APPENDIX P:

HIGH-FLOW EXPERIMENT PROTOCOL FOR THE PREFERRED ALTERNATIVE

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HIGH-FLOW EXPERIMENT PROTOCOL FOR THE PREFERRED ALTERNATIVE

High-volume dam releases for sediment conservation are an experimental action that would be implemented under the preferred alternative (Alternative D) of the Glen Canyon Dam Long-Term Experimental and Management Plan (LTEMP). Implementation of high-flow experiments (HFEs) under the preferred alternative would follow the HFE protocol described below for the overall process of implementation of HFEs, including implementation considerations and conditions that would result in discontinuing specific experiments.

HFE releases are restricted to limited periods of the year when the highest volumes of sediment are most likely available for building sandbars. Water year releases would follow the pattern identified for the preferred alternative as adopted by the Secretary of the Interior in the LTEMP Record of Decision (ROD) and the Long Range Operating Criteria (LROC) as currently implemented through the 2007 Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Powell and Lake Mead (Reclamation 2007a). Sediment-triggered HFEs may be made in spring (March or April) or fall (October or November) (Figure P-1). Fall Extended HFEs duration would range from less than 1 hr to 250 hr. Spring and fall HFEs which are not Extended HFEs, would have a duration range from less than 1 hr to 96 hr. Proactive HFEs may be made in spring or early summer (April, May or June), and would have a duration range up to 24 hr. HFE magnitude would range from 31,500 cfs to 45,000 cfs. Frequency of HFEs would be determined by tributary sediment inputs, annual release volumes, resource conditions, and the decision process carried out by the Department of the Interior (DOI) (Sections 2.2.4.3 and 2.2.4.4 of the EIS). Extended-duration fall HFEs are limited to a frequency of 4 times total in a 20 year period.

The HFE protocol uses a “store and release” approach for sediment-triggered HFEs, in which sediment inputs are tracked over two accounting periods, one for each seasonal HFE: spring (December through June) and fall (July through November) (Figure P-1). In addition, the HFE protocol can trigger proactive spring HFEs that would be tested only in years with high annual water volume (i.e., ≥10 maf) when no sediment-triggered HFE occurs. Implementation of an HFE may require reallocating water from other months in order to maintain flows above the required minimum (i.e., 5,000 to 8,000 cfs). The protocol would implement the maximum possible magnitude and duration of HFE that would achieve a positive sand mass balance in Marble Canyon, as determined by modeling.

P.1 DECISION-MAKING PROCESS

The HFE protocol is a decision-making process that consists of three components: (1) planning, (2) modeling, and (3) decision and implementation. The following three subsections describe each of these components.

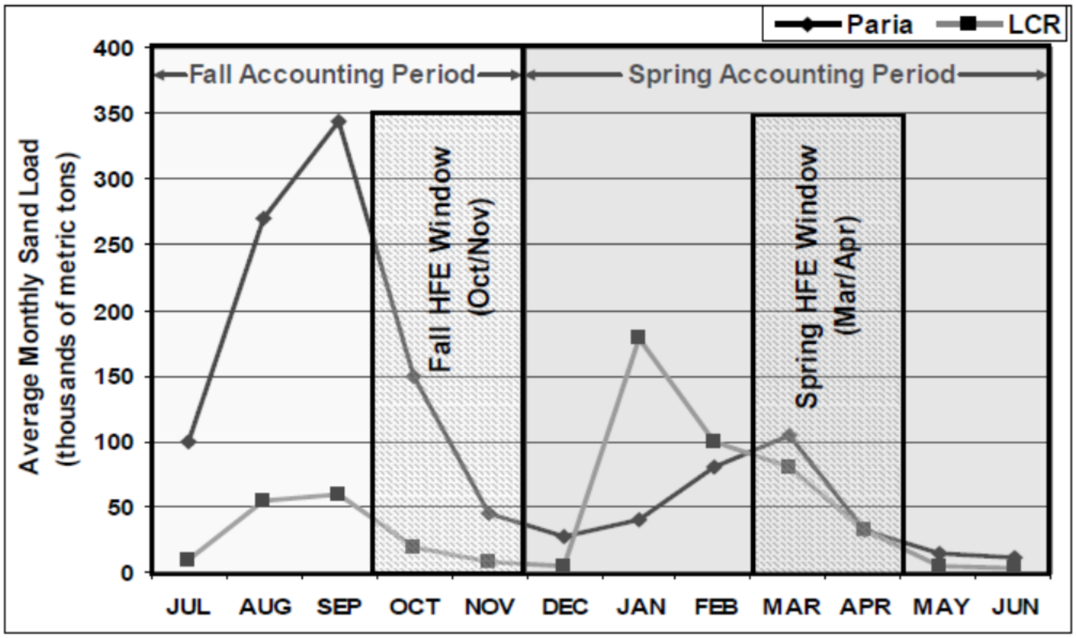

FIGURE P-1 Average Monthly Sand Load from the Paria River and Little Colorado River Showing the Fall and Spring HFE Accounting Periods and Implementation Windows

P.1.1 Planning

The first component of the HFE protocol is planning. An important aspect of planning is the development and implementation of research and monitoring activities appropriate to monitor the effects of the HFEs. The Bureau of Reclamation (Reclamation) would be prepared to conduct an HFE if resource conditions are suitable, there is sufficient sediment input or projected annual release to trigger an HFE, and DOI determines conditions are suitable for proceeding. An annual process prior to a decision on conducting experiments, including an HFE, would evaluate the information on the status and trends of the following resources: (1) water quality and water delivery, (2) humpback chub, (3) sediment, (4) riparian ecosystems, (5) historic properties and traditional cultural properties, (6) Tribal concerns, (7) hydropower production and Western Area Power Administration's (WAPA's) assessment of the status of the Basin Fund, (8) the rainbow trout fishery, (9) recreation, and (10) other resources. Although these resources are listed for consideration on a regular basis, DOI intends to retain sufficient flexibility in implementation of HFEs to allow for response to unforeseen circumstances or events that involve any other resources not listed here. The recent discovery of nonnative green sunfish in the Glen Canyon reach illustrates the need to be responsive to unforeseen conditions.

In implementing HFEs and other experiments, the DOI will exercise a formal process of stakeholder engagement to ensure decisions are made with sufficient information regarding the condition and potential effects on important resources. As an initial platform to discuss potential future experimental actions, the DOI will hold Glen Canyon Dam Adaptive Management Program (GCDAMP) annual reporting meetings for all interested stakeholders; these meetings will present the best available scientific information and learning from previously implemented experiments and ongoing monitoring of resources. As a follow up to this process, the DOI will meet with the GCDAMP Technical Work Group (TWG) to discuss the experimental actions being contemplated for the year.

The DOI also will conduct monthly Glen Canyon Dam operational coordination meetings or calls with the DOI bureaus (U.S. Geological Survey [USGS], National Park Service [NPS], Fish and Wildlife Service [FWS], Bureau of Indian Affairs [BIA], and Reclamation), Western Area Power Administration (WAPA), Arizona Game and Fish Department (AZGFD), and representatives from the Basin States and the Upper Colorado River Commission (UCRC). Each DOI bureau will provide updates on the status of resources and dam operations. In addition, WAPA will provide updates on the status of the Basin Fund, projected purchase power prices, and its financial and operational considerations. These meetings or calls are intended to provide an opportunity for participants to share and obtain the most up-to-date information on dam operational considerations and the status of resources (including ecological, cultural, Tribal, recreation, and the Basin Fund). One liaison from each Basin State and from the UCRC will be allowed to participate in the monthly operational coordination meetings or calls.

P.1.2 Modeling

Mathematical models are used to make recommendations for future sediment-triggered HFEs using contemporary sediment data and forecasted hydrologic data to determine whether suitable sediment and hydrology conditions exist for a sediment-triggered HFE.

The two basic inputs for the modeling are the water input or hydrology, which is taken from the Colorado River Simulation System (CRSS) (Reclamation 1988, 2007b) and the sediment input, which in this case is restricted to inputs from the Paria River. A flow routing model (Wiele and Smith 1996) is used to simulate water passing downstream. A sediment budget model (Wright et al. 2010) is used to integrate the flow routing with the sediment inputs and outputs to determine whether or not a sediment mass balance is achieved for sediment-triggered HFEs (Russell and Huang 2010).

The sand budget is the net amount of sand in metric tons that has accumulated in the river channel over some period of time. In the Paria River, the two primary sand input periods are July through October and January through March (Figure P-1). During these two periods, sand is being accumulated at a higher rate than in other months. In order to accommodate the decision process and to address other resource needs or concerns, the sediment-triggered HFE windows are two-months long (October–November and March–April).

The sand budget model would use the sediment inputs and estimates the outputs for three river reaches where sand is tracked: (1) Lees Ferry/Paria River (RM 0) to RM 30, (2) RM 30 to Little Colorado River (RM 61), and (3) Little Colorado River to RM 87. The first two reaches would be used to estimate the maximum possible magnitude and duration of an HFE that will not create a negative sand mass balance in Marble Canyon (RM 0 to RM 61).

Hydrologic data for implementation would be based on forecasted monthly inflow volumes from the National Weather Service's Colorado Basin River Forecast Center and Reclamation's 24-month study projected storage conditions. The 24-month study computer model projects future reservoir conditions and potential dam operations for the system reservoirs given existing reservoir conditions; inflow forecasts and projections; and a variety of operational policies and guidelines. Monthly volumes would be apportioned to daily dam releases by WAPA. Water supply forecasts and models would be needed to make these projections and uncertainty associated with these projects would need to be considered in the decision-making process (Grantz and Patno 2010). The sediment data used would be real-time accumulated inputs estimated from the Paria River streamflow gages.

Sand availability at the onset of each release window is determined by the amount of sand received from the Paria River during the accumulation period less the amount transported downstream to the Little Colorado River as estimated by the sand routing model. Sand in Grand Canyon received from the Little Colorado River is viewed as an added benefit to the amount received from the Paria River. The Little Colorado River input cycle largely follows the same accrual periods as the Paria River; however, only sand inputs from the Paria River would be used in HFE modeling recommendations.

Each run is evaluated against 16 different HFE magnitudes and durations to determine their possible occurrence in the sediment-triggered HFE window months (Table P-1). The magnitude and duration of an HFE would be determined from the stored sand mass available on October 1 and March 1 of each water year, and the forecasted hydrology. The model evaluates each of the 16 sediment-triggered HFE types sequentially starting with the highest magnitude and duration of release. For example, the initial run determines if there is enough sediment available to achieve a positive sand mass balance in Marble Canyon for a release of 45,000 cfs for 250 hours. A positive sand mass balance is defined as a condition in which the amount of sediment being delivered by tributaries into the system exceeds the amount being exported from the system by ongoing dam operations and HFEs in the accounting period under consideration.

If the model run concludes that enough sediment is not available to achieve a positive sand mass balance, the next lower magnitude or duration sediment-triggered HFE is evaluated by the model. This is repeated until a sediment-triggered HFE scenario is reached that can be implemented with the available sediment or it is determined that a sediment-triggered HFE cannot be implemented. If it is determined that a sediment-triggered HFE cannot be implemented and the projected annual volume is greater than or equal to 10 maf, a proactive spring HFE would be triggered.

TABLE P-1 List of HFEs Available for Sediment-Triggered Experiments (fall, extended-duration fall and spring) under the Preferred Alternative

HFE ID	Peak Discharge (cfs)	Duration at Peak (hours)
1	45,000	250
2	45,000	192
3	45,000	144
4	45,000	96
5	45,000	72
6	45,000	60
7	45,000	48
8	45,000	36
9	45,000	24
10	45,000	12
11	45,000	1
12	41,500	1
13	39,000	1
14	36,500	1
15	34,000	1
16	31,500	1

The modeling component is based on four key analysis phases associated with the two sand budget accounting periods and the two sediment-triggered HFE windows:

- Phase 1: Fall Accounting Period. The fall accounting period is from July 1 to November 30. Beginning on July 1 of each year, monitoring data would be used to track the sand storage from Paria River inputs in Marble Canyon.

- Phase 2: October-November HFE Window. Beginning October 1, sand storage and forecast hydrology would be evaluated using the sediment budget model to determine whether conditions are suitable for an HFE. The model determines what magnitude and duration of the HFE, if any, would produce a positive sand mass balance at the end of the accounting period. If the model produces a positive result, the largest HFE that would result in a positive sand mass balance is forwarded to the decision and implementation component (see below), which also allows for other factors to be considered in the planning process (see Section P.1.1). During the decision process, sediment input would continue to be measured, the model would continue to be run and results or output would be forwarded to decision-makers to allow for refinement of the previously recommended magnitude and duration of the HFE. If the model produces a negative result, the model would be rerun using more recent sediment input to determine whether a positive sand mass balance would be reached in time to have an HFE in the release window.

- Phase 3: Spring Accounting Period. The spring accounting period is December 1 to June 30. As with the fall accounting period, monitoring data would be used to track the sand storage conditions in Marble Canyon during this time period. This accounting would be conducted regardless of whether or not a previous October or November HFE was conducted such that two HFEs could theoretically occur in the same year. The exception to this would be following an extended-duration fall HFE, as there would be no spring HFE following an extended-duration fall HFE. The accounting would continue to consider sand storage conditions present at the end of Phase 2, whether or not an HFE has occurred.

- Phase 4: March-April sediment-triggered HFE Window. The evaluation in this phase is the same for the October-November HFE window (see Phase 2) with the model output being forwarded to the decision and implementation component. The model output would be used in the same way as for the October-November determination. Whether or not a spring HFE is scheduled, sediment inputs would continue to be monitored through the end of the spring accounting period for use in the next accounting period. Note that proactive spring HFEs (see Section P.3.2), which are triggered by water volume and not sediment inputs, could occur in April, May, or June. In addition, spring HFEs would not be tested in years when there had been an extended-duration fall HFE earlier in the same water year.

P.1.3 Decision and Implementation

The third component of the HFE protocol is decision and implementation. This component could span a portion or most of the HFE window, depending on when conditions are deemed suitable for an HFE. The output from the model runs described above is used to determine if sediment and hydrology conditions are suitable for an HFE of a given magnitude and duration. For example, if the scenario that is identified by the model cannot be implemented because of facility limitation (e.g., if one or more turbines are out of service), managers would assess the need to modify the range of magnitude and duration of the HFE. Because this EIS has considered the effects of 45,000 cfs HFEs for 1 to 250 hours, it also serves to analyze the effects of HFEs at lower magnitudes and equivalent durations.

Because the model only considers water and sediment, an added purpose of the decision and implementation component is to consider potential effects on other resources. To determine whether conditions are suitable for implementing or discontinuing HFEs, the DOI will schedule implementation meetings or calls with the DOI bureaus (USGS, NPS, FWS, BIA, and Reclamation), WAPA, AZGFD, and one liaison from each Basin State and from the UCRC, as needed or requested by the participants. The implementation group will strive to develop a consensus recommendation to bring forth to the DOI regarding resource issues as detailed at the beginning of this section as well as including WAPA's assessment of the status of the Basin Fund. The Secretary of the Interior will consider the consensus recommendations of the implementation/planning group, but retains sole discretion to decide how best to accomplish operations and experiments in any given year pursuant to the ROD and other binding obligations.

DOI also will continue separate consultation meetings with the Tribes, AZGFD, the Basin States, and UCRC upon request, or as required under existing RODs.

If the decision is made to conduct an HFE, staff of the USGS's Grand Canyon Monitoring and Research Center (GCMRC) would prepare to conduct monitoring and research in cooperation with other agencies. If not, the process would be repeated during the next accounting window. For each HFE, GCMRC staff would analyze results and integrate information from other HFEs for use in future HFE decisions.

The decision process could result in a sediment triggered HFE being considered whether or not a positive sand mass balance is projected for that release, since the decision must be made in advance of the actual sediment-triggered HFE release and there is an admitted uncertainty in the modeled forecast for both sediment input and dam releases. Caution would be exercised; however, because the sand mass balance only accounts for the difference between inputs and outputs, and does not adequately portray the erosion of sand in the river channel. Successive HFEs or intervening periods of erosion without HFEs could negatively affect the ability of future HFEs to form sandbars and beaches. Furthermore, this erosion could impact other resources and it is advisable to ensure that the net amount of sand in the river channel not be depleted so as to compromise other ecosystem components and functions. The output of the model would be integrated with an assessment of the status and trend of other resources, as an acknowledgement that the decision cannot be focused solely on the condition of the sediment to ensure that the decision encompasses the impacts on the resources identified above in P-1.1.

P.2 OPERATION OF GLEN CANYON DAM UNDER THE HFE PROTOCOL

The scenarios considered below describe how Reclamation would modify the operation of Glen Canyon Dam to reallocate monthly volumes when necessary to achieve HFEs as called for under this protocol. Implementation of the protocol will be done in concert with coordinated river operations. Since 1970, the annual volume of water released from Glen Canyon Dam has been made according to the provision of the Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs (LROC) that includes a minimum objective release of 8.23 maf.

The 2007 Colorado River Interim Guidelines for Lower Basin Shortages and Coordinated Operations for Lake Power and Lake Mead (Reclamation 2007a) for lower basin shortages and the coordinated reservoir operations (Reclamation 2007b) implements relevant provisions of the LROC for an interim period through 2026. This allows Reclamation to modify these operations by allowing for potential annual releases both greater than and less than the minimum objective release under certain conditions. A more thorough description of Reclamation's process for determining and implementing annual release volumes is available in the 2007 EIS and Record of Decision (Reclamation 2007a and 2007b).

Pursuant to the 2007 Colorado River Interim Guidelines, the annual release volume from Lake Powell is projected and updated each month in response to the monthly 24-month study model run. This projected annual release volume is allocated to produce projected monthly release volumes and becomes the basis for scheduled monthly releases from Glen Canyon Dam. It is important to note that, regardless of the timing of releases, implementation of the HFE protocol would not affect annual release volumes.

HFEs could require more water than what is scheduled for release through the coordinated operation process described above. In order to perform these HFEs, reallocation of monthly releases from Glen Canyon Dam may be necessary. Monthly reallocations for an HFE would not affect annual release volumes.

P.2.1 Potential Operation of Glen Canyon Dam during the Fall HFE Implementation Window

Reclamation would attempt to implement fall HFEs by lowering the remaining days within the fall HFE period to the degree practicable up to as low as allowed under the LROC and LTEMP ROD in order to release the projected October and November volumes in the 24-month study. If a fall high-HFE could be achieved within the release volumes projected for October and November, no reallocation of the monthly volumes from other months would need to be performed.

If, however, a fall HFE could not be achieved within the release volumes projected for October and November, Reclamation would reduce the projected monthly release volumes as necessary through the remainder of the water year. The reallocation would be determined in consultation with WAPA to minimize adverse impacts on hydropower. Reallocation would only be conducted up to the amount necessary to result in the projected monthly volume for October and November being sufficient to conduct the HFE.

P.2.2 Potential Operation of Glen Canyon Dam during the Spring HFE Implementation Window

Reclamation would attempt to achieve spring HFEs by lowering the remaining days within the spring HFE period to the degree practicable up to as low as allowed under the LROC and LTEMP ROD in order to release the projected March and April volumes in the 24-month study. If the sediment-triggered spring HFE could be achieved within the release volumes projected for March and April, no reallocation of the monthly volumes from other months would need to be performed. Note that proactive spring HFEs (see Section P.3.2) would not require reallocation of water outside of the month in which they occurred because they would be 24 hours or less in duration.

If, however, Reclamation determined that it would not be possible to achieve the sediment-triggered HFE within the monthly release volumes projected for March and April, Reclamation would reduce the projected monthly release volumes as necessary through the remainder of the water year. The reallocation would be determined in consultation with WAPA to minimize adverse impacts on hydropower. The reallocation process would only be conducted up to the amount necessary to result in the projected monthly volume for March and April being sufficient to conduct the sediment-triggered HFE. If additional reallocation of the monthly volumes is required to achieve the sediment-triggered HFE, Reclamation would attempt to do so while maintaining the projected July and August release volumes in the 24-month study.

P.3 HIGH FLOW EXPERIMENTS TO BE EVALUATED UNDER THE PREFERRED ALTERNATIVE

Sediment-related experiments under the preferred alternative include (1) sediment-triggered spring and fall HFEs up to 96-hr duration; (2) short-duration (24-hr) proactive spring HFEs in high-volume equalization years (>=10 maf) prior to equalization releases; and (3) implementation of up to four extended-duration (>96 hr) HFEs, up to 250 hr long, depending on sediment conditions. The pattern of transferring water volumes from other months to make up the HFE volume would be discussed in the monthly Glen Canyon Dam operational coordination meetings described in Section P.1.

If sediment resources are stable or improving, the combination of base operations, HFEs, and other treatments would continue as prescribed for the preferred alternative. If sediment resource conditions decrease to unacceptable levels during the LTEMP period, operations may be modified to the extent allowable under the LTEMP ROD or would be evaluated and considered under a separate NEPA process, potentially including additional studies of sediment augmentation or other actions.

For all sediment experiments, testing would be modified or temporarily or permanently suspended if (1) experimental treatments were ineffective at accomplishing their objectives, or (2) there were unacceptable adverse impacts on resources. Monitoring results would be evaluated to determine whether additional tests, modification of experimental treatments, or discontinuation of experimental treatments were warranted.

Implementation of HFEs would consider resource condition assessments and resource concerns using the annual processes described in Sections P.1. HFEs may not be tested when there appears to be the potential for unacceptable impacts on the resources listed in Section P.1. In addition, there is uncertainty associated with cumulative impacts from sequential HFEs. These cumulative impacts would be considered before implementing an HFE.

P.3.1 Sediment-Triggered Spring HFEs

Under the preferred alternative, sediment-triggered spring HFEs would be implemented after an initial 2-year delay in order to enable testing of the effectiveness of trout management flows and address concerns raised by the apparent positive response of trout to the 2008 spring HFE (Korman et al. 2011; Melis et al. 2011). After the first 2 years of the LTEMP period, spring HFEs would be implemented when triggered by sediment conditions, except in water years when an extended-duration fall HFE (see description in Section P.3.4) was conducted. Modeling indicates that there may be sufficient sediment input for spring HFEs in about 26% of the years in the LTEMP period. Sediment-triggered spring HFEs would be implemented when triggered during the entire LTEMP period unless new information indicated they were not effective in building sandbars, or there were unacceptable adverse effects on resources (Section P.1).

Implementation of sediment-triggered spring HFEs would consider resource condition assessments and resource concerns using the processes described in Section P.1. Spring HFEs may not be tested when there appears to be the potential for unacceptable adverse impacts on the resources listed in Section P.1. In addition, there is uncertainty associated with the cumulative impacts of sequential HFEs on sediment, aquatic, and potentially other resources. These cumulative impacts would be considered before implementing a spring HFE particularly if a fall HFE had been implemented in the same water year.

P.3.2 Proactive Spring HFEs

GCMRC scientists identified proactive spring HFEs as a potential experimental treatment to transport and deposit in-channel sand at elevations above those of equalization flows. Proactive spring HFEs would be tested only in years with high annual release volume (i.e., ≥10 maf). A first test would be a 24-hr 45,000-cfs release conducted in April, May, or June. Duration in subsequent tests could be shortened depending on the observed effects during the first tests. It would be preferable to test proactive spring HFEs at least two to three times in the 20 year LTEMP period, but being able to do so will be dependent upon annual hydrology. Modeling indicates that proactive spring HFEs would be triggered in about 10% of the years in the LTEMP period.

Proactive spring HFEs would not be tested in the first 2 years of the LTEMP. In addition, proactive spring HFEs would not be tested in years when there had been a sediment-triggered spring HFE or an extended-duration fall HFE earlier in the same water year. Proactive spring HFEs could be performed in the same water year as a 96-hr or shorter sediment-triggered fall HFE, although prior to implementation, the potential effects of these HFEs would be carefully evaluated using the processes described in Section P.1. The first test would be carefully evaluated to determine whether additional tests were warranted based on the efficacy of building and maintaining sandbars. If initial tests show positive results without unacceptable adverse effects on the resources listed in Section P.1, proactive spring HFEs would be implemented when triggered during the entire LTEMP period.

Implementation of proactive spring HFEs would consider resource condition assessments and resource concerns using the processes described in Section P.1. Proactive spring HFEs may not be tested when there appears to be the potential for unacceptable impacts on the resources identified in Section P.1. The cumulative impacts of sequential HFEs would be considered before implementing a proactive spring HFE.

P.3.3 Sediment-Triggered Fall HFEs

Under the preferred alternative, sediment-triggered fall HFEs could be implemented throughout the 20-year LTEMP period unless new information indicated fall HFEs were not effective in building sandbars, or there were unacceptable adverse effects. Modeling indicates fall HFEs would be triggered in about 77% of the years in the LTEMP period.

Implementation of sediment-triggered fall HFEs would consider resource condition assessments and resource concerns using the processes described in Section P.1. Fall HFEs may not be tested when there appears to be the potential for unacceptable impacts on the resources listed in Section P.1. The cumulative impacts of sequential HFEs would be considered before implementing a sediment-triggered fall HFE.

P.3.4 Extended-Duration Fall HFEs

The HFE EA (Reclamation 2011) had a limit of 96-hr duration HFEs at various release levels. Under the preferred alternative, sediment-triggered fall HFEs with durations longer than 96 hr (up to 250 hr) would be tested. The duration of these extended-duration fall HFEs would be based on the amount of sediment delivered from the Paria River during the fall accounting period and would be no more than the maximum magnitude and duration of HFE that would achieve a positive sand mass balance in Marble Canyon, as determined by modeling. Based on examination of the observed historical sediment input from the Paria River, it was determined that HFEs up to 10.4 days in length (250 hr) could be supported before exhausting seasonal sediment inputs and affecting water delivery requirements. GCMRC scientists have suggested that increasing the duration of HFEs when sediment supply can support a longer duration may lead to more sand being deposited at higher elevations, resulting in bigger sandbars. Modeling indicates the sediment trigger for this treatment may be reached in 25% of the years in the LTEMP period. There would be no more than four extended-duration fall HFEs allowed over the 20-year LTEMP period.

The duration of the first implementation of an extended-duration HFE would be limited to no more than 192 hr (twice as long as the 96-hr limit). This duration is considered long enough to produce a measurable result if the treatment represents an effective approach to building sandbars under enriched sediment conditions. The duration of all tests would be based on available sediment, current hydrology, reviews of available information, the expert opinion of GCMRC and other Grand Canyon scientists, and consideration of potential effects on other resources listed in Section P.1. If feasible, monitoring would include real-time observations of sediment concentrations to determine if sediment deposition continues throughout the duration of the extended HFEs.

Implementation of extended-duration fall HFEs would consider resource condition assessments and resource concerns using the processes described in Section P.1. Extended-duration fall HFEs may not be tested when there appears to be the potential for unacceptable impacts on the resources listed in Section P.1. Because the effects of extended-duration HFEs on Lake Mead water quality are a concern, DOI will coordinate with relevant water quality monitoring programs or affected agencies prior to implementing any test of extended-duration HFEs. The cumulative impacts of sequential HFEs would be considered before implementing an extended-duration fall HFE.

Another important concern that results from the large volume of water bypassed during an extended-duration HFE is water delivery. Water delivery issues would be considered before deciding to implement an extended-duration fall HFE. An extended-duration HFE would not be implemented if annual release volume would be affected. It is possible that in lower volume years there would not be sufficient water available to support an extended-duration HFE. A 250-hr extended-duration HFE would result in a monthly total release of approximately 1.2 maf. In lower volume release years (e.g., 7.0 maf or 7.48 maf), the maximum duration may be less than 250 hr. In addition, a sediment-triggered spring HFE or proactive spring HFE would not be conducted in the same water year as an extended-duration fall HFE. If an extended-duration fall HFE was triggered but not implemented for any of the reasons described above, a fall HFE 96 hr or less in duration could be implemented instead. Implementation would necessitate reducing water volume in other months of the same water year.

In order to fully test the efficacy of these longer HFEs, several replicates would be desirable in the 20 year LTEMP period. Extended-duration HFEs would be considered successful and would be continued up to a total of four times in the 20-year LTEMP period as part of an adaptive experimental treatment if there was a widespread increase in bar size relative to ≤96-hr HFEs, and if sand mass balance was not significantly compromised relative to the ability to maintain a long-term equilibrium. Extended-duration HFEs would not continue to be tested if they were not effective in building sandbars, if resulting total sandbar volumes were no bigger than those created by shorter-duration HFEs, or if unacceptable adverse impacts on resources listed in Section P.1 were observed.

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