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Office of Environmental Management – Grand Junction

MOAB UTAH UMTRA

UMTRA Project

Moab UMTRA Project
2019 Flood Response Summary

Revision 0

August 2020

U.S. Department of Energy

Office of Environmental Management

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Moab UMTRA Project
2019 Flood Response Summary

Revision 0

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Revision History

Revision	Date	Description
0	August 2020	Initial issue.

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1.0 Introduction

The U.S. Department of Energy (DOE) Moab Uranium Mill Tailings Remedial Action (UMTRA) Project site (Moab site) is a former uranium ore-processing facility located about three miles northwest of the city of Moab in Grand County, Utah. The Colorado River forms the eastern boundary of the Moab Project site.

Several features of the Moab site are shown in Figure 1. The site is transected by the Moab Wash, which flows during significant storm events. North of the Wash is a freshwater intake structure that supplies a pond used for irrigation, dust control, decontamination, rinsing containers, and injection water as part of groundwater interim action remediation. The interim action well field is located between the toe of the tailings pile and the river south of the Moab Wash.

The site is susceptible to flooding because about 160 acres of the nearly 480 acres of the property are within the 100-year floodplain of either the Colorado River or the Moab Wash. A berm located along the Colorado River north of the Moab Wash and several off-pile areas of the site were remediated in the winter of 2010/2011 by excavating and removing the contaminated soil.

As part of this remediation, the berm previously installed along the riverbank north of Moab Wash and more than 158,000 cubic yards of contaminated soil were removed, creating areas of lower elevation. As a result of the soil remediation activities, this northern off-pile area is now more susceptible to flooding at lower river stages.

Due to higher than average 2018/2019 snowpack in the Colorado River basin, by mid-March 2019 it was apparent that the Colorado River flows resulting from the snowpack melt would likely flood portions of the site. Due to the nature of the 2019 spring runoff river flows, this document presents the pre-flood (Section 2.0), initial flood (Section 3.0), flood (Section 4.0) and post-flood (Section 5.0) stages and the activities associated with each stage. Figure 1 shows Moab site features and elevations of on-site berms. For purposes of this Summary, “well field area” is defined as the area shown on Figure 1.

The *Moab UMTRA Project Flood and Drought Mitigation Plan* (DOE-EM/GJTAC1640) outlines flood preparation actions at three river flow levels to be completed by Project personnel. Action levels are designated for Colorado River flows at the Cisco gage of 15,000 cubic feet per second (cfs), 25,000 cfs, and 35,000 cfs or greater.

Appendix A of this Summary shows 2019 Flood and Drought Mitigation Plan Maps. Appendices B and C include photographs of the site during flood stage and post-flood stage conditions, respectively. The photo captions include Colorado River flow at the Cisco gage and elevation at the Moab site gage. Appendix D contains the post-flood radiological survey results.

1.1 Purpose and Scope

The purpose of this document is to record the chronology, on-site river flow elevation, actions, and lessons learned associated with the above-average spring runoff of 2019. River flow and stage data will be useful for planning future activities on site, including operations and restoration.

This report provides a summary of flood potential monitoring, the flood event, and activities to restore operations.

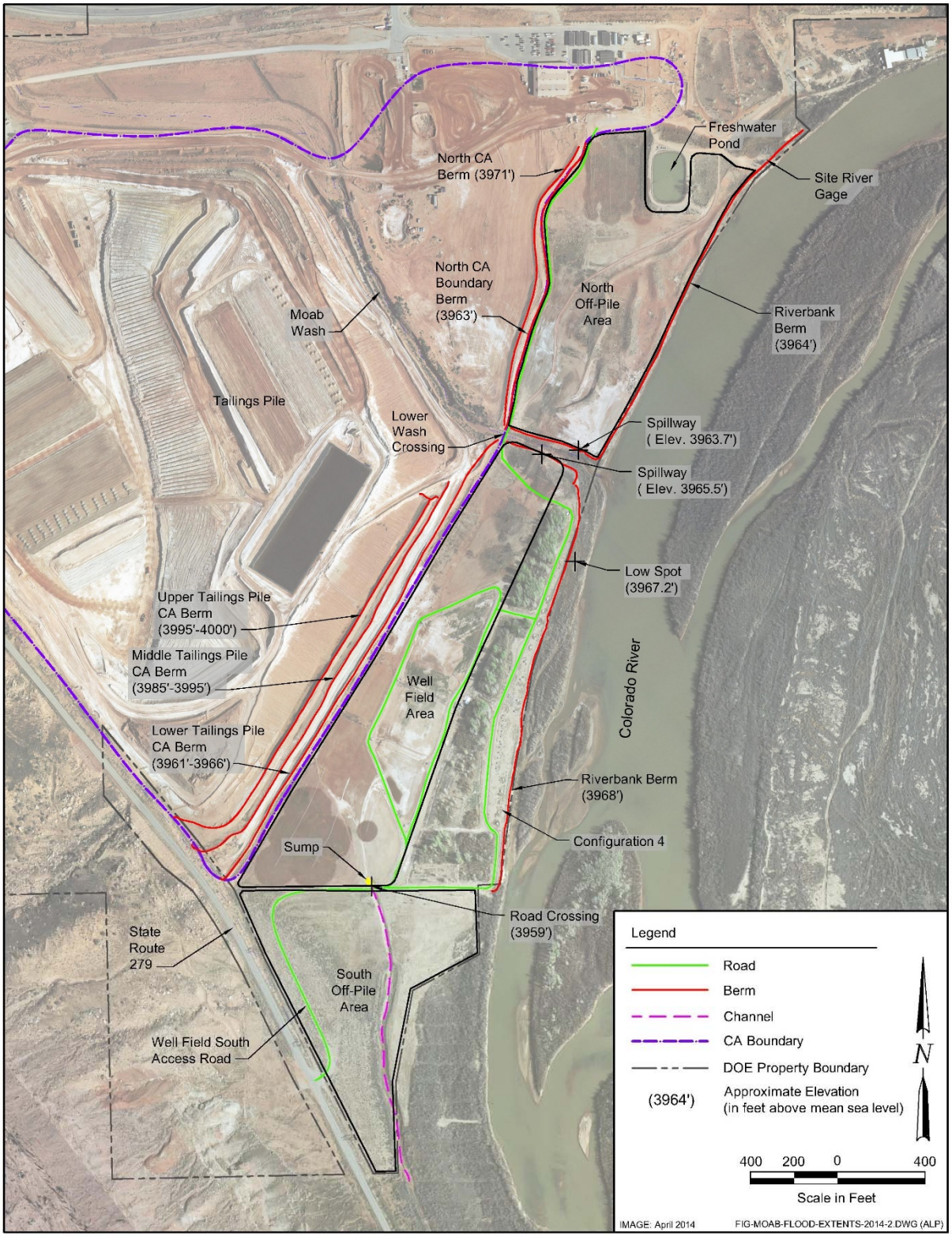

Figure 1. Moab Site Features and On-site Berm Elevations

1.2 Data Sources

Colorado River flow measurements are taken from the U.S. Geological Survey (USGS) gaging station 09180500 near Cisco, Utah, and are compared to the elevation measurements, which are made at the Moab site gage. The site gage is located at the site pumping station where river water is pumped from the river for site operations. The top of this gage is marked as 16.92 feet (ft), and the elevation at this point was measured at 3,969.00 ft mean sea level (msl). Figure 2 is a plot of the rating curve generated using data collected during the 2011 flood event, along with data collected during the 2019 runoff

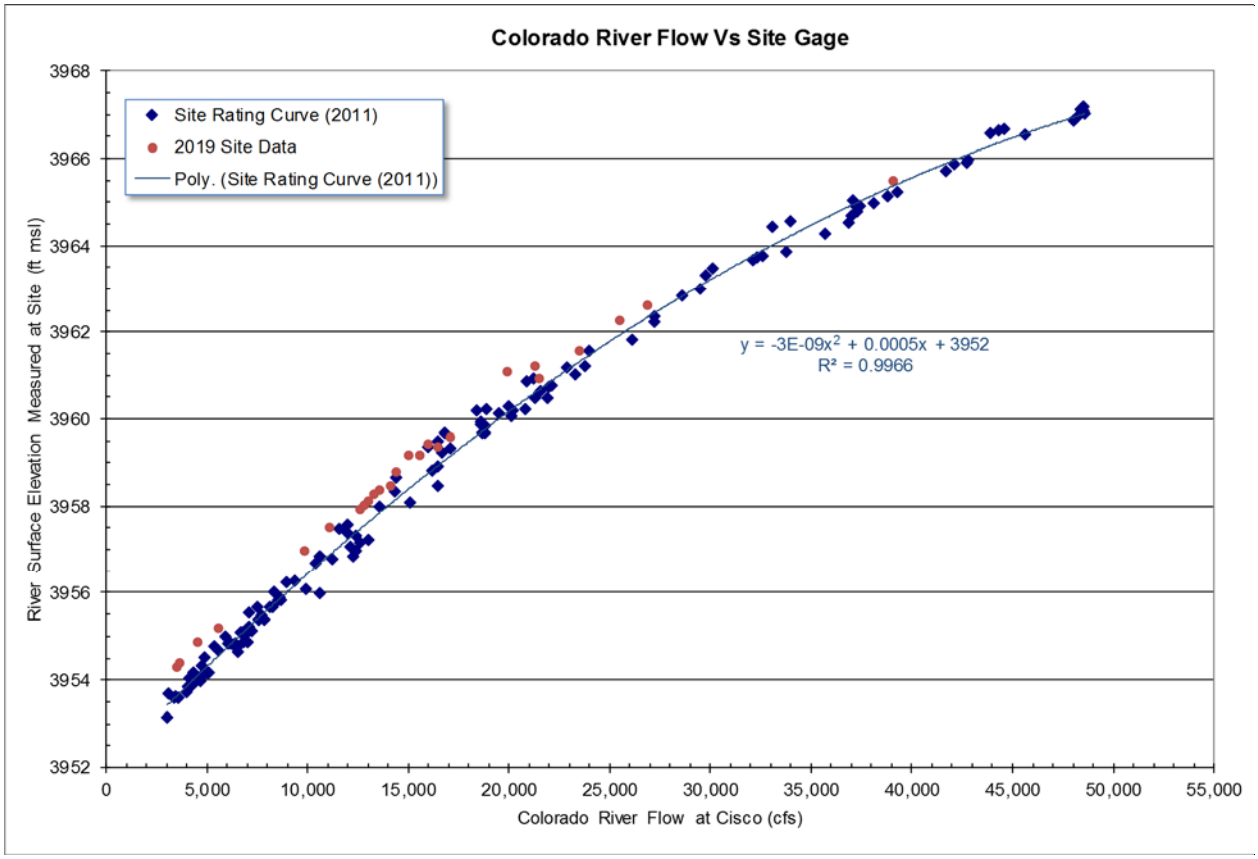

Figure 2. Cisco River Gage vs. Site Elevation Gage

The data collected during the ascending portion of the 2019 hydrograph were similar to those measured in 2011, and the equation used to convert the river flows to a river surface elevation was still valid. The gradient of the river (the elevation drop over a given distance divided by the distance) varies from the site gage to the southern portion of the site at approximately one foot per half mile. Due to this difference, elevations at other site locations must be adjusted when comparing them to the elevation at the site gage.

All snowpack information was obtained from SNOTEL data collected by the NRCS, and provided by the Colorado River Basin Forecast Center (CBRFC), utilizing snow group CLRU1 "Colorado River abv Cisco." This snow group takes into account data collected from 34 different SNOTEL sites in the basin.

1.3 Recent Site Flooding

Before 2019, the most recent above-average runoff years were 2011 and 2014. Site flooding during those years is described in the *Moab UMTRA Project 2011 Flood Response Summary* (DOE-EM/GJTAC2007) and the *Moab UMTRA Project 2014 Flood Response Summary* (DOE-EM/GJTAC2152).

Figure 3 shows the snow water equivalent for snow group CLRU1 in 2011, 2014, and 2019 along with the average (based on data collected from 1981 through 2010), prepared using the Colorado Basin River Forecast Center website. Figure 4 is a hydrograph showing runoff for these same three years and the average, based on the USGS National Water Information System: Web Interface for Colorado River Cisco Gaging Station website. These websites are listed in Section 6.0.

Since the 2011 flood, several areas of the site were contoured. Portions of the north off-pile area were contoured to allow high river water to gradually inundate the area and reduce the velocity. An existing channel (Figure 1) through the south off-pile area was deepened in 2012 and extended to the southern boundary of the well field area.

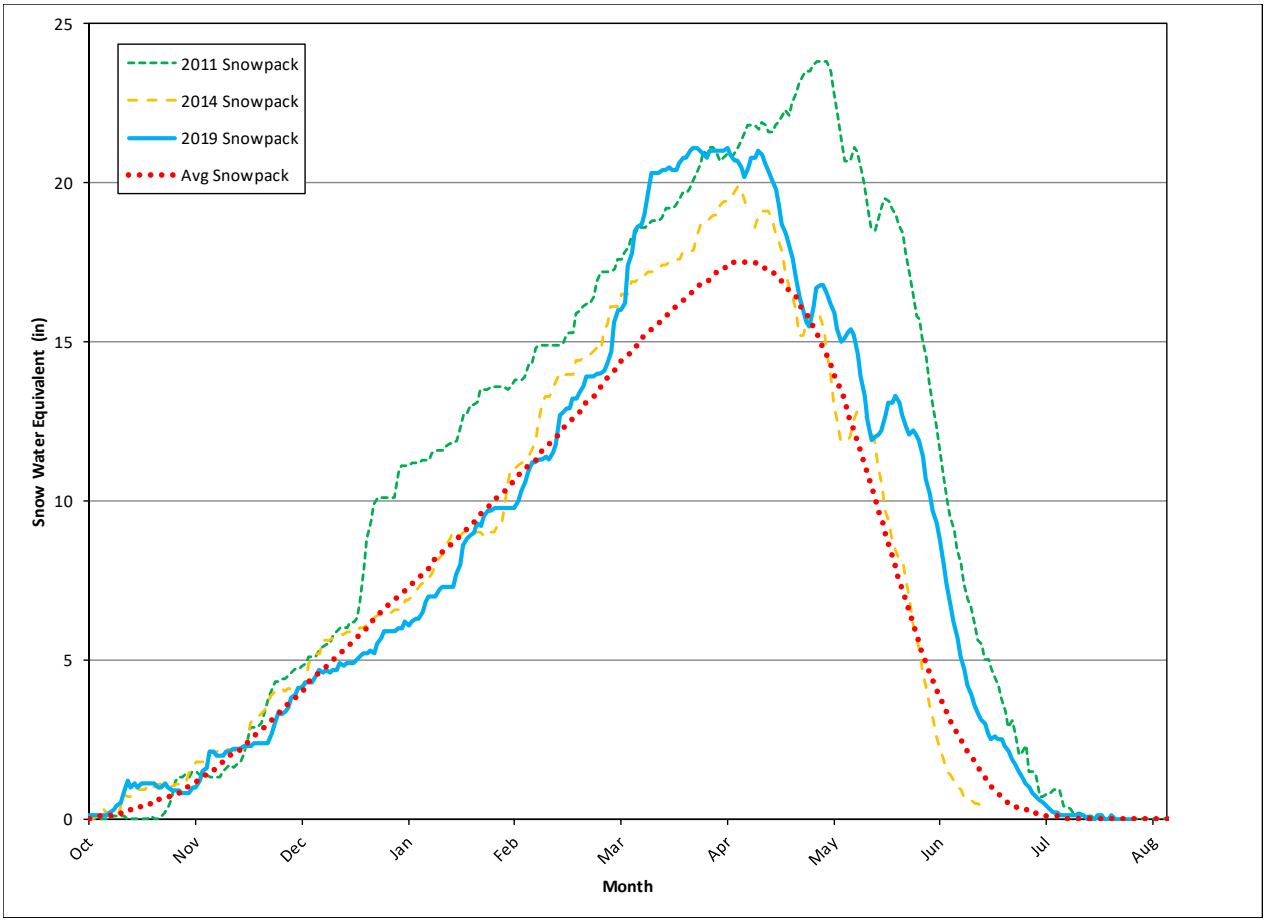

Figure 3. Snow Water Equivalent for the Cisco Gage in 2011, 2014, and 2019

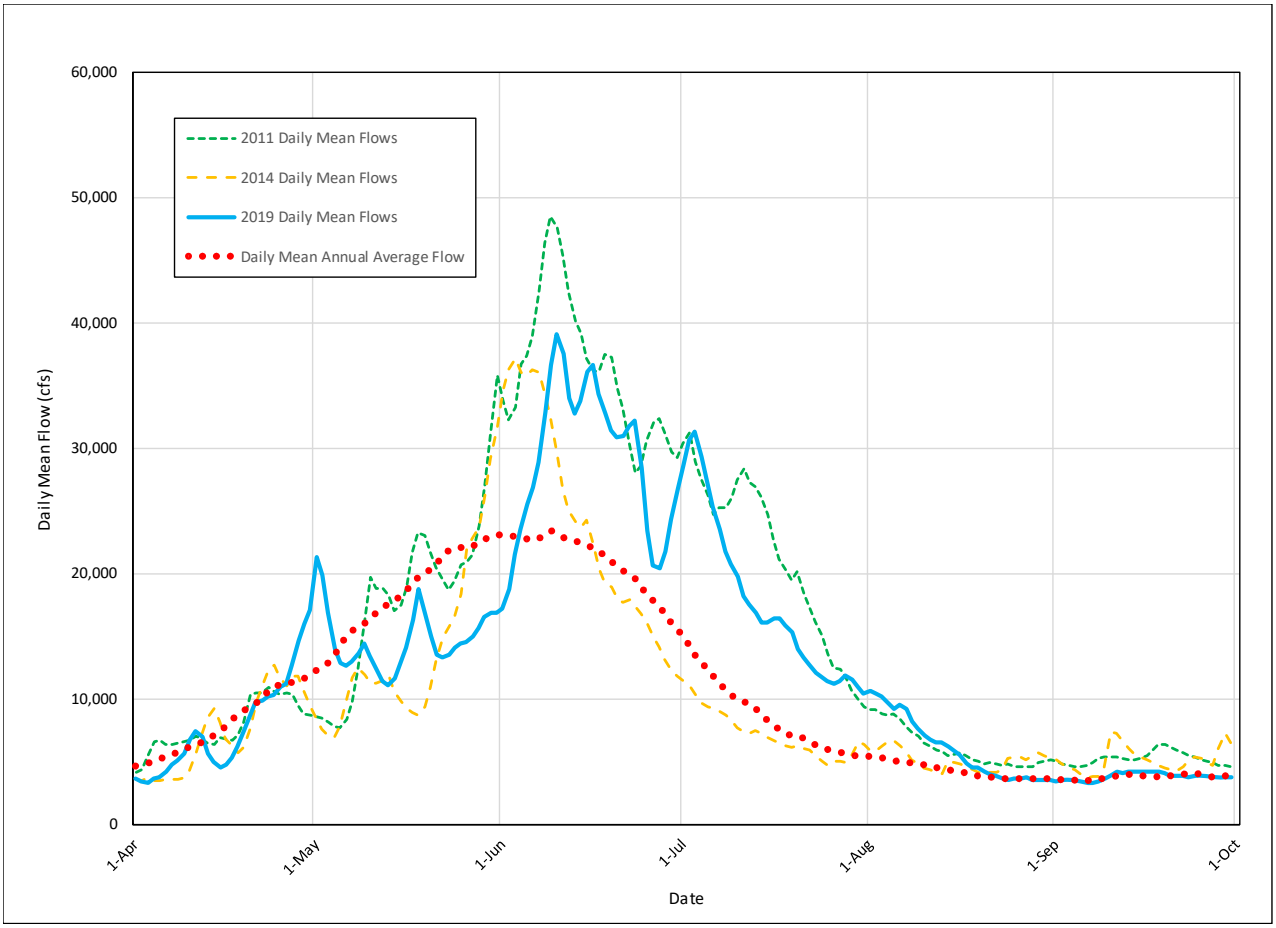

Figure 4. Hydrograph of Colorado River Runoff in 2011, 2014, and 2019

1.4 2019 Snowpack and River Flows

Figure 5 provides the average and 2019 snowpack and river flow data and displays how, on average, the snowpack melts out and the lag time of when the river spring runoff peak flow reaches the Cisco station.

The dashed lines (red for the average and blue for the 2019 data set) represent the snowpack, reported as Snow Water Equivalent (inches). These data are tied to the left side vertical axis. The solid lines, using the same color scheme, represent the Colorado River flows (cfs) and apply to the right side vertical axis. On average, the point when the snowpack starts to melt out is on April 12, and the peak spring runoff flow occurs on June 10, a lag of roughly two months.

The 2019 snowpack started significantly melting out on April 15, and the peak flow occurred on May 10. So, while the timing for the 2019 snowpack and flows nearly matched the average, the actual flows were significantly higher as result of the higher-than-average snowpack.

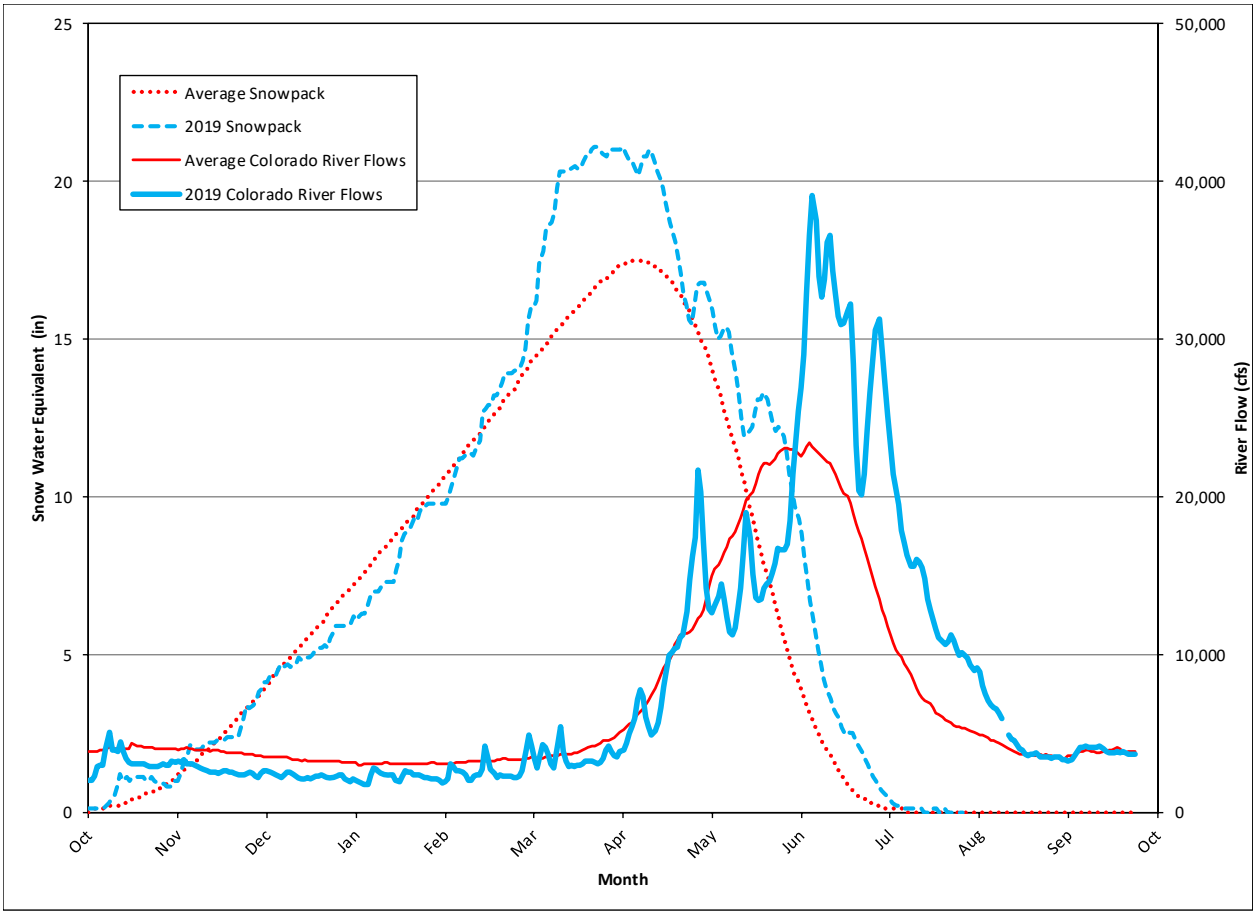

Figure 5. Average and 2019 Snowpack and Colorado River Flows

This document focuses on the river flows between April and August 2019. Figure 6 provides the average flows along with the 2019 flows and how the flows were segregated for this document and the applicable dates.

Similar to previous flood events, flood waters did not impact the site until the river exceeded approximately 20,000 cfs. On May 1, 2019, river flow reached 21,300 cfs, exceeded its banks and entered the site in the north off-pile area. However, only limited areas of the site were impacted because the flows decreased below 20,000 cfs by May 2.

Flows subsided between May 2 and June 1, and there was no significant site flooding during this time period. Starting on June 1, the river flows started increasing significantly, from 17,200 cfs to the 2019 peak flow of 39,100 cfs by June 10. During this time, flood waters reached their maximum impact on the site. Between June 10 and June 23, two smaller peaks occurred on June 16 (36,600 cfs) and June 23 (32,200 cfs).

Between June 23 and June 27, the river flows decreased from 32,200 cfs to 20,400 cfs. By July 3, the flows abruptly increased again to 31,300 cfs. Starting on July 4, the flows sharply decreased to below 20,000 cfs by July 10. By this time, flood waters were no longer flowing onto the site.

By the end of August, all flood water on site either evaporated, was pumped into a nearby irrigation plot, or naturally infiltrated, and the well field was dry.

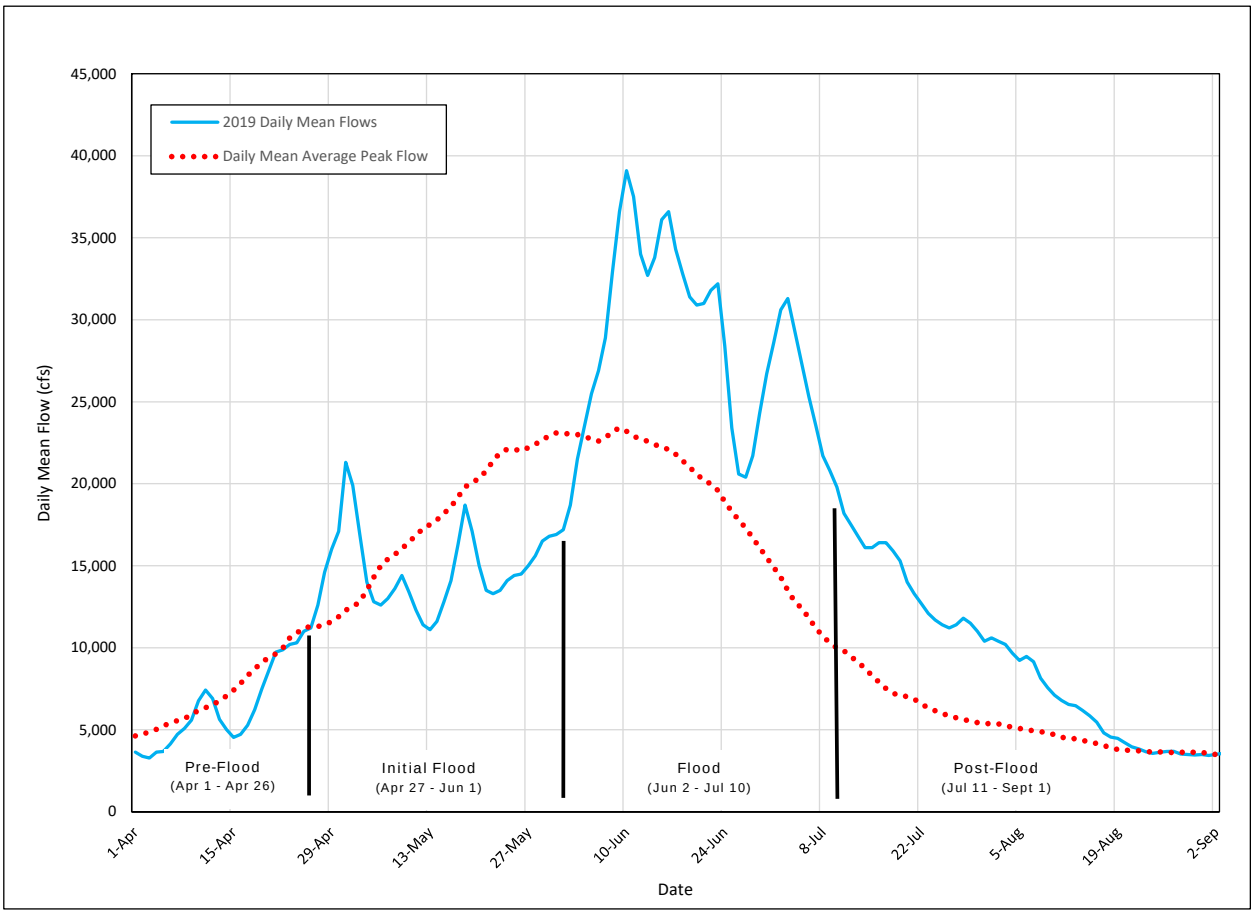

Figure 6. 2019 Hydrograph and Flood Impacts to the Site, April through August

2.0 Pre-flood Actions through April 26

In early February 2019, Groundwater Program personnel began monitoring websites (listed in Section 6.0) that provided information regarding the snowpack in the Upper Colorado River Basin when it appeared to have the potential to result in above-average river flows. In the first two weeks of March 2019, weather patterns over the Colorado River Basin produced a substantial increase in the snowpack. At this point, the 2019 snowpack deviated from the average snowpack as displayed in Figure 4.

During March and April, preparations for potential flooding were completed as the snowpack increased. Updates on snowpack and forecasted river flow were distributed to key contractor and DOE personnel. The Colorado River surface elevation at the site river gage was recorded frequently beginning on April 1.

2.1 Observations

By March 26, the snowpack reached its 2019 maximum, with a snow water equivalent of 21.1 inches. The flows between April 1 and April 26 ranged between 3,270 cfs (representative of the river base flow) and 11,200 cfs. Based on the rating curve equation (Figure 2), these flows are equivalent to river surface elevation ranging from 3,953.6 to 3,957.2 ft msl.

As shown in Figure 7, flows between April 1 and April 27 followed the average river flows, with only a few days (April 10 through 14) during this time period when the flows exceeded the average.

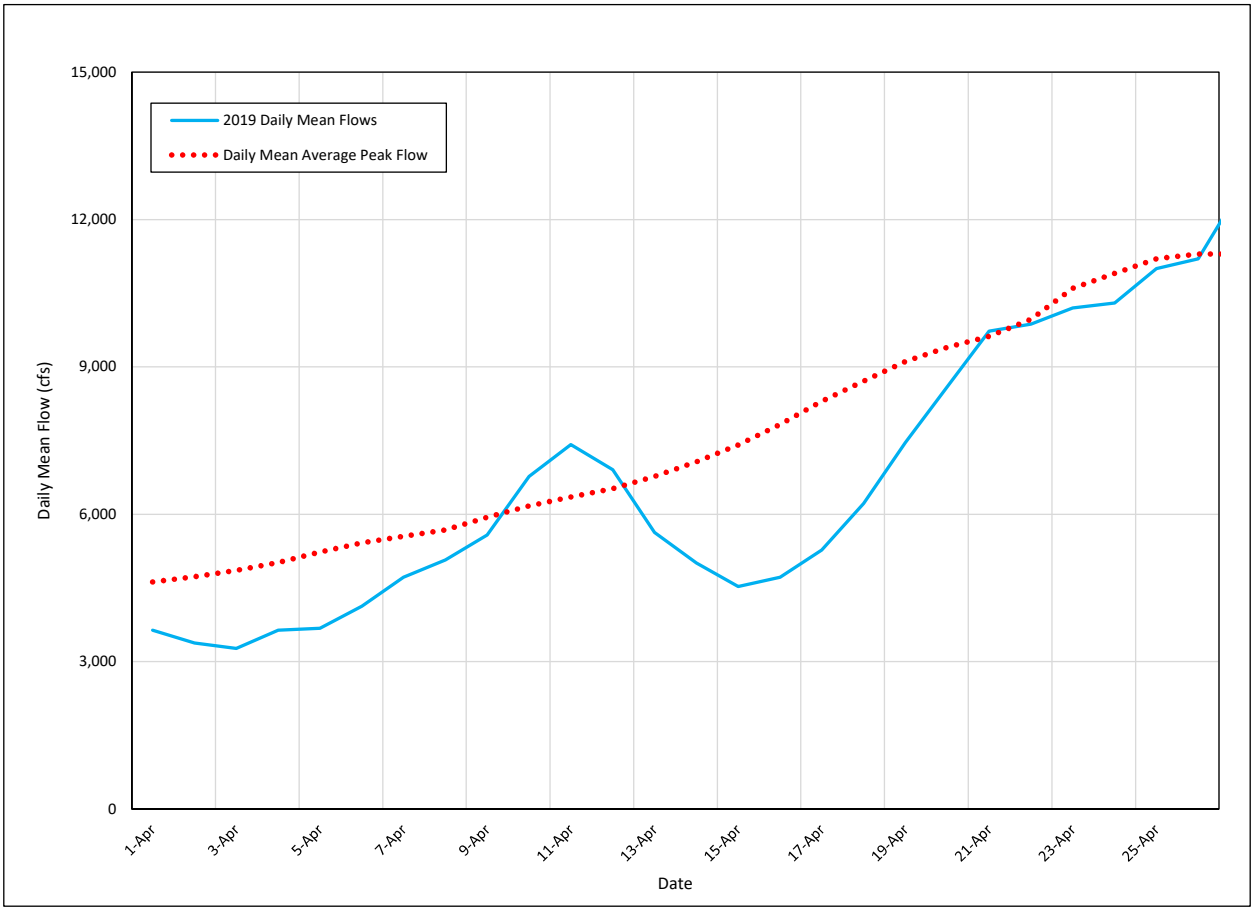

Figure 7. Average and 2019 Colorado River Flows, April 1 through 26 (Pre-flood)

2.2 Actions Completed

In preparation for the upcoming high river flows, the following actions were taken:

- New flood elevation maps were created with topographic data from April 2014. These maps were included in the updated *Flood and Drought Mitigation Plan* issued in December 2018 (Appendix A).
- Unlike previous years, all irrigation piping was left in place as it was since it was already secured to the ground.

- Groundwater, Field Management, Safety and Health, and Quality Assurance staff met to discuss the Colorado River predicted flows on April 17 and the associated actions presented in the *Flood and Drought Mitigation Plan*. The meeting to discuss the *Flood and Drought Mitigation Plan* action items for flows greater than 15,000 cfs with the operation's staff was held on April 25.
- Also during the week of April 22, revegetation equipment was moved out of the well field to higher ground, and property signs located along the riverbank were removed.
- An electrical subcontractor was contacted regarding the potential need to remove electrical equipment from the well field; a subcontractor to move the pump house to higher ground was also contacted.

Table 1 summarizes the actions completed during the pre-flood period.

Table 1. Pre-flood Actions

Action	River Flow (cfs)	On-site River Elevation (ft msl)	Date Completed
Revised and distributed the *Moab UMTRA Project Flood and Drought Mitigation Plan*	NA	NA	12/2018
Held preliminary meeting on flood preparations	5,270	3,954.6	4/17/19
Electrical Subcontractor contacted	6,220	3,955.0	4/18/19
Removed revegetation equipment from the well field	9,870 to 11,000	3,956.6 to 3,957.1	4/22/19 to 4/25/19
Held Project meeting on flood preparations	11,000	3,957.1	4/25/19

3.0 Initial Flood Actions April 27 to June 1

3.1 Observations

On April 27, the Colorado River flows started deviating from the average (Figure 8) and started increasing significantly. On April 29, the river flow was 16,000 cfs (3,959.2 ft msl), water had backed about halfway up the Moab Wash to the lower crossing, and the river exceeded its bank and began to inundate the north off-pile area.

By May 1, the flows reached 21,300 cfs (3,961.3 ft msl), and water was observed actively flowing into the north off-pile, flooding low-lying areas. Colorado River water had back flowed into Moab Wash and reached the rocks located just below the lower crossing. By May 2, when the flow decreased to 19,900 cfs, water was no longer actively flowing into the north off-pile area.

A cold front moving through the basin impacted the snow melt, and by May 6, the flows decreased to 12,600 cfs. This initial peak resulted in only minor flooding of the site, primarily to the north of Moab Wash in the north off-pile area.

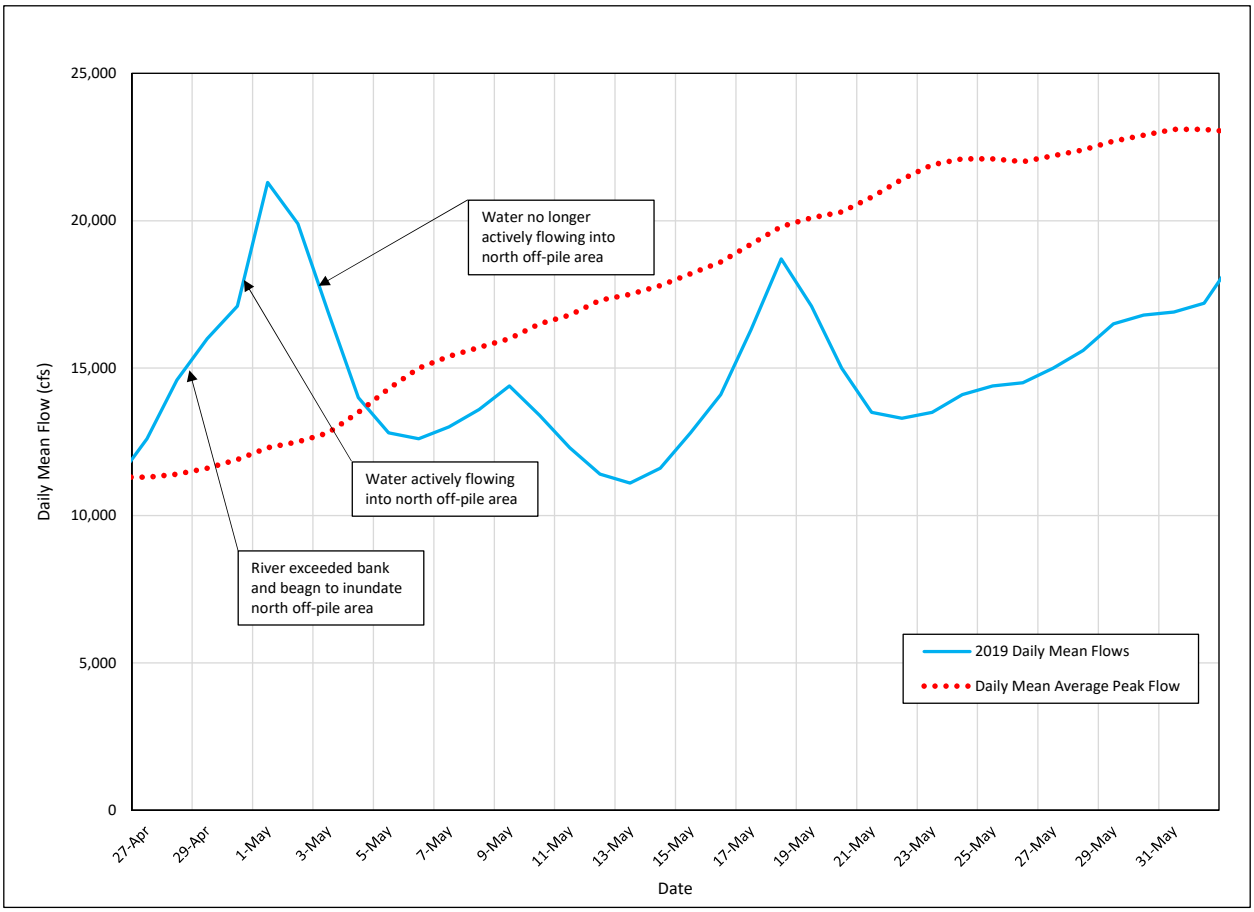

Figure 8. Average and 2019 Colorado River Flows, April 27 through June 1 (Initial Flood)

From May 7 through June 1, flows remained below average for this time period, fluctuating between 11,100 and 18,700 cfs (elevations from 3957.1 to 3960.3 ft msl). During this time, personnel were monitoring the snowpack and CBRFC websites and based on the amount of snowpack remaining after this initial melt, it was apparent that flows would again increase once the weather patterns changed.

3.2 Actions Completed

As the river initially flooded the portions of the site, the following actions outlined in the *Flood and Drought Mitigation Plan* were completed:

- On May 1, the injection system was shut down in response to the increasing flows, following the *Flood and Drought Mitigation Plan*. Parameters and water levels recorded from the Configuration 4 observation wells to confirm a freshwater lens had formed within the aquifer beneath the well field.
- The Grand County Mosquito Control Coordinator visited the site to identify areas of potential concern and treated for mosquito larva on May 5, May 9, May 15, and May 22.
- Radiological Control collected pre-flood soil samples from surface low elevation spots for radium analysis on May 22
- The CBRFC hydrologists were contacted on May 23 and May 28 to obtain updates on the predicted peak flows and information regarding any upstream reservoir releases.

- A meeting to discuss the Flood and Drought Mitigation Plan 25,000 cfs action level items was conducted on May 28 with the operation's staff, and the required walkdown and berm inspection attended by Project personnel was completed on May 29.
- On May 30, the groundwater extraction well field was shut down.

Table 2 summarizes the actions completed during site initial flooding.

Table 2. Initial Flood Actions

Action	River Flow (cfs)	On-site River Elevation (ft msl)	Date Completed
Injection System operations suspended	21,300	3,961.3	5/1/19
Grand County Mosquito Control treatment	12,800	3,957.9	5/5/19
Grand County Mosquito Control treatment	14,400	3,958.6	5/9/19
Grand County Mosquito Control treatment	12,800	3,957.9	5/15/19
RADCON collected pre-flood soil samples near base of pile	13,300	3,958.1	5/22/19
Grand County Mosquito Control treatment	13,300	3,958.1	5/22/19
Contacted CBRFC Hydrologist for peak flow update	13,500	3,958.2	5/23/19
Contacted CBRFC Hydrologist for peak flow update	15,600	3,959.1	5/28/19
Met to discuss flows over 25,000 cfs	15,600	3,959.1	5/28/19
Project 25,000+ cfs walk down/berm inspection	16,500	3,959.4	5/29/19
Groundwater Extraction System operations suspended	16,800	3,959.7	5/30/19

4.0 Flood Actions June 2 to July 10

4.1 Observations

Starting on June 2, Colorado River flows started to significantly increase, and by June 5, the flow reached 25,500 cfs (elevation of 3,962.8 ft msl), and the river water had backed up into Moab Wash to reach just below the lower crossing. On June 8, the lower crossing was flooded when the flows reached 32,900 cfs (3,965.2 ft msl). The 2019 peak flow of 39,100 cfs (3,967.0 ft msl) occurred on June 10, when water was actively flowing to the south from the lower crossing into the well field. Figure 9 displays the hydrograph and observations for this time period.

Well field flooding was compounded by flood waters that had worked their way from downstream of the site into the southern channel and started flowing north into the wellfield starting on June 11. By June 12, flood waters had reached near the base of the tailings pile. After June 18, the water had stopped flowing from the southern channel into the well field.
As displayed in Figure 9, three smaller peaks occurred over the following month (36,600 cfs on June 16, 32,200 cfs on June 23, and 31,300 cfs on July 3).

Each of these peaks resulted in continued flooding of areas of the site after the peak flows on June 10. Figure 10 displays the predicted areas impacted by a flow of 37,000 cfs, which was generated when the CBRFC predicted the peak flow would reach this level.

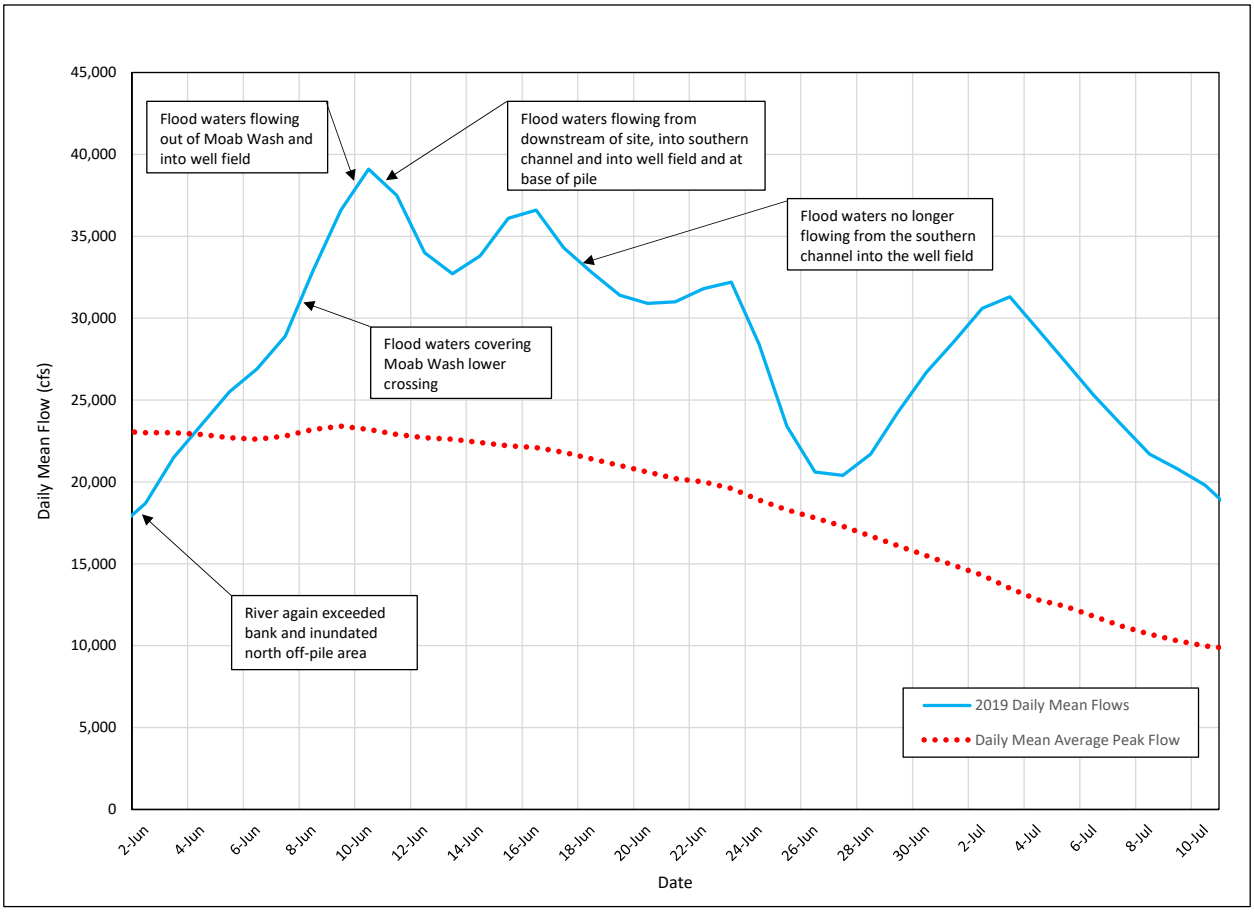

Figure 9. Average and 2019 Colorado River Flows, June 2 through July 10 (Flood)

4.2 Actions Completed

The following actions were taken while the flood waters were impacting the site:

- On June 2, a meeting was held with pertinent Project personnel to determine what actions were necessary as the flow reached above 35,000 cfs. Daily emails were also sent to alert personnel of the river flow, site gage elevation, and changes to the flooded areas on site.
- On June 3, 4, and 5, all electrical equipment was removed from the extraction well racks by BODEC Electric.
- The pumphouse was moved to higher ground (over by the State Highway 279 well field gate) by MorStorage on June 5.
- The radioparticulate sampling equipment, as well as any radon and gamma detectors, were removed from the well field and Matheson Wetlands on June 5.
- Flowmeter plates and pressure transducers were pulled from the injection, extraction, and observation wells.

- Signs along the river and a site road were removed during the first week of June and a lighted sign was added to the riverbank near the freshwater pond by operation's staff to alert boaters of underwater hazards during this same time period.
- On June 24, Utah Division of Natural Resources (DNR) was contacted regarding the ponded areas. Based on previous flood events (2011 and 2014), when DNR personnel came on site and shocked the areas but found no native fish, they decided it was not necessary to return in 2019 to take further action.
- After the active flooding had subsided, a trash pump was brought on site June 25 to transfer water from the well field into a nearby irrigation flood plot. This pump was utilized a minimum of four days/week.

Appendix B contains photos of the flooding that occurred on site.

Table 3 summarizes actions completed while flood waters impacted the site.

Table 3. Flood Actions

Action	River Flow (cfs)	On-site River Elevation (ft msl)	Date Completed
Met to discuss flows over 35,000 cfs	18,700	3,960.3	6/2/19
Electrical components (extraction pump controllers, electrical panels, power centers, CF4 heaters) removed from well field by BODEC Electric	21,500 to 25,500	3,961.4 to 3,962.8	6/3/19 to 6/5/19
Flowmeters and pressure transducers removed	25,500	3,962.8	6/5/19
Pumphouse moved near Hwy 279 gate by MorStorage	25,500	3,962.8	6/5/19
Air radioparticulate sampling equipment, radon, and TLDs removed from well field and Matheson Wetlands	25,500	3,962.8	6/5/19
Site boundary signs removed from riverbank and message sign placed near FW pond to warn boaters	NR	NR	1st week of June
Utah DNR contacted regarding ponded water in well field	28,400	3,963.8	6/24/19
Trash pump brought onsite to transfer ponded water to irrigation flood plot	23,400	3,962.1	6/25/19

CF = configuration; NR = Not Recorded

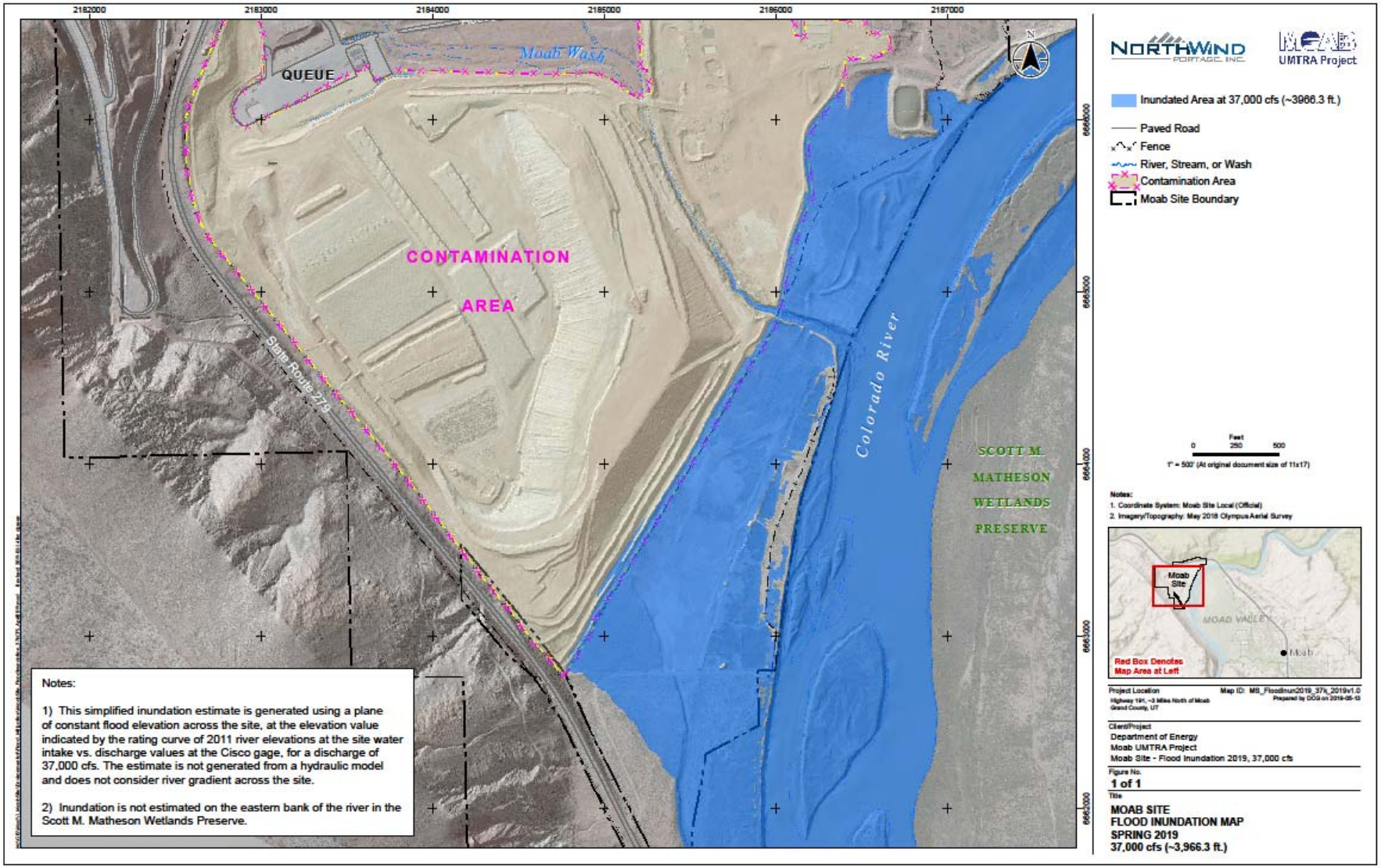

Figure 10. Predicted Flooded Areas Based on a Colorado River Flow of 37,000 cfs

5.0 Post-flood Actions July 11 to September 1

5.1 Observations

Flows gradually decreased between July 11 and September 1, from 18,200 to 3,440 cfs. As displayed in Figure 11, these flows were above average through August 23.

The roads connecting the Moab Wash lower crossing became passable in mid-July as the soil started to dry. Several areas of ponded water remained in the north off-pile area until late July. By late August, the ponded water in the well field had either evaporated, infiltrated, or was transferred to the irrigation plot by the trash pump.

Up to 6 inches of silt were deposited in portions of the north off-pile area; however, in most areas, existing vegetation survived. From the observed grain size of the deposits, the floodwater velocity was assumed to have been low enough neither to erode soils nor deposit gravels or cobbles.

Appendix C contains photos of the post-flood period. Post-flood soil samples were collected by Radiological Control in late October, and the results are presented in Appendix D.

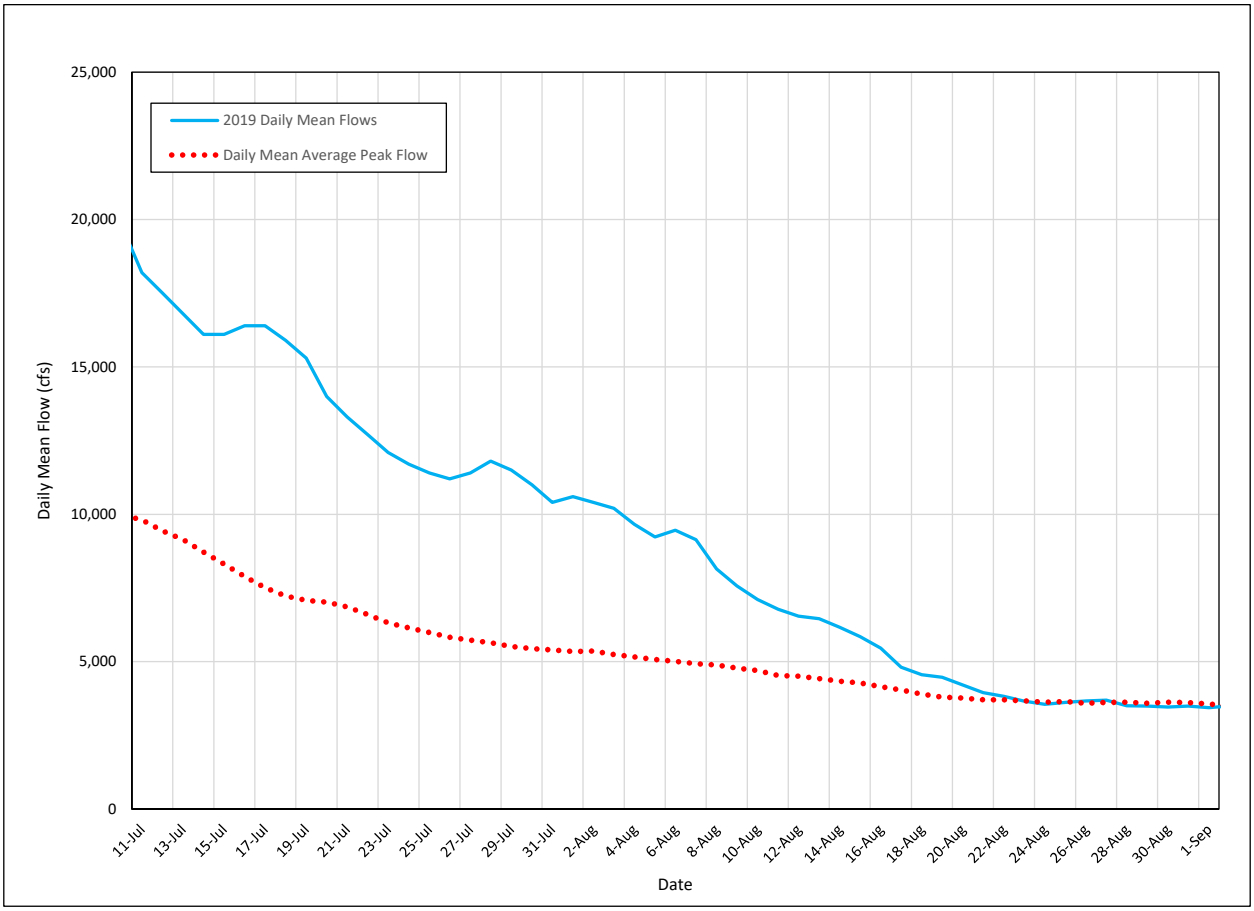

Figure 11. Average and 2019 Colorado River Flows, July 11 through September 1 (Post Flood)

5.2 Actions Completed

The flowing actions were taken after flood waters impacted the site:

- The transfer pump was utilized through July 17, at which time it was returned to the rental company. Between June 25 and July 17, an estimated 3.9 million gallons of water were transferred to the nearby flood irrigation plot.
- On July 30, MorStorage was brought back on site to replace the pumphouse to the original location using a roll off truck.
- On July 31, BODEC Electric began reinstalling all variable frequency drives, transformers, and electrical components for the extraction wells. All of the associated electrical panels were inspected, labeled, and tested. Locks and tags were removed from the main disconnect, and power was restored to the well pumps. All work was completed following National Electrical Manufacturers Association *Evaluating Water-Damaged Electrical Equipment* and *Guidelines for Handling Water-Damaged Electrical Equipment*. This work was completed by August 12.
- The groundwater extraction system was restarted on August 13, and by September 3, the freshwater injection system was restarted.
- The air particulate sampling equipment was replaced on August 28.
- Damage caused by flood water erosion in the vicinity of the Moab Wash lower crossing was repaired by the end of July.

Table 4 summarizes actions completed while flood waters impacted the site.

Table 4. Post-flood Actions

Action	River Flow (cfs)	On-site River Elevation (ft msl)	Date Completed
Rented Trash pump returned	16,400	3,959.4	7/17/19
MorStorage returned pumphouse to well field	11,000	3,957.1	7/30/19
Electrical components (extraction pump controllers, electrical panels, power centers, CF4 heaters) reinstalled in well field by BODEC Electric	10,400 to 6,500	3,956.9 to 3,955.2	7/31/19 to 8/12/19
Groundwater Extraction System restarted	6,460	3,955.1	8/13/19
Air radioparticulate sampling equipment, radon and TLDs returned to well field and Matheson Wetlands	3,510	3,953.7	8/28/19
Site boundary signs reinstalled along river bank and message sign removed FW pond	NR	NR	End of July
Repair erosion in vicinity of Moab Wash	NR	NR	End of July
Radiological Control collected soil samples from low elevation spots along CA boundary	NR	NR	10/29/19

CA = Contamination Area; CF = configuration; NR = Not Recorded

6.0 Lessons Learned

As flooding occurs on site, personnel take the opportunity to learn from the experience so the *Flood and Drought Mitigation Plan* can be revised to include any updates that may help protect property and the environment.

The following items were noted during the 2019 flood event:

- Site elevation versus river flow is not always the most accurate method of determining when and where the site will flood. The well field area elevation suggests that when the river flow reaches 25,000 cfs, this area will flood from the river backing up in the southern drainage channel. In 2019, the well field area did not flood until 39,600 cfs. However, once floodwater entered this area, it continued to flow. This suggests that something, such as plant debris or soil, was still blocking the channel and preventing the water from flowing in. Inspection of the drainage channel south of the property boundary should be included in the flood preparations.
- After the river peaked, the ponded water in the well field area had to be pumped out because the water did not flow back through the channel as expected.
- Flooding in the well field area may have been prevented by increasing the elevation of the southern side of the Moab Wash lower crossing. An evaluation should be made during flood preparations to determine if additional actions should be taken to prevent flooding of the well field area.
- Although most of the accessible signage was removed before site flooding, removing all of the signs before the start of flooding should be added to the action list.
- The costs associated with the removal and re-installation of all electrical equipment during the 2019 flood event was approximately $22,500. BODEC Electric estimated it would cost approximately $40,500 to transfer all well field electrical components onto mobile skids that would allow for an easy disconnect and relocation to higher ground in the event of another flood.

7.0 Websites

Staff monitored and/or used information from the following websites to help prepare for and respond to the 2019 flood.

- Colorado SNOTEL Snow Water Equivalent Update Graph
  http://www.wcc.nrcs.usda.gov/cgibin/snowup-graph.pl?state=CO
- Colorado River Basin Water Year Comparison Graph
  http://www.cpachecojr.com/cgi-bin/work/get_basin.cgi
- National Oceanic and Atmospheric Administration, Colorado River Basin Forecast Center, Cisco Hydrograph
  http://www.cbrfc.noaa.gov/river/station/flowplot/flowplot.cgi?CLRU1
- National Weather Service Water Resources Outlook
  http://wateroutlook.nwrfc.noaa.gov/point/ranking
- Natural Resources Conservation Service Colorado Home Page
  http://www.co.nrcs.usda.gov/snow/snow/watershed/current/daily/maps_graphs/index.html
- SNOTEL Basin Snow Water Equivalent Projection Maps with Selectable Future Conditions
  http://www.co.nrcs.usda.gov/snow/snow/watershed/current/daily/maps_graphs/swe_projections_05.html
- U.S. Geological Survey National Water Information System: Web Interface for Colorado River Cisco Gaging Station
  http://waterdata.usgs.gov/ut/nwis/uv/?site_no=09180500&agency_cd=USGS

8.0 References

DOE (U.S. Department of Energy), *Moab UMTRA Project 2011 Flood Response Summary* (DOE-EM/GJTAC2007).

DOE (U.S. Department of Energy), *Moab UMTRA Project 2014 Flood Response Summary* (DOE-EM/GJTAC2152).

DOE (U.S. Department of Energy), *Moab UMTRA Project Flood and Drought Mitigation Plan* (DOE-EM/GJTAC1640).

Appendix A.
2019 Flood and Drought Mitigation Plan Maps

Appendix A. 2019 Flood and Drought Mitigation Plan Maps

Figure A-1. Floodwater on Site at 15,000 cfs

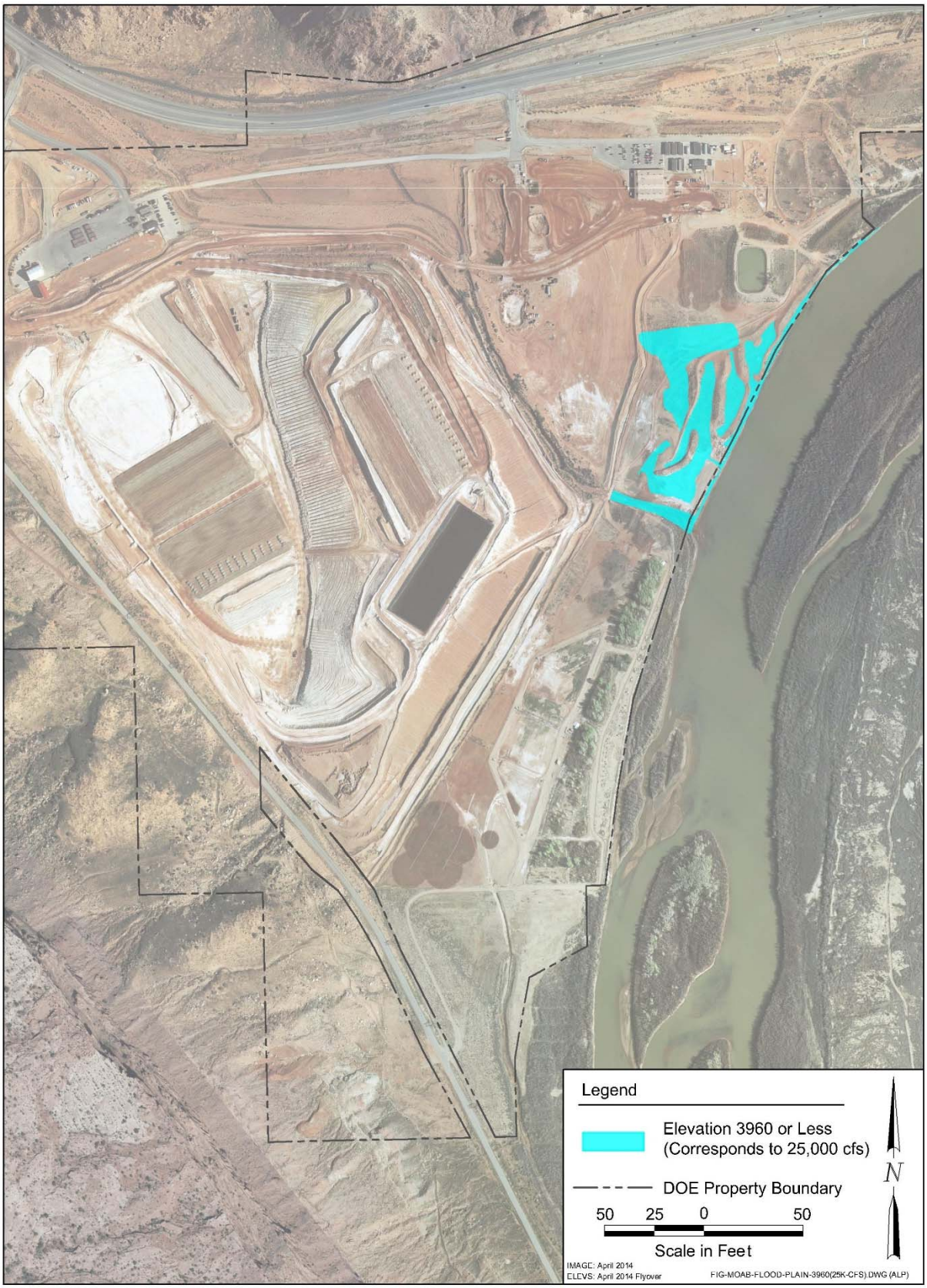

Figure A-2. Floodwater on Site at 25,000 cfs

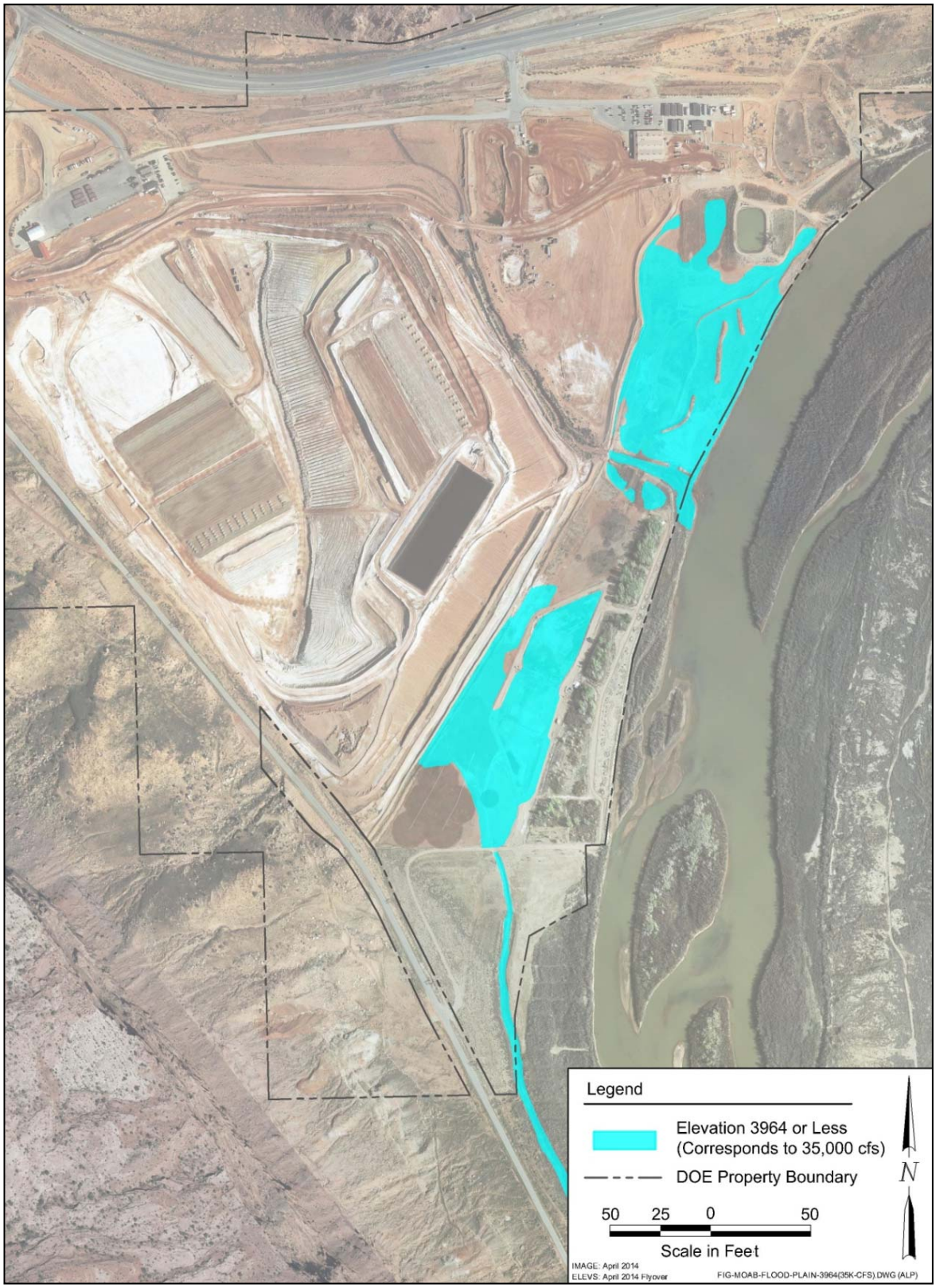

Figure A-3. Floodwater on Site at 35,000 cfs

Appendix B.
Flood Photos

Appendix B. Flood Photos

June 4, 2019
23,500 cfs; 3962.1 ft msl

Photo B-1. River Water Backing Up into Lower Reach of Moab Wash

Photo B-2. North Off-pile Area

June 5, 2019
25,500 cfs; 3962.8 ft msl

Photo B-3. Moving Pump House

Photo B-4. Moving Well Field Power Center

June 8, 2019
32,900 cfs; 3965.2 ft msl

Photo B-5. Moab Wash Lower Crossing

Photo B-6. North Off-Pile Area

June 10, 2019
39,100 cfs; 3967.0 ft msl

Photo B-7. Water Flowing from Moab Wash into Well Field

Photo B-8. North Off-Pile from Contamination Area

June 10, 2019
39,100 cfs; 3967.0 ft msl

Photo B-9. Well Field from Contamination Area

Photo B-10. Water Flowing into Well Field from Moab Wash

June 11, 2014
37,500 cfs; 3966.5 ft msl

Photo B-11. Drainage Channel through South Off-pile Area

Photo B-12. Well 0810 Vault

June 11, 2014
37,500 cfs; 3966.5 ft msl

Photo B-13. Well 0812 Vault

Photo B-14. Well 0813 Vault

June 12, 2019
34,000 cfs; 3965.5 ft msl

Photo B-15. Ponded Water in Well Field from Hwy 279

Photo B-16. Ponded Water in Well Field from Hwy 279

June 13, 2019
32,700 cfs; 3965.1 ft msl

Photo B-17. North Off-Pile from Contamination Area

Photo B-18. South of Moab Wash from Contamination Area

June 13, 2019
32,700 cfs; 3965.1 ft msl

Photo B-19. Northern End of Well Field from Contamination Area

Photo B-20. Southern End of Well Field from Contamination Area

June 18, 2019
32,800 cfs; 3965.2 ft msl

Photo B-21. Drainage Channel through South Off-pile Area

Photo B-22. Well Field from Southern End

June 24, 2019
28,400 cfs; 3963.8 ft msl

Photo B-23. Moab Wash Lower Crossing Erosion Damage

Photo B-24. Moab Wash Lower Crossing Exposed Gravel

June 25, 2019
23,400 cfs; 3962.1 ft msl

Photo B-25. Trash Pump Transferring Water from Well Field to the Irrigation Plot

Photo B-26. Well 0810

July 10, 2019
19,800 cfs; 3960.7 ft msl

Photo B-27. Well 0810

Photo B-28. Well Field Road, Well 0816

Appendix C.
Post-flood Photos

Appendix C. Post-flood Photos

July 18, 2019
15,900 cfs; 3959.2 ft msl

Photo C-1. Trash Pump Set Up at Southern End of Well Field

Photo C-2. Southern End of Well Field, Wells 0814 (L) and 0810 (R)

Appendix C. Post-flood Photos (*continued*)

July 30, 2014
11,000 cfs; 3957.1 ft msl

Photo C-3. Moving Pump House from Near Hwy 279 Gate

Photo C-4. Replacing Electrical Components on Well 0811

Appendix C. Post-flood Photos (*continued*)

August 27, 2019
3,690 cfs; 3953.8 ft msl

Photo C-5. Well 0810

Appendix D.
Radiological Survey Results

Appendix D. Radiological Survey Results

Pre-flood Samples, Collected 5/22/19						
Location Sample Number	**Sample Ticket Number**	**Sample Depth (inches)**	**Net Mass (grams)**	**Net Peak (counts)**	**Radium Conc. (pCi/g)**	**Notes**
Well F#1	RAH 839	Grab	539.9	5911	24.7	Well Field pre-flood #1, low area by vault 0815 300-330 cps
Well F#2	RAH 840	Grab	487.4	668	3.1	Well Field pre-flood #2, low area by vault 0814 200-220 cps
Well F#3	RAH 841	Grab	478	759	3.6	Well Field pre-flood #3, low area by vault 0816 200-220 cps
Post-flood Samples, Collected 10/28/19						
WF#1	RAH 110	0 - 6	419.3	1039	5.7	Sample #1 well field area in lower depression next to CA line, walk scan range 230-280 cps, 13.1 uR/hr to 14.5 uR/hr (shielded)
WF#2	RAH 111	0 - 6	354.2	1923	12.4	Sample #2 well field area in lower depression next to CA line, walk scan range 230− 280 cps, 13.1 uR/hr to 14.5 uR/hr (shielded)
WF#3	RAH 112	0 - 6	412.4	852	4.7	Sample #3 well field area in lower depression next to CA line, walk scan range 230-280 cps, 13.1 uR/hr to 14.5 uR/hr (shielded)
WF#4	RAH 113	0 - 6	374.5	849	5.2	Sample #4 well field area in lower depression next to CA line, walk scan range 230-280 cps, 13.1 uR/hr to 14.5 uR/hr (shielded)
WFAR	RAH 117	0 - 6	429.2	512	2.7	Low area of well field access road

CA = Contamination Area; Conc = concentration; pCi/g = picocuries per gram, uR/hr = micro Roentgen per hour