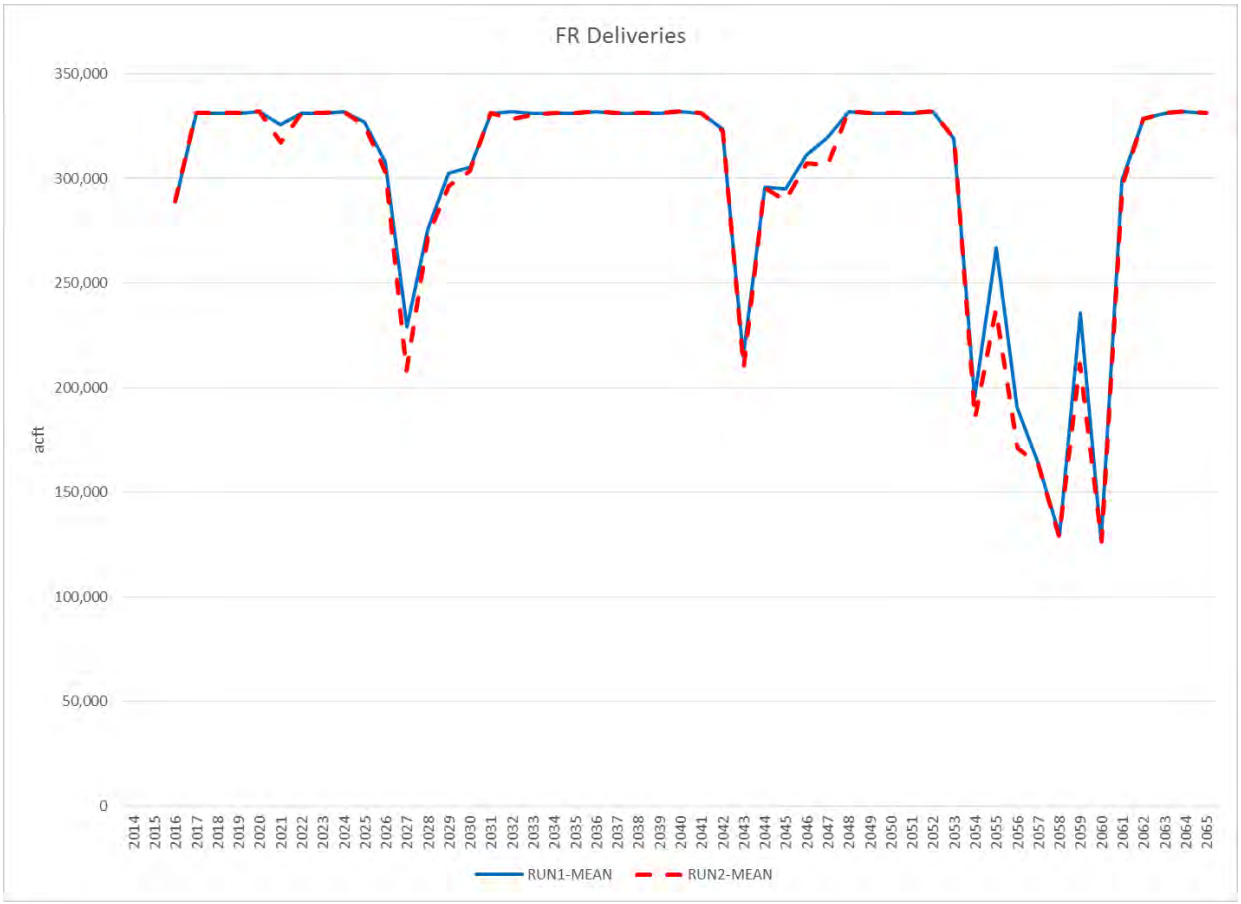


Figure 3: Releases of Floriston Rates water from upstream reservoirs.

Table 3: Total of all storage designated for Floriston Rates in Tahoe, and Boca along with Tahoe-Prosser-Exchange water, temporary FR water in Prosser reservoir, and temporary FR water in Stampede reservoir.

	FR Storage		
	Baseline Magnitude (acre-feet)	**Future Magnitude (acre-feet)**	**Difference (Impact)**
Annual Maximum	679,572	658,252	-21,320
Annual Minimum	186	181	-5
Annual Average	444,721	418,023	-26,698

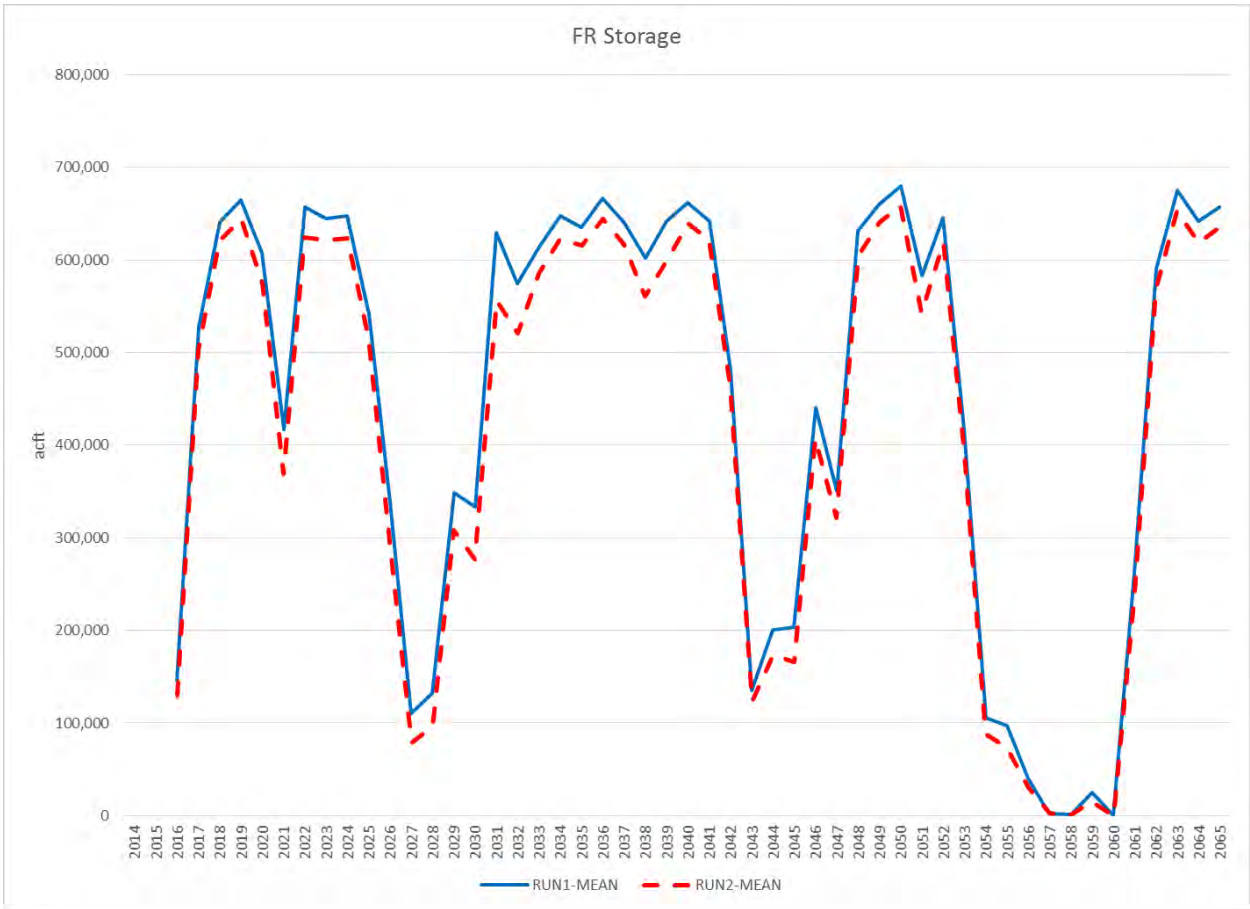


Figure 4: Total of all storage designated for Floriston Rates in Tahoe, and Boca along with Tahoe-Prosser-Exchange water, temporary FR water in Prosser reservoir, and temporary FR water in Stampede reservoir.

Table 4: Inflow to Pyramid Lake measured at the Nixon gage on the Truckee River.

	Flow on the Truckee River near Nixon		
	Baseline Magnitude (acre-feet)	**Future Magnitude (acre-feet)**	**Difference (Impact)**
Annual Maximum	1,953,932	1,954,489	557
Annual Minimum	20,487	20,791	305
Annual Average	477,669	480,240	2,571

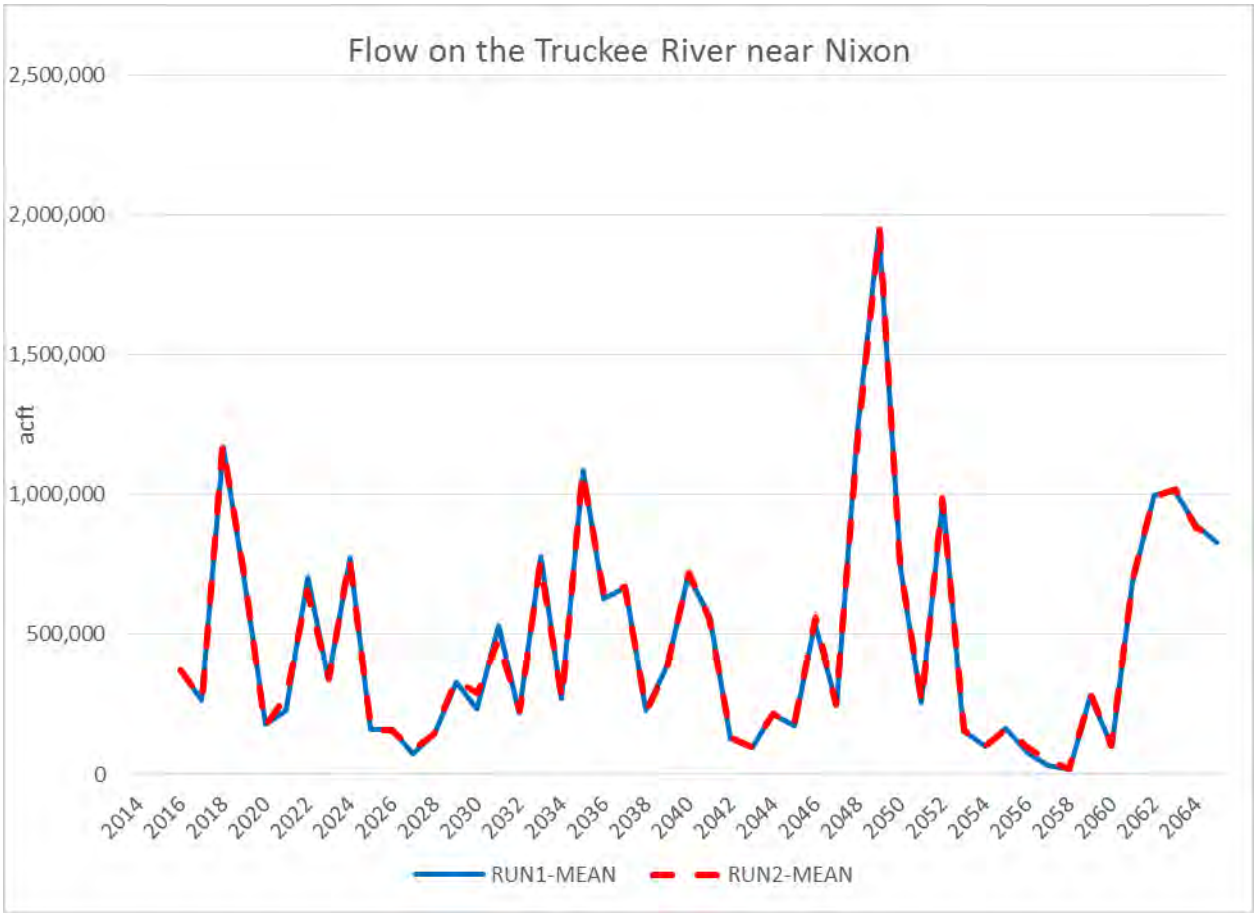


Figure 5: Inflow to Pyramid Lake measured at the Nixon gage on the Truckee River.

Table 5: Storage of all Fish Credit Water and Fish Water in the reservoirs.

	PLPT Upstream Storage		
	Baseline Magnitude (acre-feet)	**Future Magnitude (acre-feet)**	**Difference (Impact)**
Annual Maximum	210,848	210,840	-8
Annual Minimum	4,785	4,830	45
Annual Average	141,208	149,726	8,518

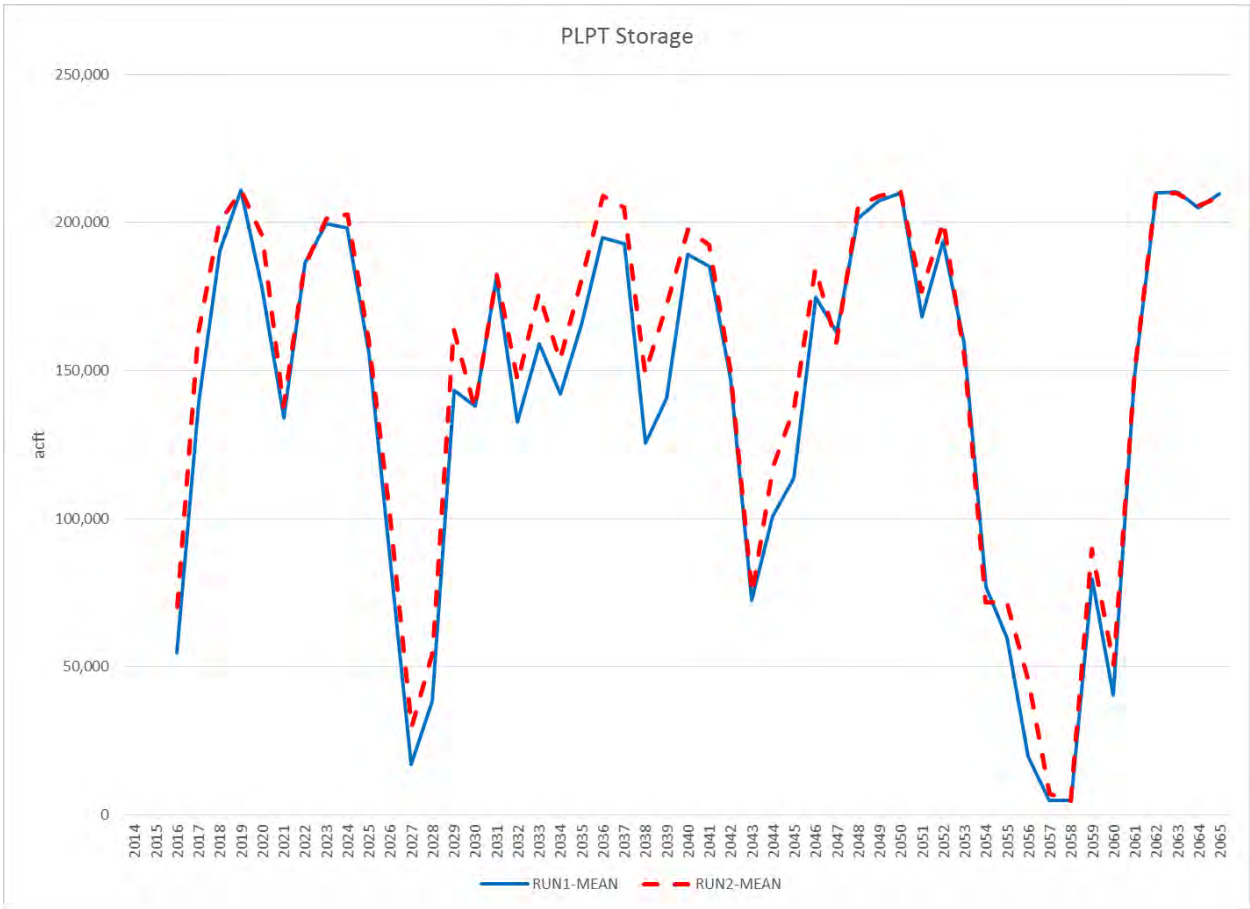


Figure 6: Storage of all Fish Credit Water and Fish Water in the reservoirs.

Table 6: Diversion of water to the water treatment plants near Chalk Bluff and Glendale, as well as uses of groundwater-regular and drought.

	Truckee Meadows Water Authority (TMWA) Delivery		
	Baseline Magnitude (acre-feet)	**Future Magnitude (acre-feet)**	**Difference (Impact)**
Annual Maximum	98,188	98,188	0
Annual Minimum	76,804	76,745	-60
Annual Average	91,103	91,072	-31

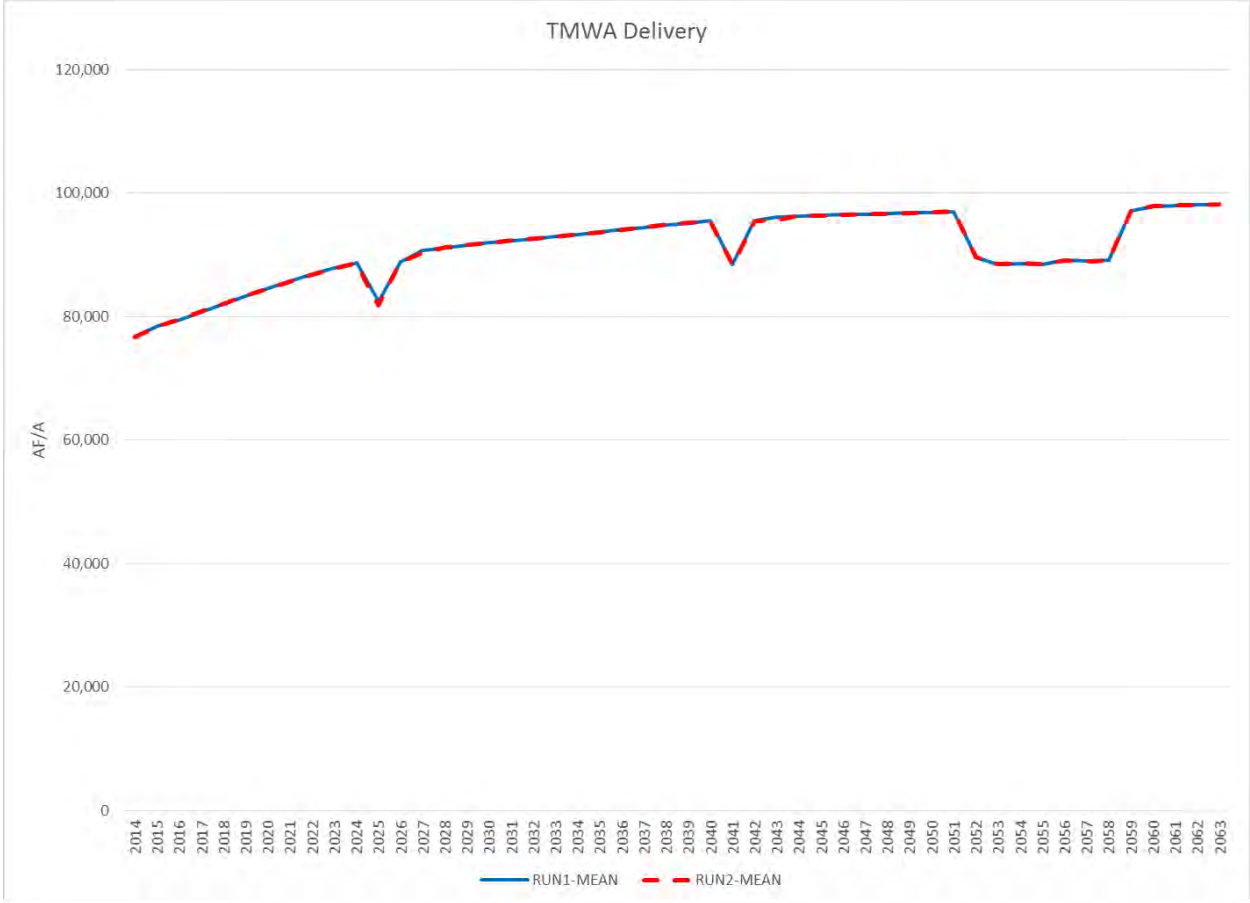


Figure 7: Diversion of water to the water treatment plants near Chalk Bluff and Glendale, as well as uses of groundwater-regular and drought.

Table 7: Storage of TMWA accounts.

	TMWA Storage		
	Baseline Magnitude (acre-feet)	**Future Magnitude (acre-feet)**	**Difference (Impact)**
Annual Maximum	101,911	91,534	-10,376
Annual Minimum	32,042	32,123	81
Annual Average	51,534	49,338	-2,197

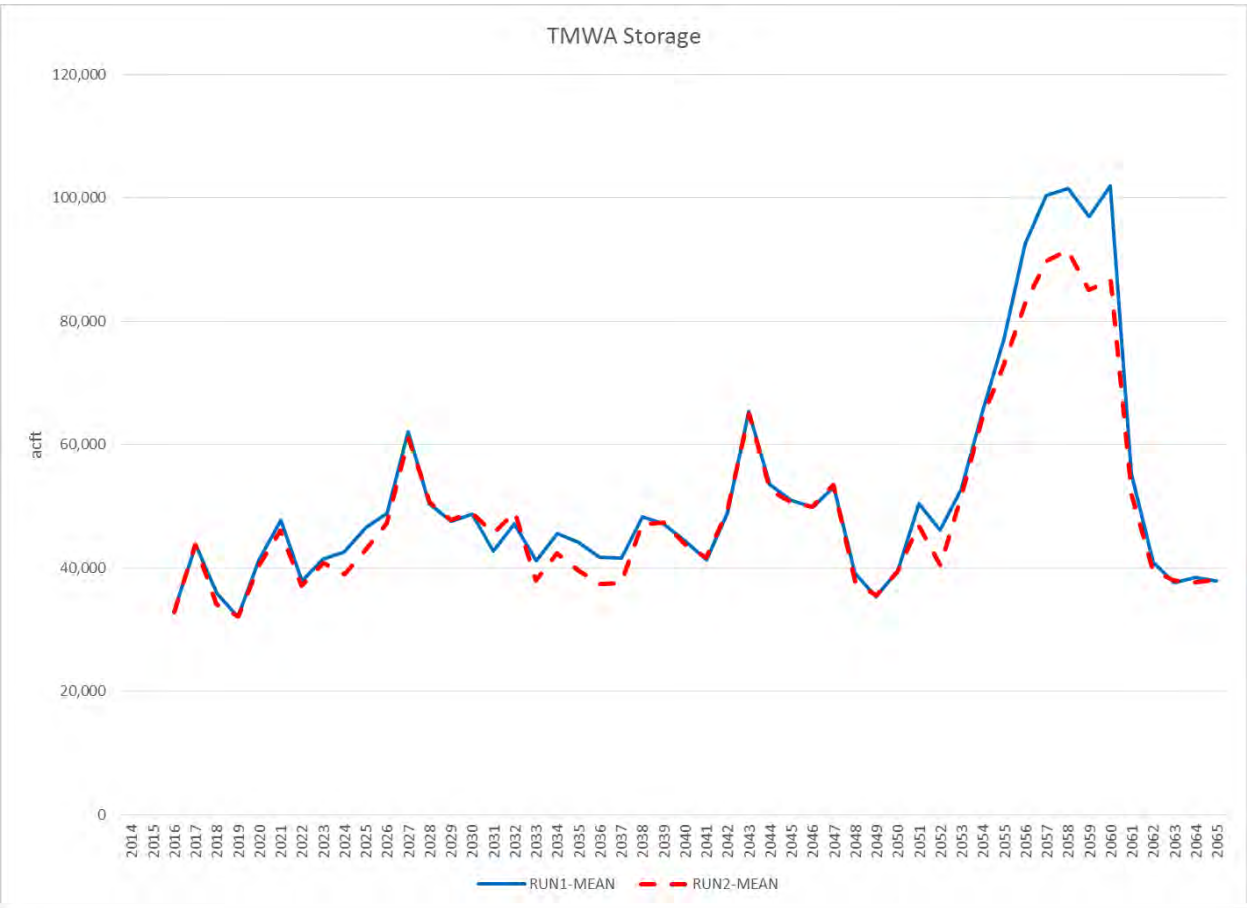


Figure 8: Storage of TMWA accounts.

Table 8: Pool elevation of Pyramid Lake in feet.

	Pyramid elevation		
	Baseline Magnitude (feet)	**Future Magnitude (feet)**	**Difference (Impact)**
Annual Maximum	3,829.1	3,829.8	0.7
Annual Minimum	3,793.5	3,793.5	0.0
Annual Average	3,809.1	3,809.4	0.4

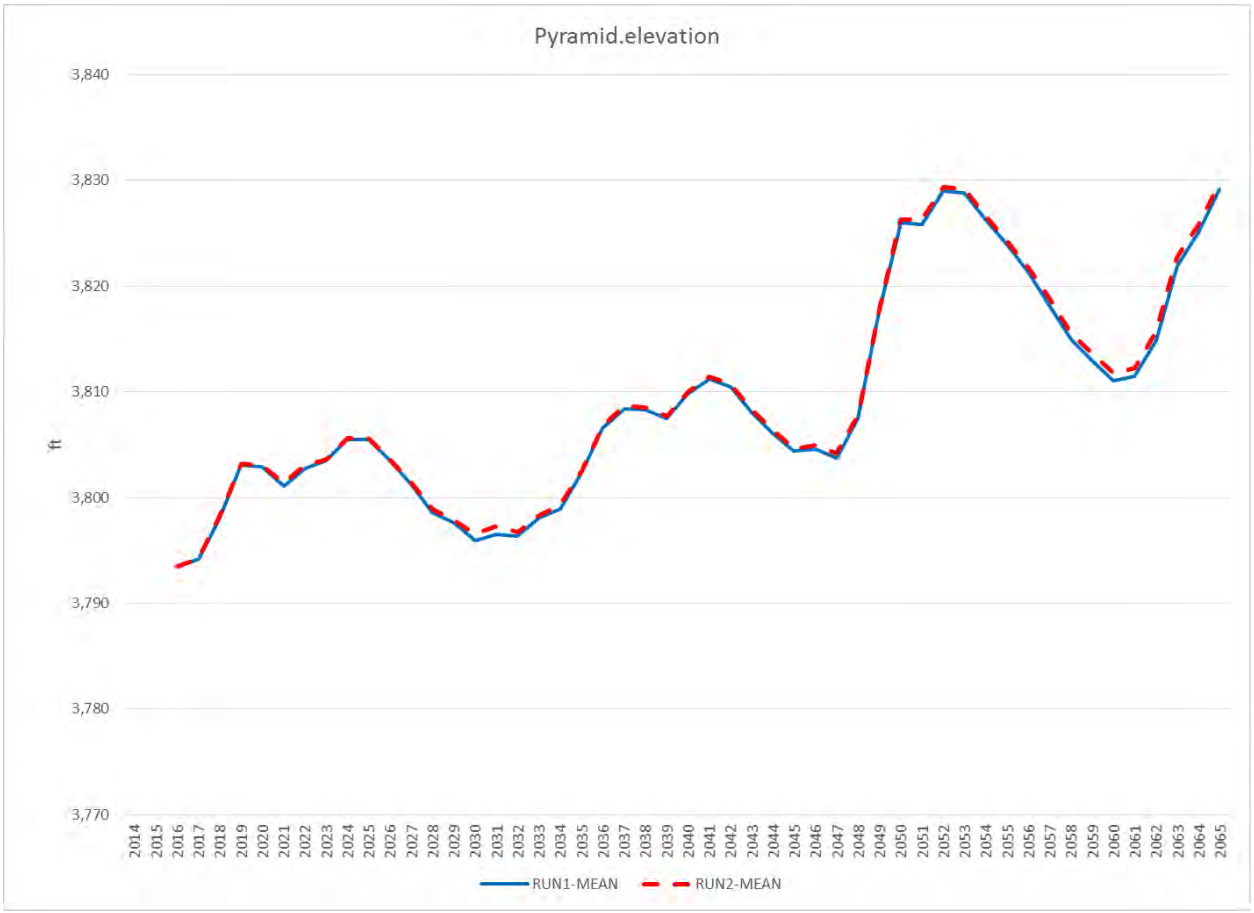


Figure 9: Pool elevation of Pyramid Lake in feet.

Table 9: Storage of California water under TROA.

	Total State of California Storage		
	Baseline Magnitude (acre-feet)	**Future Magnitude (acre-feet)**	**Difference (Impact)**
Annual Maximum	8,365	8,463	98
Annual Minimum	285	278	-7
Annual Average	4,231	4,225	-7

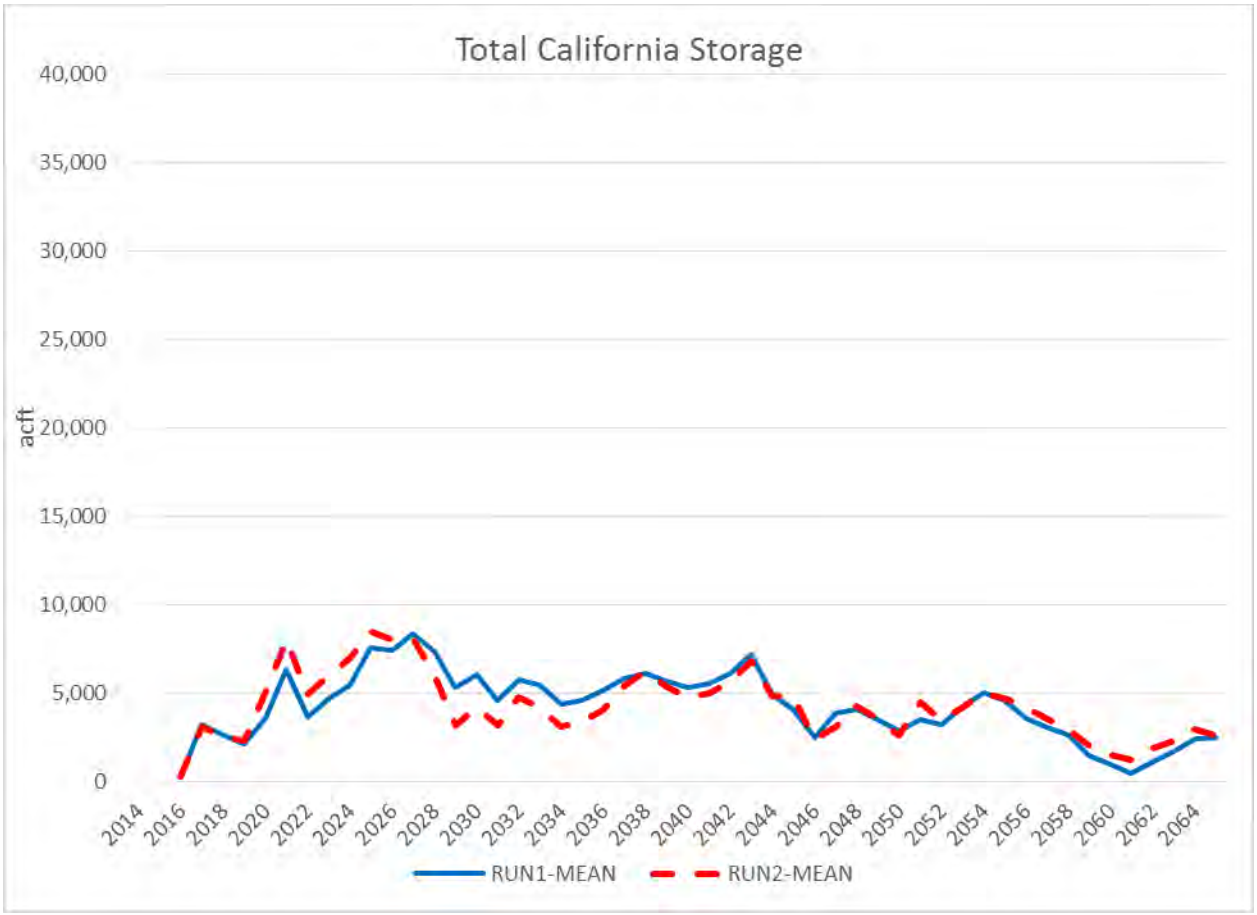


Figure 10: Storage of California water under TROA

Table 10: Diversion from the Truckee River to the Truckee Canal; equivalent to the measurement at the Wadsworth USGS gage on the Truckee Canal.

	Truckee River Delivery to the Truckee Canal		
	Baseline Magnitude (acre-feet)	**Future Magnitude (acre-feet)**	**Difference (Impact)**
Annual Maximum	227,328	226,297	-1,031
Annual Minimum	21,217	21,217	0
Annual Average	118,679	117,598	-1,081

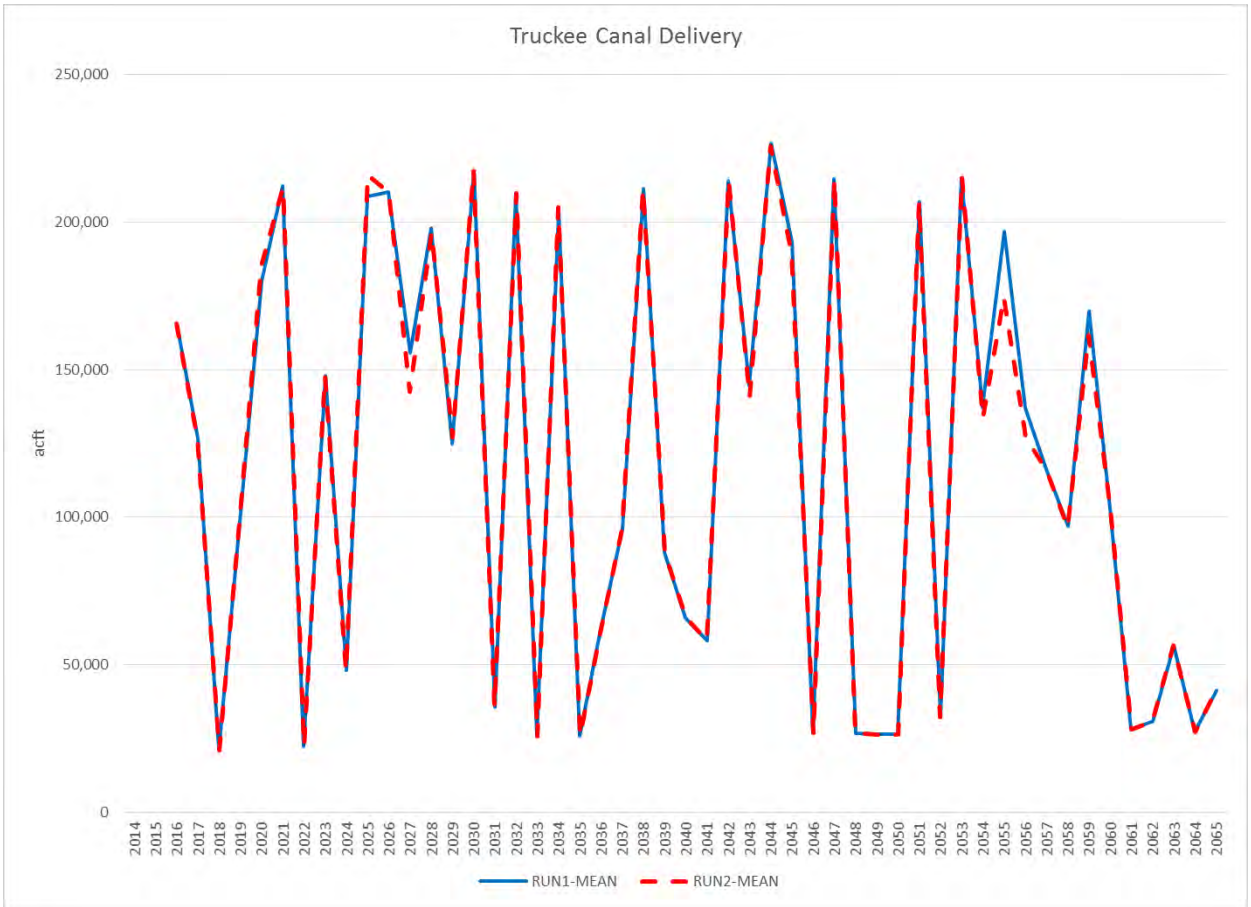


Figure 11: Diversion from the Truckee River to the Truckee Canal; equivalent to the measurement at the Wadsworth USGS gage on the Truckee Canal.

Table 11: Storage in Lahontan Reservoir—includes Newlands Project water diverted from the Truckee River and inflow from the Carson River.

	Lahontan Reservoir Storage (Newlands Project Storage)		
	Baseline Magnitude (acre-feet)	**Future Magnitude (acre-feet)**	**Difference (Impact)**
Annual Maximum	274,854	274,854	0
Annual Minimum	19,439	18,640	-798
Annual Average	173,545	173,700	155

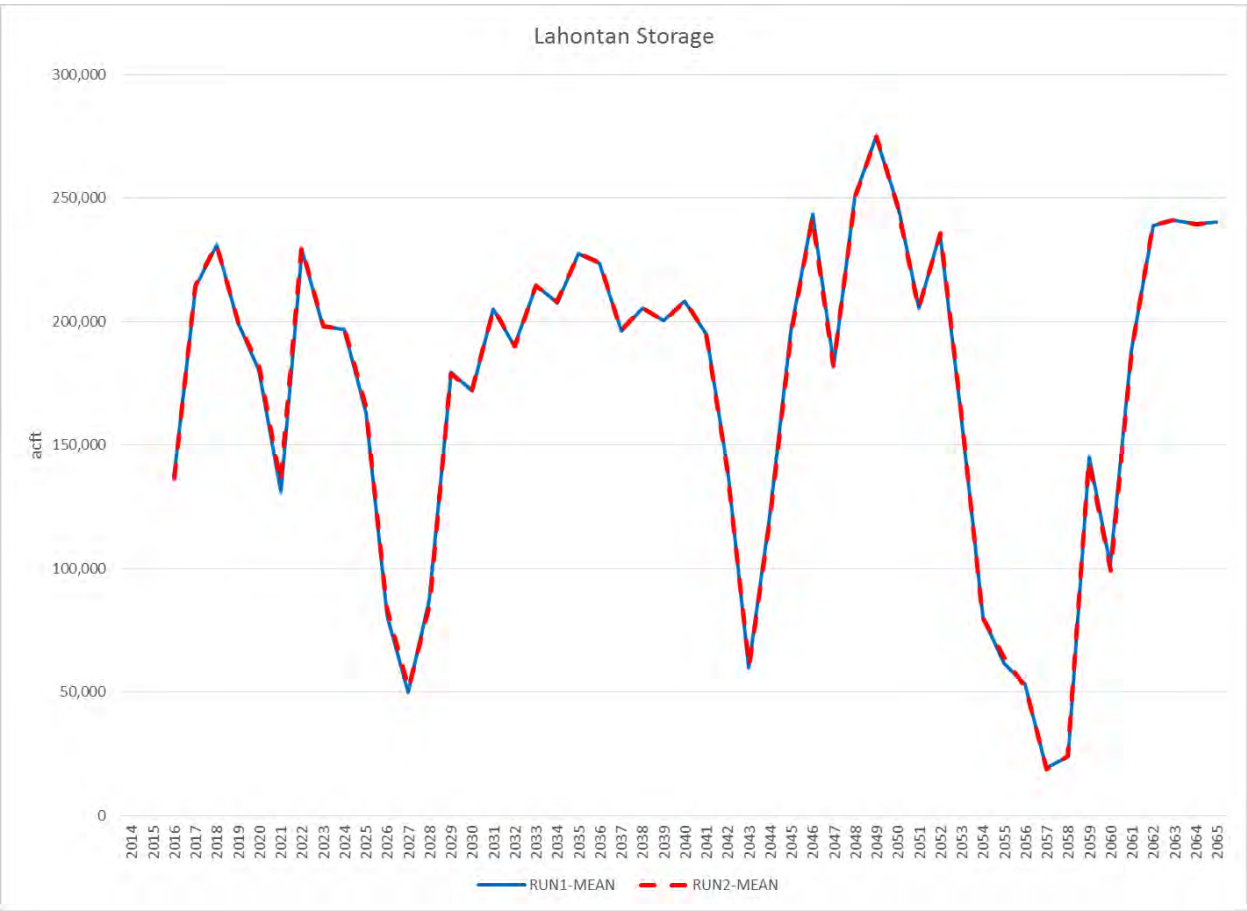


Figure 12: Storage in Lahontan Reservoir—includes Newlands Project water diverted from the Truckee River and inflow from the Carson River.

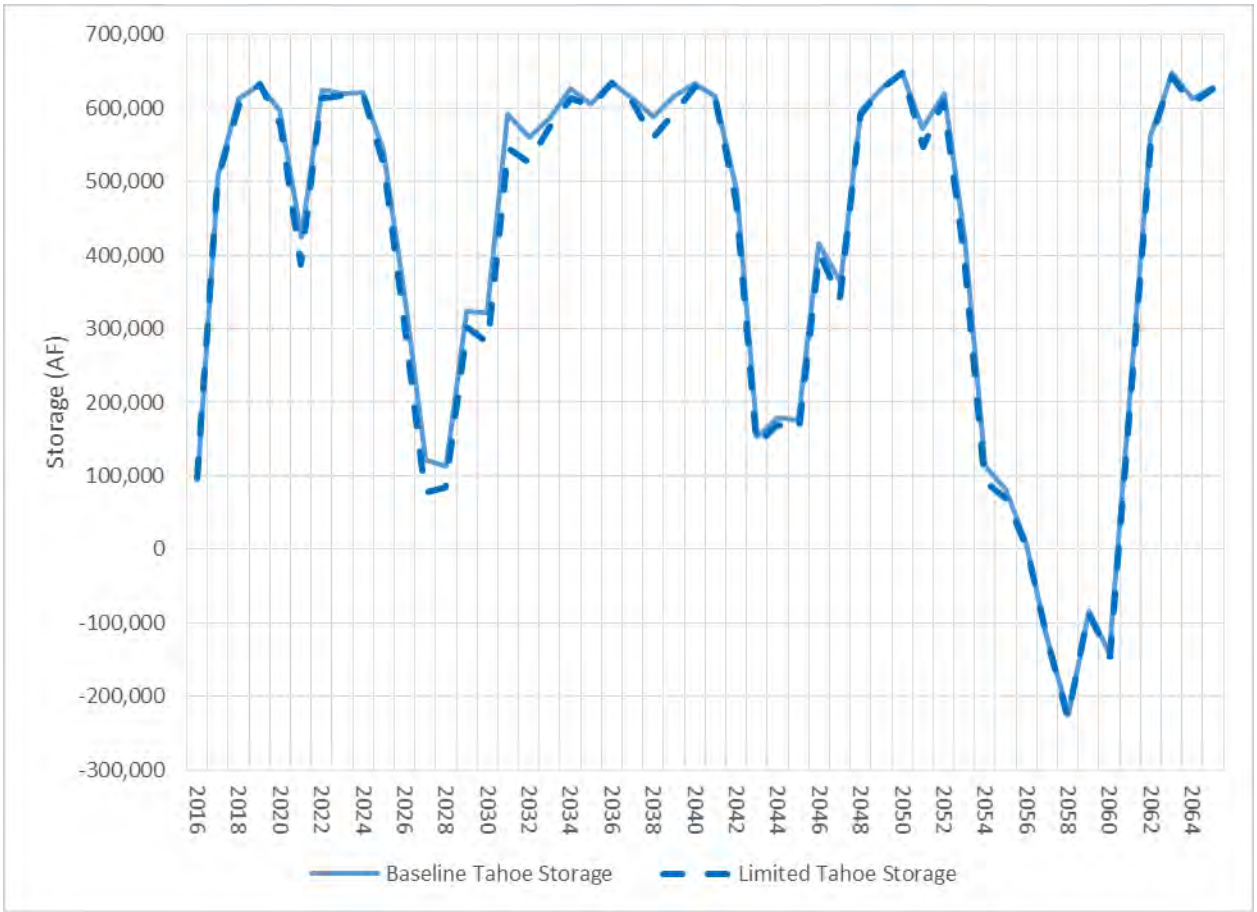


Figure 13: Lake Tahoe storage for baseline and limited Boca simulations. The impact is the quotient of the baseline minus the limited, and the baseline.

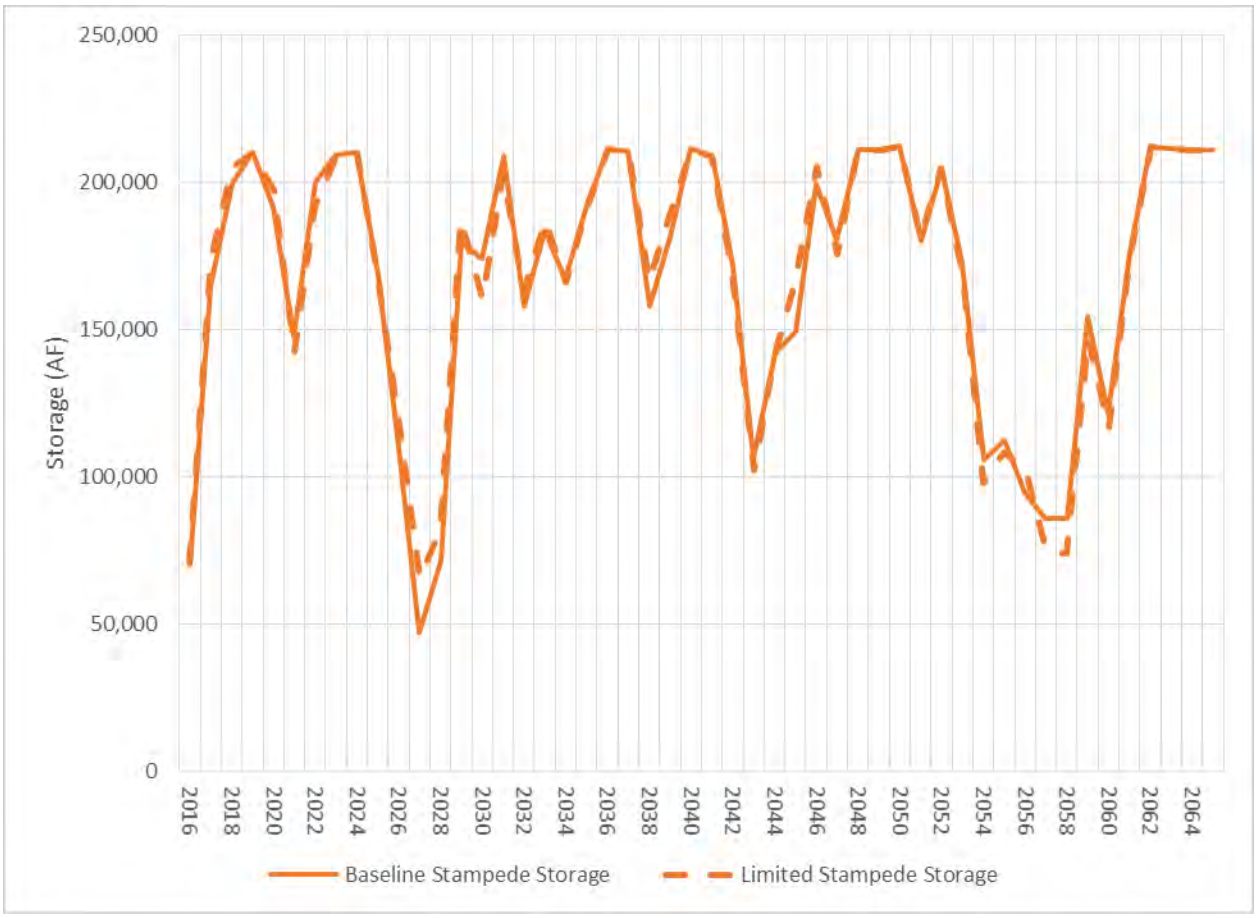


Figure 14: Stampede reservoir storage for baseline and limited Boca simulations. The impact is the quotient of the baseline minus the limited, and the baseline.

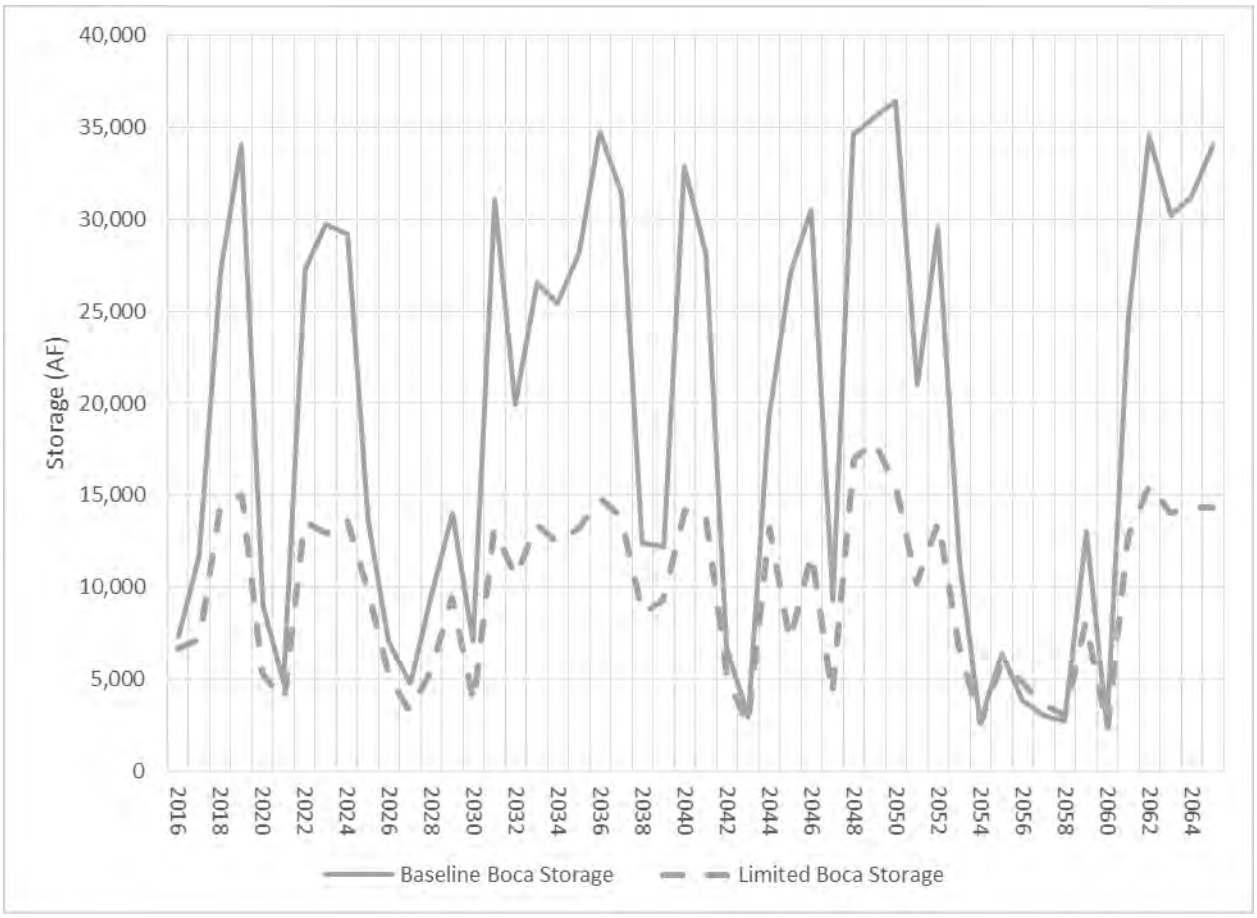


Figure 15: Boca reservoir storage for baseline and limited Boca simulations. The impact is the quotient of the baseline minus the limited, and the baseline.

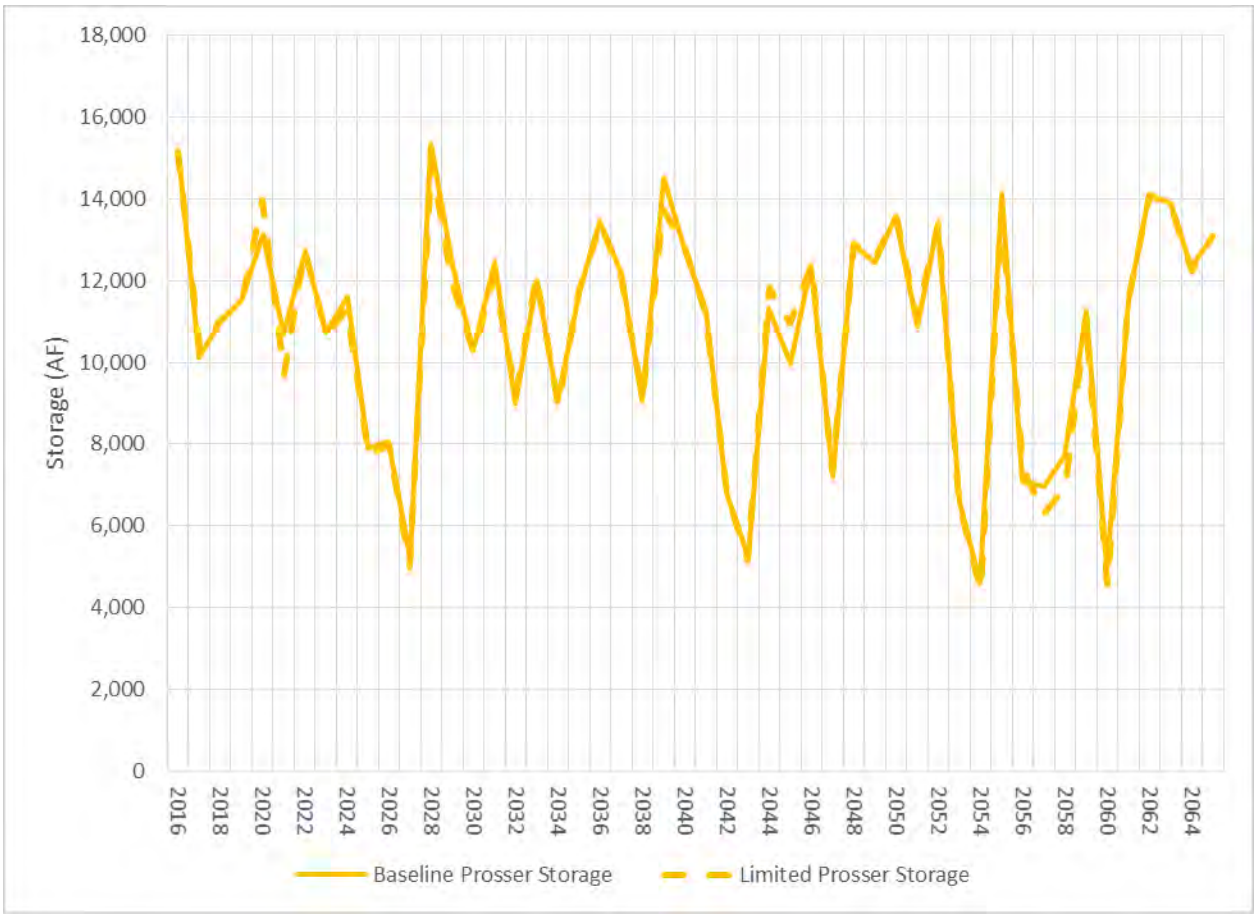


Figure 16: Prosser reservoir storage for baseline and limited Boca simulations. The impact is the quotient of the baseline minus the limited, and the baseline.

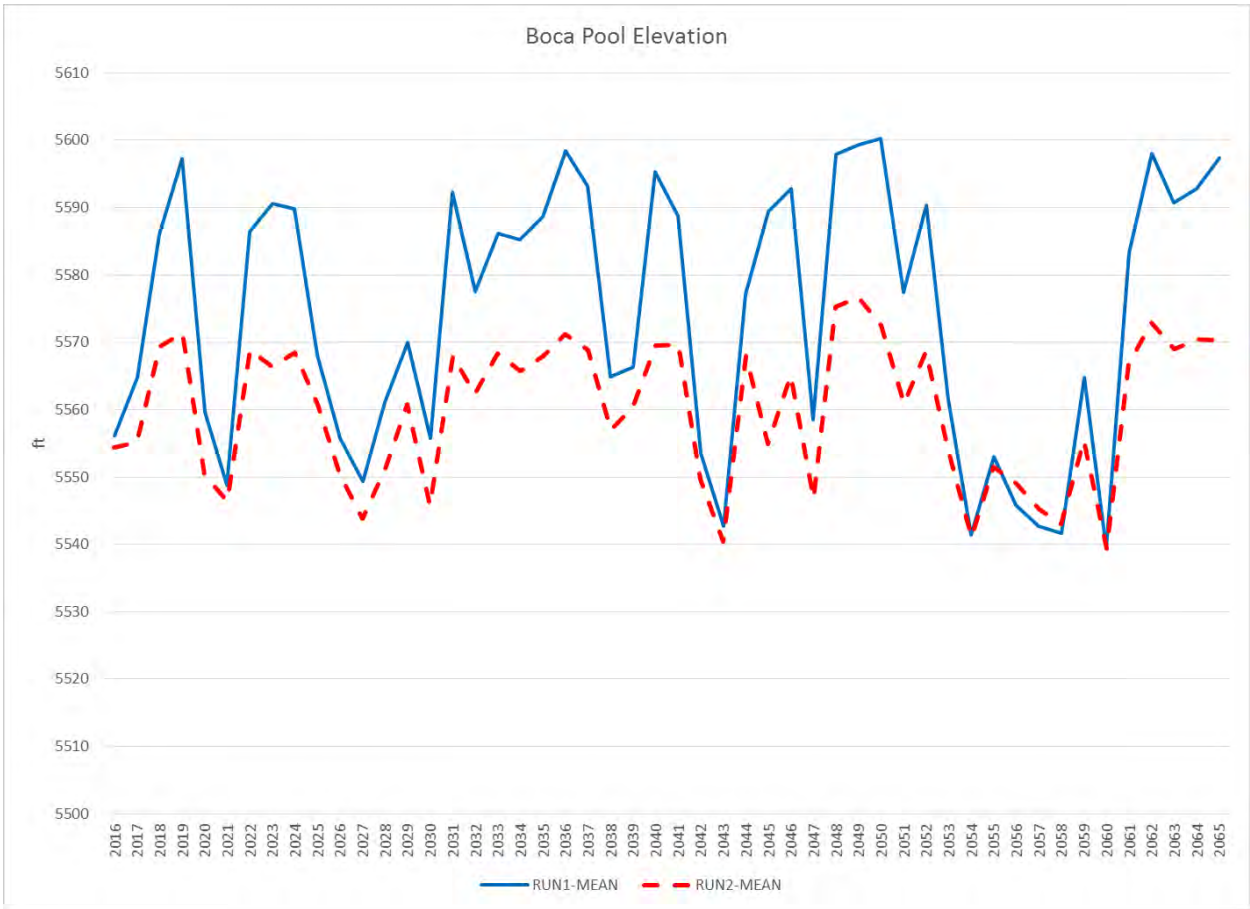


Figure 17: Annually averaged pool elevation in feet.

Table 12: Diversion to Truckee Meadows agriculture.

	Diversion to Truckee Meadows Agriculture		
	Baseline Magnitude (acre-feet)	**Future Magnitude (acre-feet)**	**Difference (Impact)**
Annual Maximum	19,734	19,734	0
Annual Minimum	2,649	2,649	0
Annual Average	13,092	12,860	-232

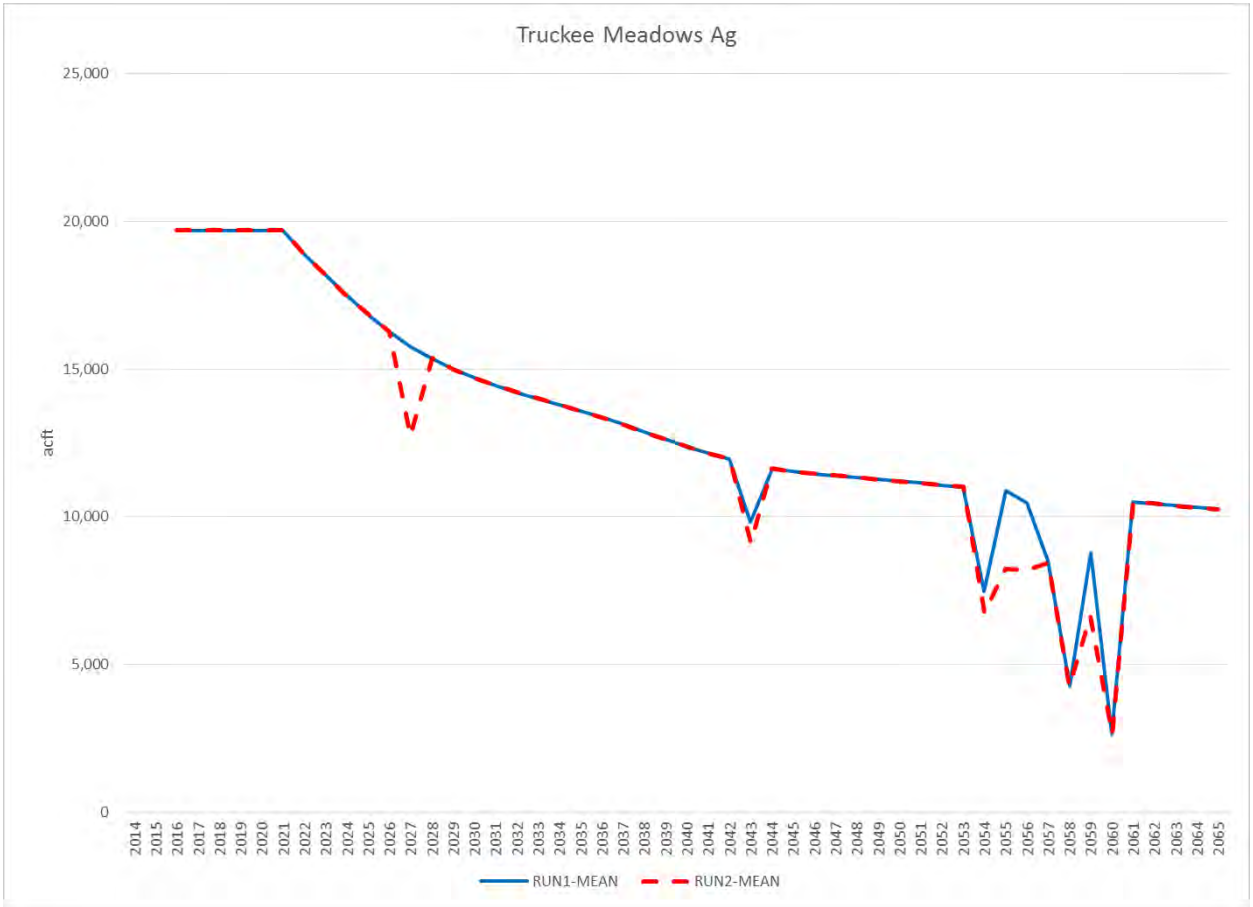


Figure 18: Diversion to Truckee Meadows agriculture.

Impact statistics were developed to assist in determining a finding of significance of impact. The statistics consider impacts to deliveries for a subset of the TROA parties and the Newlands Project as well as storage in the major upstream reservoirs.

Table 13: Impact Statistics for some water deliveries. **Note: positive impacts are decreases from the baseline to the limited, negative impacts are increases from the baseline to the limited.**

% Impact Statistics	Impact Statistics -- (Boca Baseline minus Boca Limited)/Baseline -- 603 Months of Data								
	FR Delivery	Flow at Nixon	TMWA Delivery	Truckee Canal Delivery	Truckee Meadows Ag Delivery	Tahoe Storage	Stampede Storage	Prosser Storage	Boca Storage
# of Zero Change Months	493	164	565	345	590	94	101	114	10
# Months less than -20%	0	45	0	4	0	0	21	4	28
# Months between -20% and 0%	10	175	14	106	0	43	228	217	39
# Months between 0% and 10%	77	193	24	130	2	388	202	237	39
# Months between 10% and 20%	11	17	0	3	1	47	51	25	45
# Months between 20% and 50%	7	9	0	4	1	28	0	6	230
# Months greater than 50%	5	0	0	11	9	3	0	0	212
Average % Impact	1.36%	-5.70%	0.07%	0.40%	1.35%	5.00%	-0.79%	0.82%	35.00%
Largest monthly average impact in a year	9.63%	109.36%	1.30%	20.85%	15.56%	31.19%	39.56%	10.06%	32.28%
Year of largest impact	2055	2056	2027	2056	2055	2027	2027	2058	2027
Increase or decrease	decrease	increase	decrease	decrease	decrease	decrease	increase	decrease	decrease
Range of increase magnitude below -%20 or largest increase (acft)	51 (-1.1%)	462 to 17,027 (34%)	94 (-0.9%)	2,056 to 3,832 (773%)	N/A	141 (-0.02%)	12,506 to 25,825	2,088 to 4,011	530 to 1,321
Range of decrease magnitude above %20 or largest decrease	5,412 to 17,189 (>50%)	2,736 to 20,010 (44%)	357 (8.9%)	41 to 11,723 (67%)	366 to 1,774	8,422 to 56,720	23,097 (18.4%)	1,685 to 3,757	713 to 25,152

The tables and figures presented above show any potential impact on an annual basis. During dry years, a presentation of monthly values would provide a better understanding of any such potential impact.
The results in Table *13* demonstrate that TMWA delivery is extremely robust against limiting Boca reservoir; only around 1% of months are affected by the limitation and the extent of the effect is under 10% impact.
Truckee Meadows also appears to be fairly robust; only 2% of months are affected by the limitation.
Floriston Rates deliveries are the still relatively robust with impacts over 10% observed in slightly over 3.6% of months. Most of the months impacted, 98 of 110, displayed moderate impacts between -20% and 20%.

Analysis was conducted on years designated as defined by TROA as drought years. This was done to observe potential impacts on water supply *when water is most needed*. The simulations with historical hydrology indicated nine years that were designated as drought, 2027, 2043, and seven consecutive years 2054 – 2060; these correspond to the historical hydrology from 1962, 1978, and 1989 – 1995.

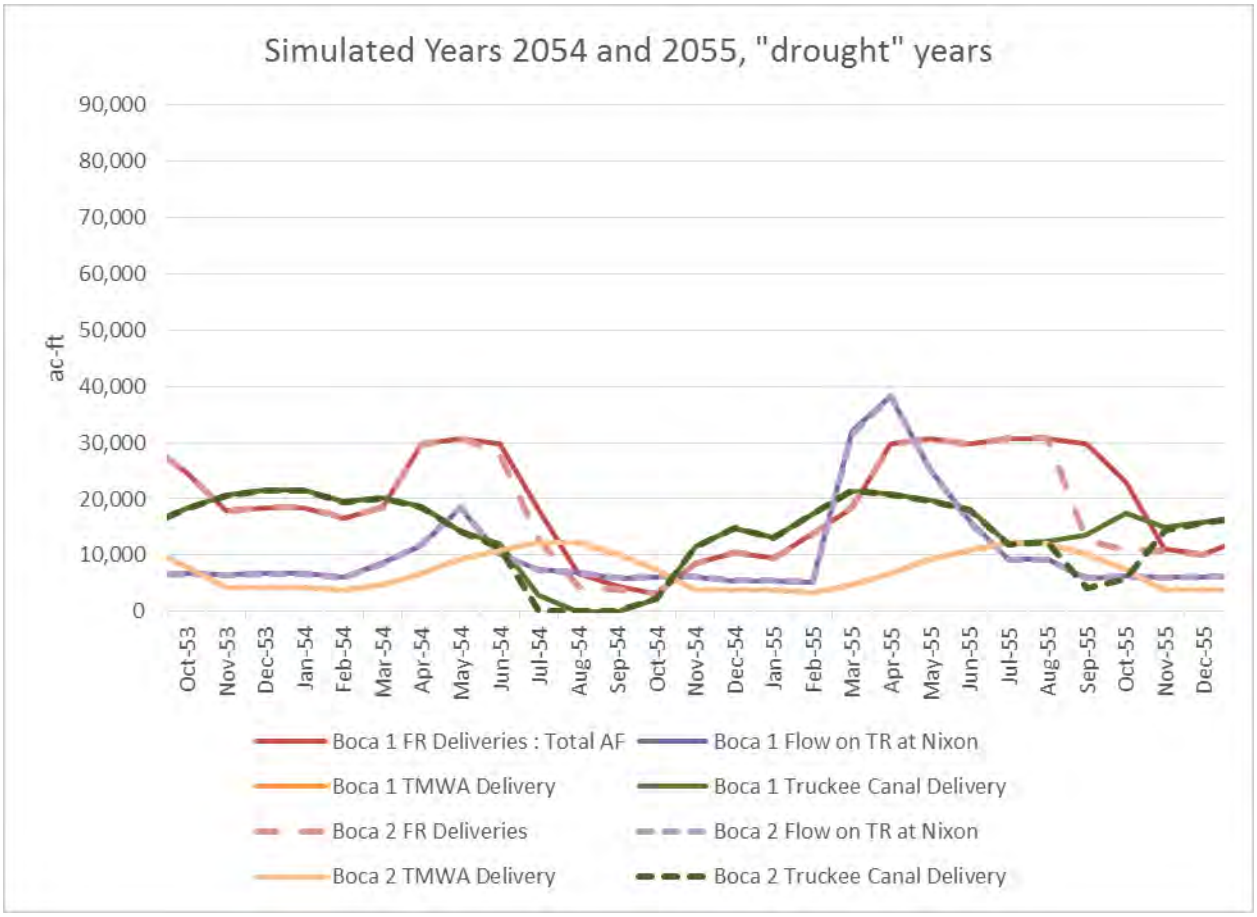


Figure 19: Comparison of the total Floriston Rates deliveries, flow at Nixon, deliveries to the Truckee Canal from the Truckee River, and TMWA deliveries for the drought years of 2054 and 2055 – corresponds to inflows from historical hydrology in 1989 and 1990.

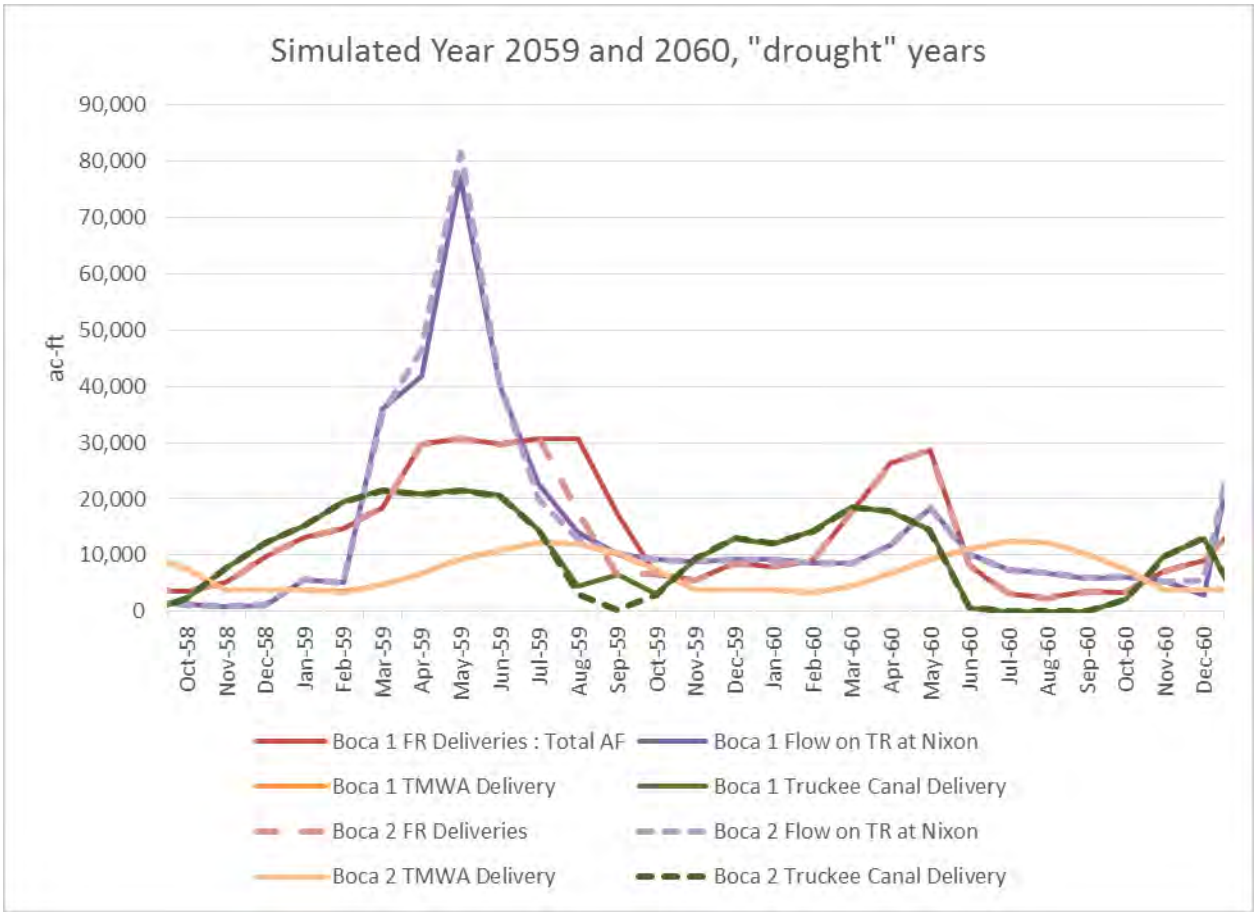


Figure 20 Comparison of the total Floriston Rates deliveries, flow at Nixon, deliveries to the Truckee Canal from the Truckee River, and TMWA deliveries for the drought years of 2059 and 2060 – corresponds to inflows from historical hydrology in 1994 and 1995.

Table 14 TMWA Annual Demands (ac-ft)

Demands	
Initial demand (acre-feet)	75,716
Build-out demand (acre-feet)	96,491

Table 15 Pyramid Lake Paiute Tribe M&I Demands (ac-ft)

Demands	
Initial demand (acre-feet)	0
Maximum demand (acre-feet)	16,377

Table 16 Pyramid Lake Paiute Tribe Agricultural Demands (ac-ft)

Demands	
Initial demand (acre-feet)	9,737
Build-out demand (acre-feet)	16,377

Table 17 PLPT Claims 1 & 2 Tribe In-Stream Water Use (ac-ft)

Demands	
Initial demand (acre-feet)	19,657
Build-out demand (acre-feet)	0

Table 18 PLPT Changed Ag Rights In-Stream Water Use (ac-ft)

Demands	
Initial demand (acre-feet)	3,950
Build-out demand (acre-feet)	3,950

Table 19 Washoe County In-Stream Demands (ac-ft)

Demands	
Initial demand (acre-feet)	2,693
Build-out demand (acre-feet)	2,693

Table 20 Farad to Derby Agricultural Demands (ac-ft)[2]

Demands	
Initial demand (acre-feet)	26,583
Build-out demand (acre-feet)	12,799

Table 9a Steamboat to Vista Agricultural Demands (ac-ft)

Demands	
Initial demand (acre-feet)	22,131
Build-out demand (acre-feet)	8,347

Table 9b Vista to Derby Agricultural Demands (ac-ft)

Demands	
Initial demand (acre-feet)	4,452
Build-out demand (acre-feet)	4,452

Table 21 Lower Truckee Agricultural Demands (Washburn and Gregory Ditches) (ac-ft)

Demands	
Initial demand (acre-feet)	509
Build-out demand (acre-feet)	509

Table 22 Lake Tahoe Basin Demands (ac-ft)

Demands	
Initial demand (acre-feet)	25,505
Build-out demand (acre-feet)	34,000

[2] Truckee Meadows agriculture, including Steamboat ditch, Highland ditch, Last Chance ditch, Cochran ditch, Orr ditch, the Hunter Creek diversion, Pioneer ditch, Noce ditch, Murphy ditch, McCarran ditch, Washburn ditch, and Gregory ditch.
It was assumed for modeling that some of the agricultural water rights in the Truckee Meadows area would be acquired by TMWA for managing future growth (email communication with TMWA in 2015)

Table 23 Newlands Project Demands (Acres unless otherwise specified)

		Initial demand (acres)	**Build-out demand (acres)**
Carson Division Rights			
Ag	Commercial and Noncommercial Farms	42,018	31,338
	Fallon Paiute-Shoshone Irrigated Lands	2,504	2,504
M&I	City of Fallon and Churchill County	766	766
Env	USFWS Water Rights	7,259	20,970
	Carson Lake and Pasture	2,244	2,244
	Fallon Paiute-Shoshone Tribal Wetlands	468	468
Carson Division Subtotal		55,260	58,290
Truckee Division Rights			
Ag	Commercial and Noncommercial Farms	907	1,451
M&I[2]	Lyon County	829	829
Truckee Division Subtotal		1,736	2,280
Newlands Project Total Acreage		**55,996**	**60,570**
Newlands Project Total MHE (acre-feet)		**198,963**	**207,402**

Table 24 City of Fernley Demands (ac-ft)

Demands	
Current demand (acre-feet)	4,040
Build-out demand (acre-feet)	16,450

Table 25 California Surface Water Demands (ac-ft)

Demands	
Initial demand (acre-feet)	10,937
Build-out demand (acre-feet)	32,000

Appendix C – CalEEMod Air Quality Model Report

Boca Dam Safety of Dams Modification Project

Nevada County, Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
User Defined Recreational	1.00	User Defined Unit	71.00	0.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	80
Climate Zone	14			**Operational Year**	2019
Utility Company					
CO2 Intensity (lb/MWhr)	0	**CH4 Intensity (lb/MWhr)**	0	**N2O Intensity (lb/MWhr)**	0

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - Total area of disturbance equals lot acreage.

Construction Phase - 12 month construction period. 7 months first season, 5 months second season. "Sheetpile" cutoff wall will be trenched and built with low strength concrete over 1 week in 2017 to assess 1 year prior to project construction.

Off-road Equipment - Backhoe used. HP values adjusted by project engineer. This phase includes spillway concrete and metalwork. Also includes asphaltic and concrete paving over dam, placement of concrete barriers, guard rail, and security gates.

Off-road Equipment - Other Const. Equip= Water Truck, street sweeper, hydroseeder used one at a time. Backhoe used. Generator power for outletworks during spillway modification

Off-road Equipment - Other Construction Equipment= Water Truck, street sweeper, hydroseeder used one at a time. Backhoe used. HP values adjusted by project engineer.

Off-road Equipment - Backhoe used. HP values adjusted by project engineer. Other Construction Equipment includes hydroseeding and hydromulch application truck.

Off-road Equipment - HP values adjusted by project engineer.

Off-road Equipment - Backhoe used. HP values adjusted by project engineer.
Off-road Equipment - Backhoe used. HP values adjusted by engineer.

Off-road Equipment - HP values adjusted by project engineer.

Off-road Equipment - Surfacing Equipment= Compactor. HP value adjusted by project engineer.

Off-road Equipment - Backhoe used. Surfacing Equipment= Compactor, with HP of 171.

Off-road Equipment - Surfacing Equipment= Compactor (171hp). HP values adjusted by project engineer.

Off-road Equipment - Other Material Handling Equipment= On-highway Haul Truck. Surfacing Equipment= Compator. HP values adjusted by project engineer.

Off-road Equipment - HP values adjusted by engineer.

Off-road Equipment - Other Material Handling Equipment=On-highway Haul Truck

Trips and VMT - ~20 workers for mixer trucks. Assume avg. 18 workers/day, 60 miles roundtrip. Trip is a truck loop. Est. provided by engineer. Assumes worse case that workers commute from outlying areas. Personnel est. based on Reclamation and contractor workers onsite.

On-road Fugitive Dust - Vendor and worker roads will be mostly paved, but will require pulling off onto unpaved areas to park. Stampede Meadows Road, the primary haul route, is paved. The remaining haul routes will not be paved.

Grading - Material imported/exported is on-site but from 1-4 miles from destinations.

Vechicle Emission Factors - No operational emissions from this project.

Vechicle Emission Factors -

Vechicle Emission Factors - No operational emissions from this project.

Construction Off-road Equipment Mitigation - Tier 2 equipment or newer will be required of the contractor. Street sweeper will work on Stampede Meadows Road at trackout spots. Use soil stabilizer. Replace ground cover. Water exposed area. Reduce vehicle speed. Clean paved roads.

Off-road Equipment - Trench excavated 200' long, 10-15' deep, 3' wide. Spoils temporarily placed east side of trench. Backfill trench half of depth with low strength concrete, using 20 mixer trucks. Remaining top half backfilled with spoils, and regraded.

Table Name	Column Name	Default Value	New Value
tblConstDustMitigation	CleanPavedRoadPercentReduction	0	75
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2

tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstEquipMitigation	Tier	No Change	Tier 2
tblConstructionPhase	NumDays	1,110.00	92.00
tblConstructionPhase	NumDays	110.00	61.00
tblConstructionPhase	NumDays	110.00	30.00
tblConstructionPhase	NumDays	110.00	32.00
tblConstructionPhase	NumDays	110.00	32.00
tblConstructionPhase	NumDays	110.00	53.00
tblConstructionPhase	NumDays	110.00	24.00
tblConstructionPhase	NumDays	75.00	61.00
tblConstructionPhase	NumDays	75.00	30.00
tblConstructionPhase	NumDays	40.00	230.00
tblConstructionPhase	NumDays	40.00	122.00
tblConstructionPhase	NumDays	40.00	122.00
tblConstructionPhase	NumDays	40.00	17.00
tblConstructionPhase	NumDays	40.00	15.00
tblConstructionPhase	NumDaysWeek	5.00	7.00
tblConstructionPhase	NumDaysWeek	5.00	7.00
tblConstructionPhase	NumDaysWeek	5.00	7.00

tblConstructionPhase	NumDaysWeek	5.00	7.00
tblConstructionPhase	NumDaysWeek	5.00	7.00
tblConstructionPhase	NumDaysWeek	5.00	7.00
tblConstructionPhase	NumDaysWeek	5.00	7.00
tblConstructionPhase	NumDaysWeek	5.00	7.00
tblConstructionPhase	NumDaysWeek	5.00	7.00
tblConstructionPhase	NumDaysWeek	5.00	7.00
tblConstructionPhase	NumDaysWeek	5.00	7.00
tblConstructionPhase	NumDaysWeek	5.00	7.00
tblConstructionPhase	NumDaysWeek	5.00	7.00
tblConstructionPhase	NumDaysWeek	5.00	7.00
tblConstructionPhase	PhaseEndDate	10/15/2018	9/30/2018
tblConstructionPhase	PhaseEndDate	12/1/2018	11/30/2018
tblConstructionPhase	PhaseEndDate	8/29/2019	8/30/2019
tblConstructionPhase	PhaseEndDate	6/16/2018	6/15/2018
tblConstructionPhase	PhaseEndDate	11/1/2018	8/15/2018
tblConstructionPhase	PhaseEndDate	10/7/2018	10/30/2018
tblConstructionPhase	PhaseEndDate	11/23/2018	10/1/2018
tblConstructionPhase	PhaseEndDate	10/30/2019	6/30/2019
tblConstructionPhase	PhaseEndDate	1/25/2018	11/30/2018
tblConstructionPhase	PhaseEndDate	4/1/2019	8/30/2019
tblConstructionPhase	PhaseEndDate	4/1/2019	5/15/2018
tblConstructionPhase	PhaseEndDate	7/2/2018	7/1/2018
tblConstructionPhase	PhaseEndDate	7/16/2018	7/15/2018
tblConstructionPhase	PhaseStartDate	7/16/2018	7/1/2018
tblConstructionPhase	PhaseStartDate	10/2/2018	10/1/2018
tblConstructionPhase	PhaseStartDate	7/31/2019	8/1/2019
tblConstructionPhase	PhaseStartDate	5/16/2018	5/15/2018

tblConstructionPhase	PhaseStartDate	10/1/2018	7/15/2018
tblConstructionPhase	PhaseStartDate	8/16/2018	9/8/2018
tblConstructionPhase	PhaseStartDate	10/31/2018	9/8/2018
tblConstructionPhase	PhaseStartDate	8/31/2019	5/1/2019
tblConstructionPhase	PhaseStartDate	6/10/2017	4/15/2018
tblConstructionPhase	PhaseStartDate	12/1/2018	5/1/2019
tblConstructionPhase	PhaseStartDate	12/1/2018	5/1/2018
tblConstructionPhase	PhaseStartDate	6/16/2018	6/15/2018
tblConstructionPhase	PhaseStartDate	7/2/2018	7/1/2018
tblGrading	AcresOfGrading	167.75	0.00
tblGrading	AcresOfGrading	75.00	0.00
tblGrading	AcresOfGrading	80.00	5.00
tblGrading	AcresOfGrading	20.00	2.00
tblGrading	AcresOfGrading	39.75	30.00
tblGrading	AcresOfGrading	66.00	2.00
tblGrading	AcresOfGrading	57.50	0.00
tblGrading	AcresOfGrading	30.50	0.00
tblGrading	AcresOfGrading	61.00	0.00
tblGrading	MaterialImported	0.00	80,000.00
tblGrading	MaterialImported	0.00	54,000.00
tblGrading	MaterialImported	0.00	102,000.00
tblGrading	MaterialImported	0.00	54,000.00
tblGrading	MeanVehicleSpeed	7.10	25.00
tblLandUse	LotAcreage	0.00	71.00
tblOffRoadEquipment	HorsePower	84.00	50.00
tblOffRoadEquipment	HorsePower	174.00	97.00
tblOffRoadEquipment	HorsePower	174.00	97.00
tblOffRoadEquipment	HorsePower	174.00	97.00

tblOffRoadEquipment	HorsePower	174.00	97.00
tblOffRoadEquipment	HorsePower	174.00	97.00
tblOffRoadEquipment	HorsePower	16.00	171.00
tblOffRoadEquipment	HorsePower	84.00	42.00
tblOffRoadEquipment	HorsePower	84.00	50.00
tblOffRoadEquipment	HorsePower	84.00	50.00
tblOffRoadEquipment	HorsePower	84.00	50.00
tblOffRoadEquipment	HorsePower	84.00	50.00
tblOffRoadEquipment	HorsePower	84.00	50.00
tblOffRoadEquipment	HorsePower	84.00	50.00
tblOffRoadEquipment	HorsePower	84.00	50.00
tblOffRoadEquipment	HorsePower	84.00	50.00
tblOffRoadEquipment	HorsePower	84.00	50.00
tblOffRoadEquipment	HorsePower	174.00	97.00
tblOffRoadEquipment	HorsePower	174.00	97.00
tblOffRoadEquipment	HorsePower	174.00	97.00
tblOffRoadEquipment	HorsePower	400.00	350.00
tblOffRoadEquipment	HorsePower	400.00	350.00
tblOffRoadEquipment	HorsePower	171.00	165.00
tblOffRoadEquipment	HorsePower	171.00	165.00
tblOffRoadEquipment	HorsePower	171.00	97.00
tblOffRoadEquipment	HorsePower	167.00	171.00
tblOffRoadEquipment	HorsePower	167.00	171.00
tblOffRoadEquipment	HorsePower	253.00	171.00
tblOffRoadEquipment	HorsePower	253.00	171.00
tblOffRoadEquipment	HorsePower	253.00	171.00
tblOffRoadEquipment	HorsePower	253.00	171.00
tblOffRoadEquipment	OffRoadEquipmentType		Excavators

tblOffRoadEquipment	OffRoadEquipmentType		Cement and Mortar Mixers
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	1.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	1.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	1.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	1.00	2.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	1.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	3.00	1.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	1.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	2.00	0.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	4.00	1.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	4.00	1.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	4.00	1.00
tblOffRoadEquipment	OffRoadEquipmentUnitAmount	4.00	1.00
tblOffRoadEquipment	UsageHours	8.00	10.00
tblOffRoadEquipment	UsageHours	8.00	10.00
tblOffRoadEquipment	UsageHours	8.00	12.00
tblOffRoadEquipment	UsageHours	8.00	12.00
tblOffRoadEquipment	UsageHours	8.00	12.00
tblOffRoadEquipment	UsageHours	8.00	10.00
tblOffRoadEquipment	UsageHours	8.00	12.00
tblOffRoadEquipment	UsageHours	8.00	12.00
tblOffRoadEquipment	UsageHours	8.00	12.00
tblOffRoadEquipment	UsageHours	8.00	10.00
tblOffRoadEquipment	UsageHours	8.00	12.00

tblOffRoadEquipment	UsageHours	8.00	12.00
tblOffRoadEquipment	UsageHours	7.00	12.00
tblOffRoadEquipment	UsageHours	8.00	4.00
tblOffRoadEquipment	UsageHours	8.00	4.00
tblOffRoadEquipment	UsageHours	8.00	10.00
tblOffRoadEquipment	UsageHours	8.00	5.00
tblOnRoadDust	HaulingPercentPave	100.00	70.00
tblOnRoadDust	HaulingPercentPave	100.00	70.00
tblOnRoadDust	HaulingPercentPave	100.00	70.00
tblOnRoadDust	HaulingPercentPave	100.00	70.00
tblOnRoadDust	HaulingPercentPave	100.00	70.00
tblOnRoadDust	HaulingPercentPave	100.00	70.00
tblOnRoadDust	HaulingPercentPave	100.00	70.00
tblOnRoadDust	HaulingPercentPave	100.00	70.00
tblOnRoadDust	HaulingPercentPave	100.00	70.00
tblOnRoadDust	HaulingPercentPave	100.00	70.00
tblOnRoadDust	HaulingPercentPave	100.00	70.00
tblOnRoadDust	HaulingPercentPave	100.00	70.00
tblOnRoadDust	HaulingPercentPave	100.00	70.00
tblOnRoadDust	HaulingPercentPave	100.00	70.00
tblOnRoadDust	HaulingPercentPave	100.00	70.00
tblOnRoadDust	VendorPercentPave	100.00	95.00
tblOnRoadDust	VendorPercentPave	100.00	95.00
tblOnRoadDust	VendorPercentPave	100.00	95.00
tblOnRoadDust	VendorPercentPave	100.00	95.00
tblOnRoadDust	VendorPercentPave	100.00	95.00
tblOnRoadDust	VendorPercentPave	100.00	95.00
tblOnRoadDust	VendorPercentPave	100.00	95.00

tblOnRoadDust	VendorPercentPave	100.00	95.00
tblOnRoadDust	VendorPercentPave	100.00	95.00
tblOnRoadDust	VendorPercentPave	100.00	95.00
tblOnRoadDust	VendorPercentPave	100.00	95.00
tblOnRoadDust	VendorPercentPave	100.00	95.00
tblOnRoadDust	VendorPercentPave	100.00	95.00
tblOnRoadDust	VendorPercentPave	100.00	95.00
tblOnRoadDust	VendorPercentPave	100.00	95.00
tblOnRoadDust	WorkerPercentPave	100.00	95.00
tblOnRoadDust	WorkerPercentPave	100.00	95.00
tblOnRoadDust	WorkerPercentPave	100.00	95.00
tblOnRoadDust	WorkerPercentPave	100.00	95.00
tblOnRoadDust	WorkerPercentPave	100.00	95.00
tblOnRoadDust	WorkerPercentPave	100.00	95.00
tblOnRoadDust	WorkerPercentPave	100.00	95.00
tblOnRoadDust	WorkerPercentPave	100.00	95.00
tblOnRoadDust	WorkerPercentPave	100.00	95.00
tblOnRoadDust	WorkerPercentPave	100.00	95.00
tblOnRoadDust	WorkerPercentPave	100.00	95.00
tblOnRoadDust	WorkerPercentPave	100.00	95.00
tblOnRoadDust	WorkerPercentPave	100.00	95.00
tblOnRoadDust	WorkerPercentPave	100.00	95.00
tblProjectCharacteristics	OperationalYear	2014	2019
tblTripsAndVMT	HaulingTripLength	20.00	0.00
tblTripsAndVMT	HaulingTripLength	20.00	0.00
tblTripsAndVMT	HaulingTripLength	20.00	0.00
tblTripsAndVMT	HaulingTripLength	20.00	0.00

tblTripsAndVMT	HaulingTripLength	20.00	0.00
tblTripsAndVMT	HaulingTripLength	20.00	0.00
tblTripsAndVMT	HaulingTripLength	20.00	0.00
tblTripsAndVMT	HaulingTripLength	20.00	0.00
tblTripsAndVMT	HaulingTripLength	20.00	0.00
tblTripsAndVMT	HaulingTripLength	20.00	0.00
tblTripsAndVMT	HaulingTripLength	20.00	0.00
tblTripsAndVMT	HaulingTripLength	20.00	0.00
tblTripsAndVMT	HaulingTripLength	20.00	0.00
tblTripsAndVMT	HaulingTripLength	20.00	0.00
tblTripsAndVMT	HaulingTripLength	20.00	0.00
tblTripsAndVMT	HaulingTripNumber	10,000.00	0.00
tblTripsAndVMT	HaulingTripNumber	6,750.00	0.00
tblTripsAndVMT	HaulingTripNumber	12,750.00	0.00
tblTripsAndVMT	HaulingTripNumber	6,750.00	0.00
tblTripsAndVMT	VendorTripLength	7.30	0.00
tblTripsAndVMT	VendorTripLength	7.30	70.00
tblTripsAndVMT	VendorTripLength	7.30	0.00
tblTripsAndVMT	VendorTripLength	7.30	50.00
tblTripsAndVMT	VendorTripLength	7.30	50.00
tblTripsAndVMT	VendorTripLength	7.30	0.00
tblTripsAndVMT	VendorTripLength	7.30	0.00
tblTripsAndVMT	VendorTripLength	7.30	0.00
tblTripsAndVMT	VendorTripLength	7.30	50.00
tblTripsAndVMT	VendorTripLength	7.30	0.00
tblTripsAndVMT	VendorTripLength	7.30	50.00
tblTripsAndVMT	VendorTripLength	7.30	0.00
tblTripsAndVMT	VendorTripLength	7.30	0.00

tblTripsAndVMT	VendorTripLength	7.30	0.00
tblTripsAndVMT	VendorTripLength	7.30	50.00
tblTripsAndVMT	VendorTripNumber	0.00	39.00
tblTripsAndVMT	VendorTripNumber	0.00	2.00
tblTripsAndVMT	VendorTripNumber	0.00	5.00
tblTripsAndVMT	VendorTripNumber	0.00	2.00
tblTripsAndVMT	VendorTripNumber	0.00	1.00
tblTripsAndVMT	VendorTripNumber	0.00	1.00
tblTripsAndVMT	WorkerTripLength	10.80	60.00
tblTripsAndVMT	WorkerTripLength	10.80	0.00
tblTripsAndVMT	WorkerTripLength	10.80	60.00
tblTripsAndVMT	WorkerTripLength	10.80	0.00
tblTripsAndVMT	WorkerTripLength	10.80	0.00
tblTripsAndVMT	WorkerTripLength	10.80	0.00
tblTripsAndVMT	WorkerTripLength	10.80	0.00
tblTripsAndVMT	WorkerTripLength	10.80	0.00
tblTripsAndVMT	WorkerTripLength	10.80	0.00
tblTripsAndVMT	WorkerTripLength	10.80	0.00
tblTripsAndVMT	WorkerTripLength	10.80	0.00
tblTripsAndVMT	WorkerTripLength	10.80	0.00
tblTripsAndVMT	WorkerTripLength	10.80	0.00
tblTripsAndVMT	WorkerTripLength	10.80	0.00
tblTripsAndVMT	WorkerTripLength	10.80	60.00
tblTripsAndVMT	WorkerTripNumber	28.00	0.00
tblTripsAndVMT	WorkerTripNumber	15.00	18.00
tblTripsAndVMT	WorkerTripNumber	25.00	0.00
tblTripsAndVMT	WorkerTripNumber	25.00	0.00
tblTripsAndVMT	WorkerTripNumber	23.00	0.00

tblTripsAndVMT	WorkerTripNumber	20.00	0.00
tblTripsAndVMT	WorkerTripNumber	30.00	0.00
tblTripsAndVMT	WorkerTripNumber	20.00	0.00
tblTripsAndVMT	WorkerTripNumber	20.00	0.00
tblTripsAndVMT	WorkerTripNumber	25.00	0.00
tblTripsAndVMT	WorkerTripNumber	38.00	0.00
tblTripsAndVMT	WorkerTripNumber	28.00	0.00
tblTripsAndVMT	WorkerTripNumber	53.00	22.00

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2017	4.4500e-003	0.0312	0.0368	8.0000e-005	0.1992	1.2700e-003	0.2005	0.0203	1.2300e-003	0.0215	0.0000	5.8140	5.8140	7.2000e-004	0.0000	5.8290
2018	1.7629	16.9754	12.7377	0.0201	16.0911	0.8299	16.9209	3.2799	0.7708	4.0506	0.0000	1,762.9491	1,762.9491	0.4280	0.0000	1,771.9378
2019	0.4760	4.7272	4.0047	5.7600e-003	5.4199	0.2375	5.6574	1.0860	0.2195	1.3055	0.0000	497.4703	497.4703	0.1361	0.0000	500.3284
Total	**2.2434**	**21.7339**	**16.7791**	**0.0260**	**21.7102**	**1.0686**	**22.7788**	**4.3861**	**0.9915**	**5.3776**	**0.0000**	**2,266.2333**	**2,266.2333**	**0.5649**	**0.0000**	**2,278.0953**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2017	4.4500e-003	0.0312	0.0368	8.0000e-005	0.0129	1.2700e-003	0.0142	1.4700e-003	1.2300e-003	2.6900e-003	0.0000	5.8140	5.8140	7.2000e-004	0.0000	5.8290
2018	1.7629	16.9754	12.7376	0.0201	0.9556	0.8299	1.7854	0.1740	0.7708	0.9448	0.0000	1,762.9473	1,762.9473	0.4280	0.0000	1,771.9361
2019	0.4760	4.7272	4.0047	5.7600e-003	0.3212	0.2375	0.5587	0.0569	0.2195	0.2765	0.0000	497.4698	497.4698	0.1361	0.0000	500.3279
Total	**2.2434**	**21.7338**	**16.7791**	**0.0260**	**1.2897**	**1.0686**	**2.3582**	**0.2324**	**0.9915**	**1.2239**	**0.0000**	**2,266.2311**	**2,266.2311**	**0.5649**	**0.0000**	**2,278.0930**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**94.06**	**0.00**	**89.65**	**94.70**	**0.00**	**77.24**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

2.2 Overall Operational

Unmitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	0.0000	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Waste						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Water						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**1.0000e-005**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**2.0000e-005**	**2.0000e-005**	**0.0000**	**0.0000**	**2.0000e-005**

2.2 Overall Operational

Mitigated Operational

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Area	0.0000	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Energy	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Mobile	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Waste						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Water						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**1.0000e-005**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**2.0000e-005**	**2.0000e-005**	**0.0000**	**0.0000**	**2.0000e-005**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

3.0 Construction Detail

Construction Phase

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Cutoff Wall Trench and Construction	Trenching	6/5/2017	6/9/2017	5	5	
2	Detour Road Maint/Dust Abatement/SWPPP Work - Season #1	Site Preparation	4/15/2018	11/30/2018	7	230	
3	Vegetation Clearing	Site Preparation	5/1/2018	5/15/2018	7	122	
4	Strip Rockfill	Grading	5/15/2018	6/15/2018	7	32	
5	Shearkey Dewatering	Site Preparation	6/15/2018	7/1/2018	7	17	
6	Run Dewatering	Site Preparation	7/1/2018	7/15/2018	7	15	
7	Spillway Modification Work	Building Construction	7/1/2018	9/30/2018	7	92	
8	Shearkey Excavation / Toe Drains	Grading	7/15/2018	8/15/2018	7	32	
9	IRBA Excavation/Hauling	Grading	9/8/2018	10/30/2018	7	53	
10	Shearkey Fill	Grading	9/8/2018	10/1/2018	7	24	
11	Stability Berm at Dam and Dike	Grading	10/1/2018	11/30/2018	7	61	
12	Detour Road Maint/Dust Abatement/SWPPP Work - Season #2	Site Preparation	5/1/2019	8/30/2019	7	122	
13	Concrete Paving and Barriers over Dam Road	Paving	5/1/2019	6/30/2019	7	61	
14	Stampede Dam Meadows Road Paving	Paving	7/1/2019	7/30/2019	7	30	
15	Final Stabilization / Restoration	Grading	8/1/2019	8/30/2019	7	30	

Acres of Grading (Site Preparation Phase): 0

Acres of Grading (Grading Phase): 0

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 0; Non-Residential Outdoor: 0 (Architectural Coating – sqft)

OffRoad Equipment

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Detour Road Maint/Dust Abatement/SWPPP Work - Season #1	Generator Sets	1	24.00	42	0.74

Detour Road Maint/Dust Abatement/SWPPP Work - Season #1	Graders	1	4.00	97	0.41
Detour Road Maint/Dust Abatement/SWPPP Work - Season #1	Other Construction Equipment	1	8.00	165	0.42
Detour Road Maint/Dust Abatement/SWPPP Work - Season #1	Rubber Tired Dozers	3	8.00	255	0.40
Detour Road Maint/Dust Abatement/SWPPP Work - Season #1	Tractors/Loaders/Backhoes	1	4.00	97	0.37
Vegetation Clearing	Graders	1	8.00	97	0.41
Vegetation Clearing	Other Material Handling Equipment	2	8.00	171	0.40
Vegetation Clearing	Rubber Tired Dozers	1	8.00	255	0.40
Vegetation Clearing	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Strip Rockfill	Excavators	1	10.00	162	0.38
Strip Rockfill	Generator Sets	1	10.00	50	0.74
Strip Rockfill	Graders	1	8.00	174	0.41
Strip Rockfill	Off-Highway Trucks	4	10.00	350	0.38
Strip Rockfill	Rubber Tired Dozers	1	8.00	255	0.40
Strip Rockfill	Scrapers	2	8.00	361	0.48
Strip Rockfill	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Shearkey Dewatering	Excavators	1	10.00	162	0.38
Shearkey Dewatering	Generator Sets	3	10.00	50	0.74
Shearkey Dewatering	Rubber Tired Dozers	3	8.00	255	0.40
Shearkey Dewatering	Tractors/Loaders/Backhoes	1	10.00	97	0.37
Run Dewatering	Excavators	1	5.00	162	0.38
Run Dewatering	Generator Sets	3	10.00	50	0.74
Run Dewatering	Rubber Tired Dozers	3	8.00	255	0.40
Run Dewatering	Tractors/Loaders/Backhoes	1	5.00	97	0.37
Spillway Modification Work	Cranes	1	7.00	226	0.29
Spillway Modification Work	Excavators	1	12.00	162	0.38
Spillway Modification Work	Forklifts	3	8.00	89	0.20
Spillway Modification Work	Generator Sets	1	12.00	50	0.74

Spillway Modification Work	Surfacing Equipment	1	3.00	171	0.30
Spillway Modification Work	Tractors/Loaders/Backhoes	1	12.00	97	0.37
Spillway Modification Work	Welders	1	8.00	46	0.45
Shearkey Excavation / Toe Drains	Excavators	1	10.00	162	0.38
Shearkey Excavation / Toe Drains	Generator Sets	1	10.00	50	0.74
Shearkey Excavation / Toe Drains	Graders	1	10.00	97	0.41
Shearkey Excavation / Toe Drains	Off-Highway Trucks	5	10.00	350	0.38
Shearkey Excavation / Toe Drains	Rubber Tired Dozers	2	10.00	255	0.40
Shearkey Excavation / Toe Drains	Scrapers	0	8.00	361	0.48
Shearkey Excavation / Toe Drains	Tractors/Loaders/Backhoes	0	8.00	97	0.37
IRBA Excavation/Hauling	Dumpers/Tenders	11	12.00	171	0.38
IRBA Excavation/Hauling	Excavators	1	12.00	162	0.38
IRBA Excavation/Hauling	Graders	1	12.00	97	0.41
IRBA Excavation/Hauling	Rubber Tired Dozers	2	12.00	255	0.40
IRBA Excavation/Hauling	Scrapers	0	8.00	361	0.48
IRBA Excavation/Hauling	Tractors/Loaders/Backhoes	0	8.00	97	0.37
Shearkey Fill	Excavators	2	8.00	162	0.38
Shearkey Fill	Generator Sets	1	12.00	50	0.74
Shearkey Fill	Graders	1	12.00	97	0.41
Shearkey Fill	Rubber Tired Dozers	1	12.00	255	0.40
Shearkey Fill	Scrapers	2	8.00	361	0.48
Shearkey Fill	Surfacing Equipment	2	12.00	171	0.30
Shearkey Fill	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Stability Berm at Dam and Dike	Excavators	2	8.00	162	0.38
Stability Berm at Dam and Dike	Generator Sets	1	12.00	50	0.74
Stability Berm at Dam and Dike	Graders	1	12.00	97	0.41
Stability Berm at Dam and Dike	Rubber Tired Dozers	1	12.00	255	0.40
Stability Berm at Dam and Dike	Scrapers	2	8.00	361	0.48

Stability Berm at Dam and Dike	Surfacing Equipment	2	12.00	171	0.30
Stability Berm at Dam and Dike	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Detour Road Maint/Dust Abatement/SWPPP Work - Season #2	Graders	1	4.00	97	0.41
Detour Road Maint/Dust Abatement/SWPPP Work - Season #2	Other Construction Equipment	1	8.00	165	0.42
Detour Road Maint/Dust Abatement/SWPPP Work - Season #2	Rubber Tired Dozers	3	8.00	255	0.40
Detour Road Maint/Dust Abatement/SWPPP Work - Season #2	Tractors/Loaders/Backhoes	1	4.00	97	0.37
Concrete Paving and Barriers over Dam Road	Excavators	1	8.00	162	0.38
Concrete Paving and Barriers over Dam Road	Generator Sets	2	8.00	50	0.74
Concrete Paving and Barriers over Dam Road	Pavers	2	8.00	125	0.42
Concrete Paving and Barriers over Dam Road	Paving Equipment	2	8.00	130	0.36
Concrete Paving and Barriers over Dam Road	Rollers	2	8.00	80	0.38
Concrete Paving and Barriers over Dam Road	Tractors/Loaders/Backhoes	1	8.00	97	0.37
Stampede Dam Meadows Road Paving	Generator Sets	1	8.00	50	0.74
Stampede Dam Meadows Road Paving	Other Material Handling Equipment	2	8.00	171	0.40
Stampede Dam Meadows Road Paving	Pavers	2	8.00	125	0.42
Stampede Dam Meadows Road Paving	Paving Equipment	2	8.00	130	0.36
Stampede Dam Meadows Road Paving	Rollers	2	8.00	80	0.38
Stampede Dam Meadows Road Paving	Surfacing Equipment	1	8.00	171	0.30
Final Stabilization / Restoration	Excavators	2	8.00	162	0.38
Final Stabilization / Restoration	Generator Sets	1	8.00	50	0.74
Final Stabilization / Restoration	Graders	1	8.00	97	0.41
Final Stabilization / Restoration	Other Construction Equipment	1	8.00	97	0.42
Final Stabilization / Restoration	Rubber Tired Dozers	1	8.00	255	0.40
Final Stabilization / Restoration	Scrapers	2	8.00	361	0.48
Final Stabilization / Restoration	Tractors/Loaders/Backhoes	1	8.00	97	0.37
Cutoff Wall Trench and Construction	Excavators	1	8.00	162	0.38

Cutoff Wall Trench and Construction	Cement and Mortar Mixers	20	8.00	9	0.56

Trips and VMT

Phase Name	Offroad Equipment Count	Worker Trip Number	Vendor Trip Number	Hauling Trip Number	Worker Trip Length	Vendor Trip Length	Hauling Trip Length	Worker Vehicle Class	Vendor Vehicle Class	Hauling Vehicle Class
Detour Road Maint/Dust Abatement	7	18.00	0.00	0.00	60.00	0.00	0.00	LD_Mix	HDT_Mix	HHDT
Vegetation Clearing	8	0.00	0.00	0.00	0.00	0.00	0.00	LD_Mix	HDT_Mix	HHDT
Strip Rockfill	12	0.00	0.00	0.00	0.00	0.00	0.00	LD_Mix	HDT_Mix	HHDT
Shearkey Dewatering	8	0.00	2.00	0.00	0.00	50.00	0.00	LD_Mix	HDT_Mix	HHDT
Run Dewatering	8	0.00	0.00	0.00	0.00	0.00	0.00	LD_Mix	HDT_Mix	HHDT
Spillway Modification Work	9	0.00	1.00	0.00	0.00	50.00	0.00	LD_Mix	HDT_Mix	HHDT
Shearkey Excavation / Toe Drains	10	0.00	0.00	0.00	0.00	0.00	0.00	LD_Mix	HDT_Mix	HHDT
IRBA Excavation/Hauling	15	0.00	0.00	0.00	0.00	0.00	0.00	LD_Mix	HDT_Mix	HHDT
Shearkey Fill	11	0.00	0.00	0.00	0.00	0.00	0.00	LD_Mix	HDT_Mix	HHDT
Stability Berm at Dam and Dike	11	0.00	39.00	0.00	0.00	70.00	0.00	LD_Mix	HDT_Mix	HHDT
Detour Road Maint/Dust Abatement	6	18.00	0.00	0.00	60.00	0.00	0.00	LD_Mix	HDT_Mix	HHDT
Concrete Paving and Barriers over Dam Ro	10	0.00	2.00	0.00	0.00	50.00	0.00	LD_Mix	HDT_Mix	HHDT
Stampede Dam Meadows Road Pavin	10	0.00	5.00	0.00	0.00	50.00	0.00	LD_Mix	HDT_Mix	HHDT
Final Stabilization / Restoration	9	0.00	0.00	0.00	0.00	0.00	0.00	LD_Mix	HDT_Mix	HHDT
Cutoff Wall Trench and Construction	21	22.00	1.00	0.00	60.00	50.00	0.00	LD_Mix	HDT_Mix	HHDT

3.1 Mitigation Measures Construction

Use Cleaner Engines for Construction Equipment

Use Soil Stabilizer

Replace Ground Cover

Water Exposed Area

Reduce Vehicle Speed on Unpaved Roads

Clean Paved Roads

3.2 Cutoff Wall Trench and Construction - 2017

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	3.8400e-003	0.0285	0.0240	5.0000e-005		1.2300e-003	1.2300e-003		1.1900e-003	1.1900e-003	0.0000	3.5189	3.5189	6.1000e-004	0.0000	3.5318
Total	**3.8400e-003**	**0.0285**	**0.0240**	**5.0000e-005**		**1.2300e-003**	**1.2300e-003**		**1.1900e-003**	**1.1900e-003**	**0.0000**	**3.5189**	**3.5189**	**6.1000e-004**	**0.0000**	**3.5318**

3.2 Cutoff Wall Trench and Construction - 2017

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	9.0000e-005	1.2800e-003	7.7000e-004	0.0000	7.2900e-003	2.0000e-005	7.3100e-003	7.5000e-004	2.0000e-005	7.7000e-004	0.0000	0.3450	0.3450	0.0000	0.0000	0.3450
Worker	5.1000e-004	1.4400e-003	0.0121	3.0000e-005	0.1919	2.0000e-005	0.1919	0.0195	2.0000e-005	0.0196	0.0000	1.9501	1.9501	1.0000e-004	0.0000	1.9522
Total	**6.0000e-004**	**2.7200e-003**	**0.0128**	**3.0000e-005**	**0.1992**	**4.0000e-005**	**0.1992**	**0.0203**	**4.0000e-005**	**0.0203**	**0.0000**	**2.2950**	**2.2950**	**1.0000e-004**	**0.0000**	**2.2972**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	3.8400e-003	0.0285	0.0240	5.0000e-005		1.2300e-003	1.2300e-003		1.1900e-003	1.1900e-003	0.0000	3.5189	3.5189	6.1000e-004	0.0000	3.5318
Total	**3.8400e-003**	**0.0285**	**0.0240**	**5.0000e-005**		**1.2300e-003**	**1.2300e-003**		**1.1900e-003**	**1.1900e-003**	**0.0000**	**3.5189**	**3.5189**	**6.1000e-004**	**0.0000**	**3.5318**

3.2 Cutoff Wall Trench and Construction - 2017

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	9.0000e-005	1.2800e-003	7.7000e-004	0.0000	4.9000e-004	2.0000e-005	5.1000e-004	6.0000e-005	2.0000e-005	8.0000e-005	0.0000	0.3450	0.3450	0.0000	0.0000	0.3450
Worker	5.1000e-004	1.4400e-003	0.0121	3.0000e-005	0.0124	2.0000e-005	0.0124	1.4100e-003	2.0000e-005	1.4200e-003	0.0000	1.9501	1.9501	1.0000e-004	0.0000	1.9522
Total	**6.0000e-004**	**2.7200e-003**	**0.0128**	**3.0000e-005**	**0.0129**	**4.0000e-005**	**0.0130**	**1.4700e-003**	**4.0000e-005**	**1.5000e-003**	**0.0000**	**2.2950**	**2.2950**	**1.0000e-004**	**0.0000**	**2.2972**

3.3 Detour Road Maint/Dust Abatement/SWPPP Work - Season #1 - 2018

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					2.0776	0.0000	2.0776	1.1420	0.0000	1.1420	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.6605	6.0242	4.6655	5.4500e-003		0.3082	0.3082		0.2873	0.2873	0.0000	474.3806	474.3806	0.1311	0.0000	477.1327
Total	**0.6605**	**6.0242**	**4.6655**	**5.4500e-003**	**2.0776**	**0.3082**	**2.3858**	**1.1420**	**0.2873**	**1.4294**	**0.0000**	**474.3806**	**474.3806**	**0.1311**	**0.0000**	**477.1327**

3.3 Detour Road Maint/Dust Abatement/SWPPP Work - Season #1 - 2018

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0153	0.0472	0.3860	1.0200e-003	7.2226	5.9000e-004	7.2232	0.7351	5.5000e-004	0.7356	0.0000	70.5884	70.5884	3.4300e-003	0.0000	70.6604
Total	**0.0153**	**0.0472**	**0.3860**	**1.0200e-003**	**7.2226**	**5.9000e-004**	**7.2232**	**0.7351**	**5.5000e-004**	**0.7356**	**0.0000**	**70.5884**	**70.5884**	**3.4300e-003**	**0.0000**	**70.6604**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0810	0.0000	0.0810	0.0445	0.0000	0.0445	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.6605	6.0242	4.6655	5.4500e-003		0.3082	0.3082		0.2873	0.2873	0.0000	474.3800	474.3800	0.1311	0.0000	477.1321
Total	**0.6605**	**6.0242**	**4.6655**	**5.4500e-003**	**0.0810**	**0.3082**	**0.3892**	**0.0445**	**0.2873**	**0.3319**	**0.0000**	**474.3800**	**474.3800**	**0.1311**	**0.0000**	**477.1321**

3.3 Detour Road Maint/Dust Abatement/SWPPP Work - Season #1 - 2018

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0153	0.0472	0.3860	1.0200e-003	0.4677	5.9000e-004	0.4683	0.0529	5.5000e-004	0.0535	0.0000	70.5884	70.5884	3.4300e-003	0.0000	70.6604
Total	**0.0153**	**0.0472**	**0.3860**	**1.0200e-003**	**0.4677**	**5.9000e-004**	**0.4683**	**0.0529**	**5.5000e-004**	**0.0535**	**0.0000**	**70.5884**	**70.5884**	**3.4300e-003**	**0.0000**	**70.6604**

3.4 Vegetation Clearing - 2018

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0452	0.0000	0.0452	0.0248	0.0000	0.0248	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0276	0.2717	0.2203	2.7000e-004		0.0164	0.0164		0.0151	0.0151	0.0000	24.9911	24.9911	7.7800e-003	0.0000	25.1545
Total	**0.0276**	**0.2717**	**0.2203**	**2.7000e-004**	**0.0452**	**0.0164**	**0.0616**	**0.0248**	**0.0151**	**0.0399**	**0.0000**	**24.9911**	**24.9911**	**7.7800e-003**	**0.0000**	**25.1545**

3.4 Vegetation Clearing - 2018

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					1.7600e-003	0.0000	1.7600e-003	9.7000e-004	0.0000	9.7000e-004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0276	0.2717	0.2203	2.7000e-004		0.0164	0.0164		0.0151	0.0151	0.0000	24.9910	24.9910	7.7800e-003	0.0000	25.1544
Total	**0.0276**	**0.2717**	**0.2203**	**2.7000e-004**	**1.7600e-003**	**0.0164**	**0.0182**	**9.7000e-004**	**0.0151**	**0.0161**	**0.0000**	**24.9910**	**24.9910**	**7.7800e-003**	**0.0000**	**25.1544**

3.4 Vegetation Clearing - 2018

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.5 Strip Rockfill - 2018

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.1035	0.0000	0.1035	0.0539	0.0000	0.0539	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.1466	1.5513	0.9838	1.9400e-003		0.0672	0.0672		0.0621	0.0621	0.0000	175.1222	175.1222	0.0534	0.0000	176.2430
Total	**0.1466**	**1.5513**	**0.9838**	**1.9400e-003**	**0.1035**	**0.0672**	**0.1708**	**0.0539**	**0.0621**	**0.1160**	**0.0000**	**175.1222**	**175.1222**	**0.0534**	**0.0000**	**176.2430**

3.5 Strip Rockfill - 2018

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					4.0400e-003	0.0000	4.0400e-003	2.1000e-003	0.0000	2.1000e-003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.1466	1.5513	0.9838	1.9400e-003		0.0672	0.0672		0.0621	0.0621	0.0000	175.1220	175.1220	0.0534	0.0000	176.2427
Total	**0.1466**	**1.5513**	**0.9838**	**1.9400e-003**	**4.0400e-003**	**0.0672**	**0.0713**	**2.1000e-003**	**0.0621**	**0.0642**	**0.0000**	**175.1220**	**175.1220**	**0.0534**	**0.0000**	**176.2427**

3.5 Strip Rockfill - 2018

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.6 Shearkey Dewatering - 2018

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.1536	0.0000	0.1536	0.0844	0.0000	0.0844	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0520	0.4508	0.3761	4.6000e-004		0.0227	0.0227		0.0213	0.0213	0.0000	39.6061	39.6061	0.0105	0.0000	39.8266
Total	**0.0520**	**0.4508**	**0.3761**	**4.6000e-004**	**0.1536**	**0.0227**	**0.1762**	**0.0844**	**0.0213**	**0.1057**	**0.0000**	**39.6061**	**39.6061**	**0.0105**	**0.0000**	**39.8266**

3.6 Shearkey Dewatering - 2018

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	5.9000e-004	7.9500e-003	4.9300e-003	3.0000e-005	0.0496	1.4000e-004	0.0497	5.0800e-003	1.3000e-004	5.2100e-003	0.0000	2.3073	2.3073	2.0000e-005	0.0000	2.3077
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**5.9000e-004**	**7.9500e-003**	**4.9300e-003**	**3.0000e-005**	**0.0496**	**1.4000e-004**	**0.0497**	**5.0800e-003**	**1.3000e-004**	**5.2100e-003**	**0.0000**	**2.3073**	**2.3073**	**2.0000e-005**	**0.0000**	**2.3077**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					5.9900e-003	0.0000	5.9900e-003	3.2900e-003	0.0000	3.2900e-003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0520	0.4508	0.3761	4.6000e-004		0.0227	0.0227		0.0213	0.0213	0.0000	39.6061	39.6061	0.0105	0.0000	39.8266
Total	**0.0520**	**0.4508**	**0.3761**	**4.6000e-004**	**5.9900e-003**	**0.0227**	**0.0286**	**3.2900e-003**	**0.0213**	**0.0246**	**0.0000**	**39.6061**	**39.6061**	**0.0105**	**0.0000**	**39.8266**

3.6 Shearkey Dewatering - 2018

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	5.9000e-004	7.9500e-003	4.9300e-003	3.0000e-005	3.3300e-003	1.4000e-004	3.4700e-003	4.1000e-004	1.3000e-004	5.5000e-004	0.0000	2.3073	2.3073	2.0000e-005	0.0000	2.3077
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**5.9000e-004**	**7.9500e-003**	**4.9300e-003**	**3.0000e-005**	**3.3300e-003**	**1.4000e-004**	**3.4700e-003**	**4.1000e-004**	**1.3000e-004**	**5.5000e-004**	**0.0000**	**2.3073**	**2.3073**	**2.0000e-005**	**0.0000**	**2.3077**

3.7 Run Dewatering - 2018

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.1355	0.0000	0.1355	0.0745	0.0000	0.0745	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0433	0.3705	0.3051	3.7000e-004		0.0184	0.0184		0.0173	0.0173	0.0000	31.3511	31.3511	8.1500e-003	0.0000	31.5221
Total	**0.0433**	**0.3705**	**0.3051**	**3.7000e-004**	**0.1355**	**0.0184**	**0.1539**	**0.0745**	**0.0173**	**0.0918**	**0.0000**	**31.3511**	**31.3511**	**8.1500e-003**	**0.0000**	**31.5221**

3.7 Run Dewatering - 2018

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					5.2800e-003	0.0000	5.2800e-003	2.9000e-003	0.0000	2.9000e-003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0433	0.3705	0.3051	3.7000e-004		0.0184	0.0184		0.0173	0.0173	0.0000	31.3510	31.3510	8.1500e-003	0.0000	31.5221
Total	**0.0433**	**0.3705**	**0.3051**	**3.7000e-004**	**5.2800e-003**	**0.0184**	**0.0237**	**2.9000e-003**	**0.0173**	**0.0202**	**0.0000**	**31.3510**	**31.3510**	**8.1500e-003**	**0.0000**	**31.5221**

3.7 Run Dewatering - 2018

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.8 Spillway Modification Work - 2018

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1524	1.2302	0.9797	1.5300e-003		0.0724	0.0724		0.0680	0.0680	0.0000	131.7075	131.7075	0.0360	0.0000	132.4637
Total	**0.1524**	**1.2302**	**0.9797**	**1.5300e-003**		**0.0724**	**0.0724**		**0.0680**	**0.0680**	**0.0000**	**131.7075**	**131.7075**	**0.0360**	**0.0000**	**132.4637**

3.8 Spillway Modification Work - 2018

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	1.6000e-003	0.0215	0.0134	7.0000e-005	0.1341	3.9000e-004	0.1345	0.0138	3.6000e-004	0.0141	0.0000	6.2434	6.2434	4.0000e-005	0.0000	6.2443
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**1.6000e-003**	**0.0215**	**0.0134**	**7.0000e-005**	**0.1341**	**3.9000e-004**	**0.1345**	**0.0138**	**3.6000e-004**	**0.0141**	**0.0000**	**6.2434**	**6.2434**	**4.0000e-005**	**0.0000**	**6.2443**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.1524	1.2302	0.9797	1.5300e-003		0.0724	0.0724		0.0680	0.0680	0.0000	131.7073	131.7073	0.0360	0.0000	132.4635
Total	**0.1524**	**1.2302**	**0.9797**	**1.5300e-003**		**0.0724**	**0.0724**		**0.0680**	**0.0680**	**0.0000**	**131.7073**	**131.7073**	**0.0360**	**0.0000**	**132.4635**

3.8 Spillway Modification Work - 2018

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	1.6000e-003	0.0215	0.0134	7.0000e-005	9.0100e-003	3.9000e-004	9.4000e-003	1.1200e-003	3.6000e-004	1.4800e-003	0.0000	6.2434	6.2434	4.0000e-005	0.0000	6.2443
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**1.6000e-003**	**0.0215**	**0.0134**	**7.0000e-005**	**9.0100e-003**	**3.9000e-004**	**9.4000e-003**	**1.1200e-003**	**3.6000e-004**	**1.4800e-003**	**0.0000**	**6.2434**	**6.2434**	**4.0000e-005**	**0.0000**	**6.2443**

3.9 Shearkey Excavation / Toe Drains - 2018

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.2450	0.0000	0.2450	0.1330	0.0000	0.1330	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.1431	1.4327	0.9120	1.7700e-003		0.0642	0.0642		0.0593	0.0593	0.0000	160.1408	160.1408	0.0487	0.0000	161.1637
Total	**0.1431**	**1.4327**	**0.9120**	**1.7700e-003**	**0.2450**	**0.0642**	**0.3092**	**0.1330**	**0.0593**	**0.1923**	**0.0000**	**160.1408**	**160.1408**	**0.0487**	**0.0000**	**161.1637**

3.9 Shearkey Excavation / Toe Drains - 2018

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					9.5500e-003	0.0000	9.5500e-003	5.1900e-003	0.0000	5.1900e-003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.1431	1.4327	0.9120	1.7700e-003		0.0642	0.0642		0.0593	0.0593	0.0000	160.1406	160.1406	0.0487	0.0000	161.1635
Total	**0.1431**	**1.4327**	**0.9120**	**1.7700e-003**	**9.5500e-003**	**0.0642**	**0.0738**	**5.1900e-003**	**0.0593**	**0.0645**	**0.0000**	**160.1406**	**160.1406**	**0.0487**	**0.0000**	**161.1635**

3.9 Shearkey Excavation / Toe Drains - 2018

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.10 IRBA Excavation/Hauling - 2018

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.6818	0.0000	0.6818	0.3040	0.0000	0.3040	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.1273	1.2936	0.9770	1.0500e-003		0.0685	0.0685		0.0630	0.0630	0.0000	96.1833	96.1833	0.0299	0.0000	96.8121
Total	**0.1273**	**1.2936**	**0.9770**	**1.0500e-003**	**0.6818**	**0.0685**	**0.7502**	**0.3040**	**0.0630**	**0.3670**	**0.0000**	**96.1833**	**96.1833**	**0.0299**	**0.0000**	**96.8121**

3.10 IRBA Excavation/Hauling - 2018

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0266	0.0000	0.0266	0.0119	0.0000	0.0119	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.1273	1.2936	0.9770	1.0500e-003		0.0685	0.0685		0.0630	0.0630	0.0000	96.1831	96.1831	0.0299	0.0000	96.8120
Total	**0.1273**	**1.2936**	**0.9770**	**1.0500e-003**	**0.0266**	**0.0685**	**0.0951**	**0.0119**	**0.0630**	**0.0749**	**0.0000**	**96.1831**	**96.1831**	**0.0299**	**0.0000**	**96.8120**

3.10 IRBA Excavation/Hauling - 2018

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.11 Shearkey Fill - 2018

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.1125	0.0000	0.1125	0.0602	0.0000	0.0602	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0963	0.9895	0.7108	1.0200e-003		0.0499	0.0499		0.0461	0.0461	0.0000	91.7741	91.7741	0.0275	0.0000	92.3524
Total	**0.0963**	**0.9895**	**0.7108**	**1.0200e-003**	**0.1125**	**0.0499**	**0.1624**	**0.0602**	**0.0461**	**0.1063**	**0.0000**	**91.7741**	**91.7741**	**0.0275**	**0.0000**	**92.3524**

3.11 Shearkey Fill - 2018

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					4.3900e-003	0.0000	4.3900e-003	2.3500e-003	0.0000	2.3500e-003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0963	0.9895	0.7108	1.0200e-003		0.0499	0.0499		0.0461	0.0461	0.0000	91.7740	91.7740	0.0275	0.0000	92.3523
Total	**0.0963**	**0.9895**	**0.7108**	**1.0200e-003**	**4.3900e-003**	**0.0499**	**0.0543**	**2.3500e-003**	**0.0461**	**0.0485**	**0.0000**	**91.7740**	**91.7740**	**0.0275**	**0.0000**	**92.3523**

3.11 Shearkey Fill - 2018

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

3.12 Stability Berm at Dam and Dike - 2018

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.2755	0.0000	0.2755	0.1514	0.0000	0.1514	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.2446	2.5149	1.8066	2.5900e-003		0.1268	0.1268		0.1172	0.1172	0.0000	233.2591	233.2591	0.0700	0.0000	234.7289
Total	**0.2446**	**2.5149**	**1.8066**	**2.5900e-003**	**0.2755**	**0.1268**	**0.4023**	**0.1514**	**0.1172**	**0.2687**	**0.0000**	**233.2591**	**233.2591**	**0.0700**	**0.0000**	**234.7289**

3.12 Stability Berm at Dam and Dike - 2018

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0519	0.7695	0.3966	2.5400e-003	4.8547	0.0141	4.8689	0.4977	0.0130	0.5107	0.0000	225.2942	225.2942	1.5100e-003	0.0000	225.3260
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0519**	**0.7695**	**0.3966**	**2.5400e-003**	**4.8547**	**0.0141**	**4.8689**	**0.4977**	**0.0130**	**0.5107**	**0.0000**	**225.2942**	**225.2942**	**1.5100e-003**	**0.0000**	**225.3260**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0107	0.0000	0.0107	5.9100e-003	0.0000	5.9100e-003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.2446	2.5149	1.8066	2.5900e-003		0.1268	0.1268		0.1172	0.1172	0.0000	233.2588	233.2588	0.0700	0.0000	234.7286
Total	**0.2446**	**2.5149**	**1.8066**	**2.5900e-003**	**0.0107**	**0.1268**	**0.1375**	**5.9100e-003**	**0.1172**	**0.1231**	**0.0000**	**233.2588**	**233.2588**	**0.0700**	**0.0000**	**234.7286**

3.12 Stability Berm at Dam and Dike - 2018

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0519	0.7695	0.3966	2.5400e-003	0.3262	0.0141	0.3403	0.0404	0.0130	0.0534	0.0000	225.2942	225.2942	1.5100e-003	0.0000	225.3260
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0519**	**0.7695**	**0.3966**	**2.5400e-003**	**0.3262**	**0.0141**	**0.3403**	**0.0404**	**0.0130**	**0.0534**	**0.0000**	**225.2942**	**225.2942**	**1.5100e-003**	**0.0000**	**225.3260**

3.13 Detour Road Maint/Dust Abatement/SWPPP Work - Season #2 - 2019

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					1.1020	0.0000	1.1020	0.6058	0.0000	0.6058	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.2482	2.5988	1.9738	2.1900e-003		0.1295	0.1295		0.1191	0.1191	0.0000	196.7753	196.7753	0.0623	0.0000	198.0827
Total	**0.2482**	**2.5988**	**1.9738**	**2.1900e-003**	**1.1020**	**0.1295**	**1.2315**	**0.6058**	**0.1191**	**0.7249**	**0.0000**	**196.7753**	**196.7753**	**0.0623**	**0.0000**	**198.0827**

3.13 Detour Road Maint/Dust Abatement/SWPPP Work - Season #2 - 2019

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	6.6700e-003	0.0223	0.1794	5.4000e-004	3.8311	3.0000e-004	3.8314	0.3899	2.8000e-004	0.3902	0.0000	36.0870	36.0870	1.6600e-003	0.0000	36.1220
Total	**6.6700e-003**	**0.0223**	**0.1794**	**5.4000e-004**	**3.8311**	**3.0000e-004**	**3.8314**	**0.3899**	**2.8000e-004**	**0.3902**	**0.0000**	**36.0870**	**36.0870**	**1.6600e-003**	**0.0000**	**36.1220**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0430	0.0000	0.0430	0.0236	0.0000	0.0236	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.2482	2.5988	1.9738	2.1900e-003		0.1295	0.1295		0.1191	0.1191	0.0000	196.7750	196.7750	0.0623	0.0000	198.0824
Total	**0.2482**	**2.5988**	**1.9738**	**2.1900e-003**	**0.0430**	**0.1295**	**0.1725**	**0.0236**	**0.1191**	**0.1428**	**0.0000**	**196.7750**	**196.7750**	**0.0623**	**0.0000**	**198.0824**

3.13 Detour Road Maint/Dust Abatement/SWPPP Work - Season #2 - 2019

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	6.6700e-003	0.0223	0.1794	5.4000e-004	0.2481	3.0000e-004	0.2484	0.0281	2.8000e-004	0.0284	0.0000	36.0870	36.0870	1.6600e-003	0.0000	36.1220
Total	**6.6700e-003**	**0.0223**	**0.1794**	**5.4000e-004**	**0.2481**	**3.0000e-004**	**0.2484**	**0.0281**	**2.8000e-004**	**0.0284**	**0.0000**	**36.0870**	**36.0870**	**1.6600e-003**	**0.0000**	**36.1220**

3.14 Concrete Paving and Barriers over Dam Road - 2019

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0898	0.7785	0.7727	1.2200e-003		0.0423	0.0423		0.0397	0.0397	0.0000	104.6526	104.6526	0.0292	0.0000	105.2647
Paving	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0898**	**0.7785**	**0.7727**	**1.2200e-003**		**0.0423**	**0.0423**		**0.0397**	**0.0397**	**0.0000**	**104.6526**	**104.6526**	**0.0292**	**0.0000**	**105.2647**

3.14 Concrete Paving and Barriers over Dam Road - 2019

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	2.0300e-003	0.0262	0.0170	9.0000e-005	0.1778	4.8000e-004	0.1783	0.0182	4.4000e-004	0.0187	0.0000	8.1410	8.1410	5.0000e-005	0.0000	8.1421
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**2.0300e-003**	**0.0262**	**0.0170**	**9.0000e-005**	**0.1778**	**4.8000e-004**	**0.1783**	**0.0182**	**4.4000e-004**	**0.0187**	**0.0000**	**8.1410**	**8.1410**	**5.0000e-005**	**0.0000**	**8.1421**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0898	0.7785	0.7727	1.2200e-003		0.0423	0.0423		0.0397	0.0397	0.0000	104.6525	104.6525	0.0292	0.0000	105.2646
Paving	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0898**	**0.7785**	**0.7727**	**1.2200e-003**		**0.0423**	**0.0423**		**0.0397**	**0.0397**	**0.0000**	**104.6525**	**104.6525**	**0.0292**	**0.0000**	**105.2646**

3.14 Concrete Paving and Barriers over Dam Road - 2019

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	2.0300e-003	0.0262	0.0170	9.0000e-005	0.0120	4.8000e-004	0.0124	1.4800e-003	4.4000e-004	1.9200e-003	0.0000	8.1410	8.1410	5.0000e-005	0.0000	8.1421
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**2.0300e-003**	**0.0262**	**0.0170**	**9.0000e-005**	**0.0120**	**4.8000e-004**	**0.0124**	**1.4800e-003**	**4.4000e-004**	**1.9200e-003**	**0.0000**	**8.1410**	**8.1410**	**5.0000e-005**	**0.0000**	**8.1421**

3.15 Stampede Dam Meadows Road Paving - 2019

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0440	0.4232	0.4110	6.5000e-004		0.0221	0.0221		0.0205	0.0205	0.0000	56.8599	56.8599	0.0170	0.0000	57.2172
Paving	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0440**	**0.4232**	**0.4110**	**6.5000e-004**		**0.0221**	**0.0221**		**0.0205**	**0.0205**	**0.0000**	**56.8599**	**56.8599**	**0.0170**	**0.0000**	**57.2172**

3.15 Stampede Dam Meadows Road Paving - 2019

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	2.5000e-003	0.0322	0.0209	1.1000e-004	0.2186	5.9000e-004	0.2192	0.0224	5.5000e-004	0.0230	0.0000	10.0094	10.0094	7.0000e-005	0.0000	10.0108
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**2.5000e-003**	**0.0322**	**0.0209**	**1.1000e-004**	**0.2186**	**5.9000e-004**	**0.2192**	**0.0224**	**5.5000e-004**	**0.0230**	**0.0000**	**10.0094**	**10.0094**	**7.0000e-005**	**0.0000**	**10.0108**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Off-Road	0.0440	0.4232	0.4110	6.5000e-004		0.0221	0.0221		0.0205	0.0205	0.0000	56.8598	56.8598	0.0170	0.0000	57.2171
Paving	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0440**	**0.4232**	**0.4110**	**6.5000e-004**		**0.0221**	**0.0221**		**0.0205**	**0.0205**	**0.0000**	**56.8598**	**56.8598**	**0.0170**	**0.0000**	**57.2171**

3.15 Stampede Dam Meadows Road Paving - 2019

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	2.5000e-003	0.0322	0.0209	1.1000e-004	0.0147	5.9000e-004	0.0153	1.8200e-003	5.5000e-004	2.3700e-003	0.0000	10.0094	10.0094	7.0000e-005	0.0000	10.0108
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**2.5000e-003**	**0.0322**	**0.0209**	**1.1000e-004**	**0.0147**	**5.9000e-004**	**0.0153**	**1.8200e-003**	**5.5000e-004**	**2.3700e-003**	**0.0000**	**10.0094**	**10.0094**	**7.0000e-005**	**0.0000**	**10.0108**

3.16 Final Stabilization / Restoration - 2019

Unmitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					0.0903	0.0000	0.0903	0.0497	0.0000	0.0497	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0828	0.8459	0.6300	9.6000e-004		0.0421	0.0421		0.0389	0.0389	0.0000	84.9452	84.9452	0.0259	0.0000	85.4891
Total	**0.0828**	**0.8459**	**0.6300**	**9.6000e-004**	**0.0903**	**0.0421**	**0.1325**	**0.0497**	**0.0389**	**0.0886**	**0.0000**	**84.9452**	**84.9452**	**0.0259**	**0.0000**	**85.4891**

3.16 Final Stabilization / Restoration - 2019

Unmitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated Construction On-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Fugitive Dust					3.5200e-003	0.0000	3.5200e-003	1.9400e-003	0.0000	1.9400e-003	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Off-Road	0.0828	0.8459	0.6300	9.6000e-004		0.0421	0.0421		0.0389	0.0389	0.0000	84.9451	84.9451	0.0259	0.0000	85.4890
Total	**0.0828**	**0.8459**	**0.6300**	**9.6000e-004**	**3.5200e-003**	**0.0421**	**0.0457**	**1.9400e-003**	**0.0389**	**0.0409**	**0.0000**	**84.9451**	**84.9451**	**0.0259**	**0.0000**	**85.4890**

3.16 Final Stabilization / Restoration - 2019

Mitigated Construction Off-Site

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Hauling	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Vendor	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Worker	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

4.0 Operational Detail - Mobile

4.1 Mitigation Measures Mobile

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

4.2 Trip Summary Information

	Average Daily Trip Rate			Unmitigated	Mitigated
Land Use	Weekday	Saturday	Sunday	Annual VMT	Annual VMT
User Defined Recreational	0.00	0.00	0.00		
Total	0.00	0.00	0.00		

4.3 Trip Type Information

	Miles			Trip %			Trip Purpose %		
Land Use	H-W or C-W	H-S or C-C	H-O or C-NW	H-W or C-W	H-S or C-C	H-O or C-NW	Primary	Diverted	Pass-by
User Defined Recreational	9.50	7.30	7.30	0.00	0.00	0.00	0	0	0

LDA	LDT1	LDT2	MDV	LHD1	LHD2	MHD	HHD	OBUS	UBUS	MCY	SBUS	MH
0.336638	0.055996	0.254972	0.152543	0.080267	0.009426	0.018056	0.074926	0.001646	0.000532	0.009401	0.000598	0.004999

4.4 Fleet Mix

5.0 Energy Detail

Historical Energy Use: N

5.1 Mitigation Measures Energy

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Electricity Mitigated						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Electricity Unmitigated						0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Mitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
NaturalGas Unmitigated	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

5.2 Energy by Land Use - NaturalGas

Unmitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
User Defined Recreational	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

5.2 Energy by Land Use - NaturalGas

Mitigated

	NaturalGas Use	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Land Use	kBTU/yr	tons/yr										MT/yr					
User Defined Recreational	0	0.0000	0.0000	0.0000	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**

5.3 Energy by Land Use - Electricity

Unmitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
User Defined Recreational	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

5.3 Energy by Land Use - Electricity

Mitigated

	Electricity Use	Total CO2	CH4	N2O	CO2e
Land Use	kWh/yr	MT/yr			
User Defined Recreational	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

6.0 Area Detail

6.1 Mitigation Measures Area

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Category	tons/yr										MT/yr					
Mitigated	0.0000	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Unmitigated	0.0000	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005

6.2 Area by SubCategory

Unmitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.0000	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Total	**0.0000**	**0.0000**	**1.0000e-005**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**2.0000e-005**	**2.0000e-005**	**0.0000**	**0.0000**	**2.0000e-005**

Mitigated

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
SubCategory	tons/yr										MT/yr					
Architectural Coating	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Consumer Products	0.0000					0.0000	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Landscaping	0.0000	0.0000	1.0000e-005	0.0000		0.0000	0.0000		0.0000	0.0000	0.0000	2.0000e-005	2.0000e-005	0.0000	0.0000	2.0000e-005
Total	**0.0000**	**0.0000**	**1.0000e-005**	**0.0000**		**0.0000**	**0.0000**		**0.0000**	**0.0000**	**0.0000**	**2.0000e-005**	**2.0000e-005**	**0.0000**	**0.0000**	**2.0000e-005**

7.0 Water Detail

7.1 Mitigation Measures Water

	Total CO2	CH4	N2O	CO2e
Category	MT/yr			
Mitigated	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000

7.2 Water by Land Use

Unmitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
User Defined Recreational	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

7.2 Water by Land Use

Mitigated

	Indoor/Outdoor Use	Total CO2	CH4	N2O	CO2e
Land Use	Mgal	MT/yr			
User Defined Recreational	0 / 0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

8.0 Waste Detail

8.1 Mitigation Measures Waste

Category/Year

	Total CO2	CH4	N2O	CO2e
	MT/yr			
Mitigated	0.0000	0.0000	0.0000	0.0000
Unmitigated	0.0000	0.0000	0.0000	0.0000

8.2 Waste by Land Use

Unmitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
User Defined Recreational	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

Mitigated

	Waste Disposed	Total CO2	CH4	N2O	CO2e
Land Use	tons	MT/yr			
User Defined Recreational	0	0.0000	0.0000	0.0000	0.0000
Total		**0.0000**	**0.0000**	**0.0000**	**0.0000**

9.0 Operational Offroad

Equipment Type	Number	Hours/Day	Days/Year	Horse Power	Load Factor	Fuel Type

10.0 Vegetation

Appendix D – Indian Trust Asset Coordination

Indian Trust Assets
Request Form

**Please send your request to: Kevin Clancy at kclancy@usbr.gov.

Date:

Requested by	Alex Woodward, x 5056
Fund	RXR0680A2
WBS	RX154700040024107
Cost Center	2015200
Region # (if other than MP)	(NA)
Project Name	Boca Dam Safety of Dams Modification Project
CEC or EA Number	(NA)
Project Description	Boca Dam is subject to structural failure under certain conditions due to the presence of liquefiable alluvium (i.e., sand and gravel) under the dam's foundation. During a significant earthquake event, the alluvium may lose its shear strength (seismic induced liquefaction) and lead to excessive embankment deformation and cracking or overtopping of the dam. In order to reduce the risk in case of such an event happening, Reclamation intends to take corrective action. Corrective actions may include a structural alternative (referred to as the Preferred Alternative in this document), a reservoir restriction, or a reservoir breach. We are seeking an ITA determination on all of the considered alternatives, as follows: 1. No Action Alternative: This alternative involves no action, no risk reduction, and assumes continued operation of Boca Dam with no changes. A risk analysis by Reclamation indicates that continued operation of the dam without structural

	modifications or operational restrictions would place the downstream population at a level of risk that does not meet current Reclamation public protection guidelines. 2. Preferred Alternative: Reclamation's Preferred Alternative at Boca Dam to protect against overtopping or cracking failure during a seismic event is construction of a shear key, stability berm, and modifying the spillway crest structure. The shear key and stability berm will be constructed on the downstream side of the main embankment and dike and would include a chimney filter and new toe drain. A portion of the stability berm width will extended to the top of the dam increasing the crest width. This alternative would reduce the seismic risks and meet Reclamation's interim Public Protection Guidelines for the protection of life. A temporary reservoir drawdown to elevation 5,581 feet (NAVD88) will be implemented June 15 – November 15 of the first construction year to expose the IRBA. This could cause a temporary, minor reduction in water storage, and a temporary shift in the timing of water deliveries from spring to fall. 3. Reservoir Restriction: A permanent reservoir restriction would involve drawing down the level of the water in the reservoir to an elevation of 5583 feet. Operation of the reservoir would change to where the highest water level would not be able to exceed 5583 feet except during a flood event. Following the flood event, the reservoir would be returned to elevation 5583 as quickly as possible. This action would not require the modification of the outlet works, control house, spillway, dam, or dike. By restricting the reservoir, the risks of overtopping and/or internal erosion through cracking due to a seismic event would be addressed. By increasing the freeboard, the risk of overtopping due to deformations would be reduced. Similarly, by reducing the reservoir water surface (RWS) elevation, the gradient across the transverse cracking would be reduced, thus the risk of internal erosion associated with earthquake induced cracking would be decreased. 4. Dam Breach: This alternative involves breaching of the Boca Dam main embankment and totally

	draining the reservoir. After the breach is complete, a new river channel through the dam site would be constructed. This alternative includes: excavating a trapezoid shaped breach channel in the main embankment, the width and elevation at the bottom of breach channel would be close to the original streambed configuration, placing upstream riprap material in the breach channel for erosion control, abandoning the spillway and outlet works intake structures, and seeding grasses for erosion control purposes in areas disturbed by the breach and channel contouring activities. Additionally, this alternative also would involve rerouting of the public roadway currently across the crest of the dam which includes earthwork, roadway surfacing, and bridge construction.
*Project Location (Township, Range, Section, e.g., T12 R5E S10, or XY cords)	Study Area Center Coordinates (NAD 83) Latitude 39.400227°N Longitude -120.090590°W UTM 10S 750526 4365231 U.S. PLS Sections 16, 21, and 28 of Township 18 North, Range 17 East MDB&M USGS 7.5-Min Quadrangle Name: Boca, California

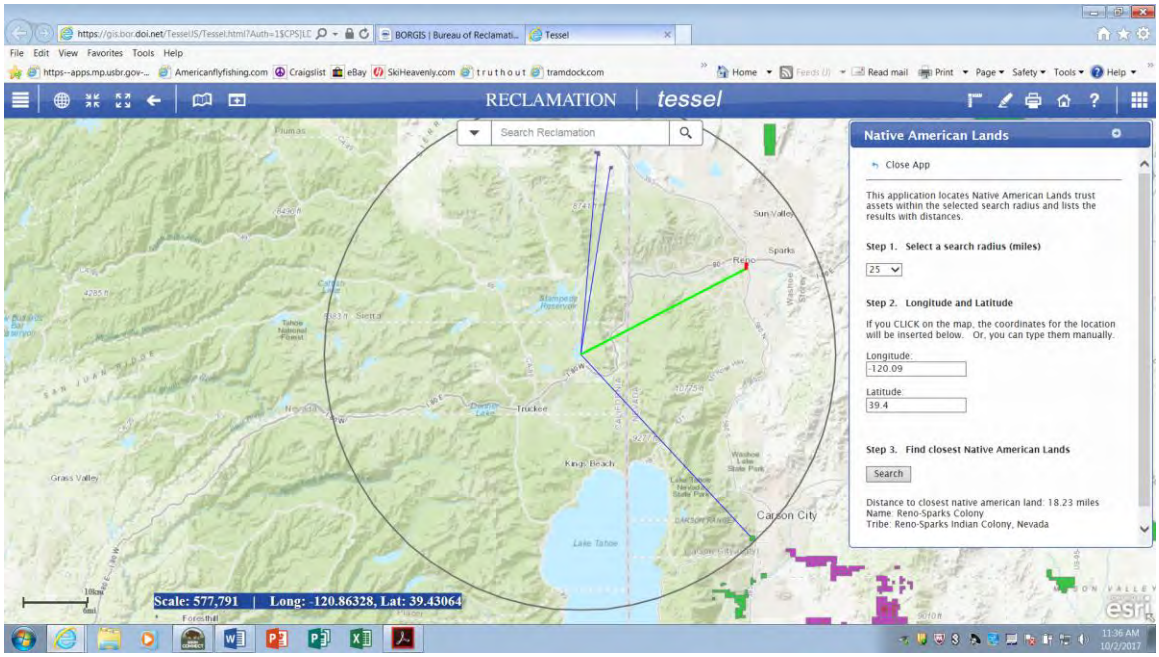
*Please include map with request, if available.

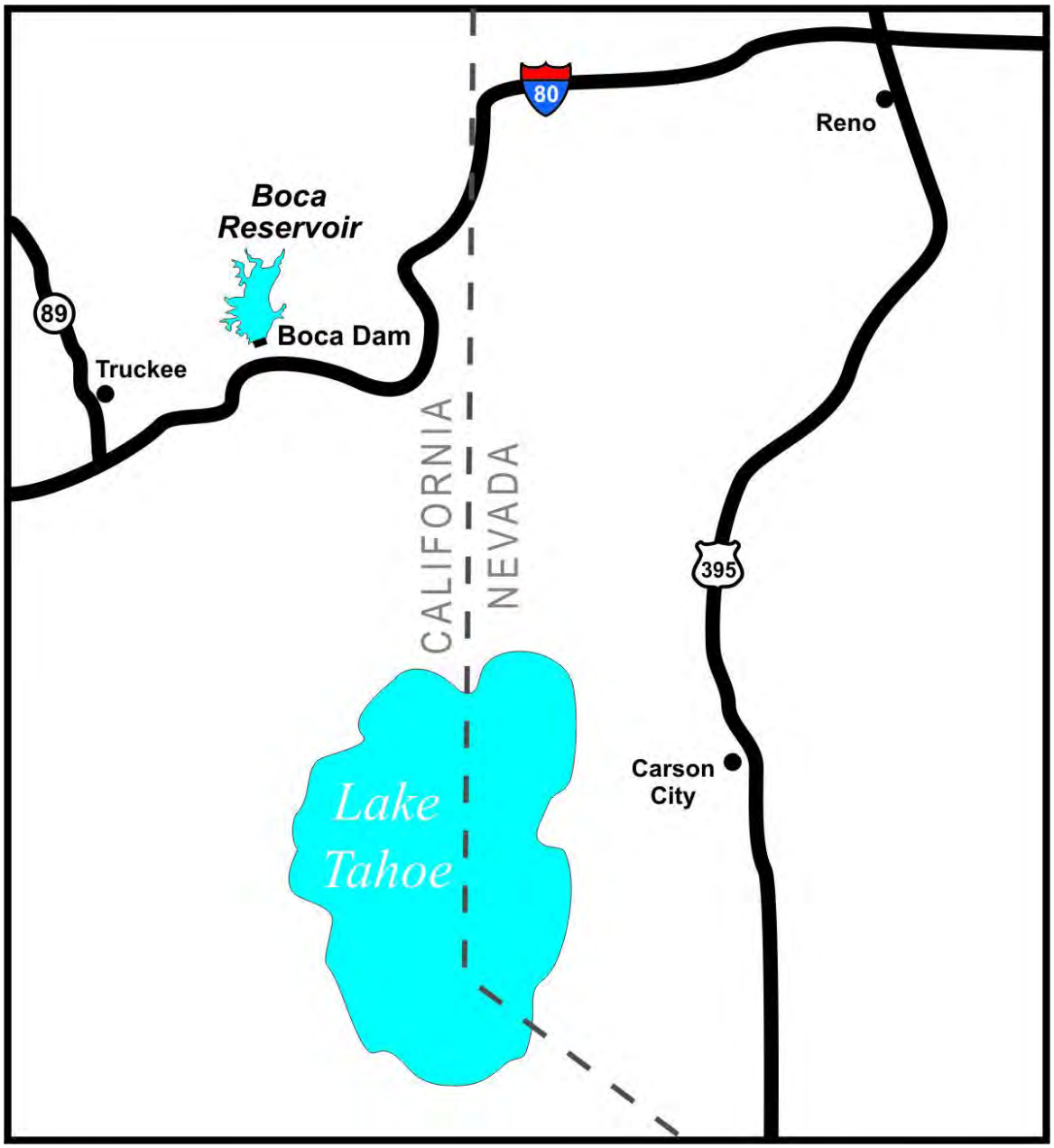
ITA Determination:

The closest ITA to **Boca Dam Safety of Dams Modification Project** is the **Reno Sparks Indian Colony** about 18 miles to the northeast. (See attached image).

Based on the nature of the planned work it **does not** appear to be in an area that will impact Indian hunting or fishing resources or water rights nor is the proposed activity on actual Indian lands. It is reasonable to assume that the proposed action **will not** have any impacts on ITAs.

K.Clancy	Kevin Clancy	10/02/2017
Signature	Printed name of approver	Date




80
Reno
Boca
Reservoir
89
Boca Dam
Truckee
CALIFORNIA
NEVADA
395
Lake
Tahoe
Carson
City

RECLAMATION
Managing Water in the West