# 12 Appendix C – Technical Memoranda

## 12.9 Project Drainage Plan and Reservoir Spillway Designs

# Memo

**Eagle Mountain Pumped Storage Project - Project Drainage Plan and Reservoir Spillway Designs**

Prepared by: Nick Miller, P.E. and Richard A. Westmore, P.E.

October 22, 2009

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This Technical Memorandum (TM) was prepared in response to the Federal Energy Regulatory Commission's (FERC) letter referencing Schedule A: Deficiency of License Application, Project No. 13123-002---California Eagle Mountain Pumped Storage Project, Eagle Crest Energy Company (ECEC), specifically Item 5. *"Per section 4.41(g)(1), please provide detailed plan, section, and profile views of the spillway crest, spillway chute, energy dissipation structure and channel from the spillway to lower reservoir"*. Based on the FERC's request, additional information and drawings regarding the spillway, chute, energy dissipation structure and channel have been developed.

This TM also addresses the FERC's letter referencing Schedule B: Additional Information Request for License Application, Project No. 13123-002-California Eagle Mountain Pumped Storage Project, Eagle Crest Energy Company, specifically Item 14, which requests additional information regarding the Probable Maximum Flood and the use of Eagle Creek for conveyance of storm-water flows emanating from drainages associated with the Pumped Storage Project.

As a related issue this TM also addresses compatibility of the surface water conveyance system for the Pumped Storage Project with storm-water conveyance facilities planned for the proposed Eagle Mountain landfill on adjacent lands. In addition, this TM addresses the following comments received from FERC relative to surface water resources of the Project:

> *In Exhibit E, section 2.2.1, page 2-2, you state that the project would be located entirely off-stream and would not intercept a surface water course. However, in Exhibit E, section 3.3.4.1, page 3-76, you state that Eagle Creek is an intermittent surface water source and in Exhibit A, section 1.3, page 1-6, and in Exhibit E, section 2.2.1, page 2-6, you suggest that Eagle Creek would discharge into the lower reservoir by indicating that Eagle Creek would be used to convey spilled flows from the upper reservoir. Please clarify if Eagle Creek or any other surface water courses would be used by the proposed project.*

*In the hydrology calculations for the Probable Maximum Precipitation and Flood and resulting runoff inflow calculations to the reservoirs contained in the Standard Design Report (Exhibit F, Appendix B.1), you report the individual drainage area to the upper reservoir as approximately 1.17 square miles and the lower reservoir as 2.85 square miles. The U.S. Geological Survey (USGS) gage no. 10253600, Eagle Creek at Eagle Mountain, which was active from October 1, 1960 to September 30, 1966, reports the drainage area as 7.71 square miles. As indicated in AIR 13, your description of the proposed project and your proposal to use the Eagle Creek channel to route spilled flows into the lower reservoir suggest that the Eagle Creek drainage area should be included in your calculations. We estimate that the total drainage area of the lower reservoir would be about 9 square miles, not including the drainage area of the upper reservoir. Therefore, please provide the following information:*

- *a. a map clearly showing the location of the flow path from the upper reservoir spillway to the lower reservoir, including the location of Eagle Creek and the portion that would be used by the proposed project;*
- *b. revised calculations for the Probable Maximum Precipitation and Flood if the drainage area calculations used in the license application were incorrect;*
- *c. general descriptive information on Eagle Creek such as channel geomorphology, soil types, channel capacity, gradient, and other characteristics that could influence the ability of Eagle Creek to function as a conveyance channel for spilled flows; and*
- *d. any hydrologic information on Eagle Creek (excluding the information available from USGS gage no. 10253600) that would help to explain the seasonality and quantity of flow in this creek.*

### Existing Site Drainage Features and Watershed Conditions

There are two main surface drainage features at the project site, Eagle Creek and Bald Eagle Creek, which are shown on **Figure DLA5-1**. Both are ephemeral streams, and both currently drain into the East Mine Pit where flows are contained. Eagle Creek is artificially blocked in two locations by embankments in the main channel placed to divert flood flows into the existing East Pit of the mine (future site of the Lower Reservoir) as a means to provide flood protection at the Eagle Mountain town site. With the development of the Pumped Storage Project, Bald Eagle Creek and Eagle Creek will continue to flow into the Lower Reservoir, as they have in the past. The Upper Reservoir of the Project will intercept a small tributary of Eagle Creek.

Eagle Creek is generally dry throughout the year, except during large storm events, which occur infrequently in this area of California. USGS gage (10253600) data for Eagle Creek was collected between 1960 and 1966. During this period only three events were recorded, all having daily mean discharges less than 20 cfs. Hourly flow data were not reported for the gage. Eagle Creek has a watershed area of approximately

7.3 square miles (excluding the Upper Reservoir drainage basin) upstream of the Eagle Mountain town site and varies considerably in width and gradient. The watershed area was measured by GEI using available USGS mapping and the estimate is slightly smaller than the 7.7 square miles reported for the abandoned gaging station. The channel morphology is typical of streams draining the Eagle Mountains; steep incised channels in the higher elevations leading to broader less-defined channels that essentially disappear into the broad alluvial fans that lie along the foot of the steeper slopes. Bare desert soils exposed to rainfall are subjected to physical and chemical processes that change the hydraulic properties of the soil near the surface. When dried, a hard layer is formed in the soil surface that is often called "desert crust," commonly enriched in calcite or silica. Desert crust decreases the infiltration rate of soils, thereby increasing runoff and soil erosion, reducing the availability of water to the root zone, and impeding seedling and plant growth (Water/Science and Issues, 2003, Noam Weisbrod, 2003, Gale Group).

Prior to mine development and its engineered diversion into the East Pit, Eagle Creek discharged into the broad alluvial fan at the Eagle Mountain town site with dispersal of flow to the south and east away from the mine feature and the town site. Flood flows from the steeper portions of the watershed would have spread over a very broad area and flow depths during large flooding events would have been shallow in the numerous dry washes draining the alluvial fan. This spreading alluvial fan feature is clearly shown on Figure DLA5-1.

The landfill Report of Waste Discharge (GeoSyntec, 1992) does not provide descriptions of the Eagle Creek and Bald Eagle Creek channels and only shows and describes the surficial soils east of the town site (the alluvial fan or debris flow). We expect that the channels in the steeper portions of the watershed are incised into bedrock over overburden and are relatively stable. As the creek channels transition to the alluvial fan, we anticipate the stream channels of the region, including Eagle Creek, are incised by water-caused erosion into alluvial deposits and are less stable and more prone to erosion.

Currently, Eagle Creek is diverted in two locations by embankments in the main channel that direct flood flows into the existing East Pit of the mine (Lower Reservoir), engineered works that were completed many years ago during active mining operations to provide flood protection at the Eagle Mountain town site. This drainage pattern is proposed to be retained for development of the permitted first four phases of the landfill. The unpermitted fifth phase of the landfill involves using the East Pit for waste storage. When this would occur, according to previously published drainage plans (CM Engineering, 1991), the diversion of Eagle Creek to the East Pit would be eliminated and replaced with a new channel and detention basin constructed to manage storm-water runoff from the site. This system for the landfill project was intended to be designed for the 100-year rainfall event.

## Proposed Pumped Storage Reservoirs

The proposed Pumped Storage Project will use the East Pit for water storage as part of a water cycling operation. Water will be pumped from the Lower Reservoir (East Pit) to the Upper Reservoir (Central Pit) during evening and weekend hours and subsequently released from the Upper Reservoir to generate energy in peak energy demand periods and as needed to support ancillary services for regional transmission grid operations. The volume of water that can normally be cycled between the two reservoirs is the “active” storage, which is 17,700 acre-feet. Because of the closed nature of the system, both reservoirs cannot be full at the same time. Minimum storage in the Upper Reservoir is 2,300 acre-feet and minimum storage in the Lower Reservoir is 4,200 acre-feet.

## Upper Reservoir Hydrologic Design

The Upper Reservoir will be contained within the Central Pit of the Eagle Mountain Mine by the use of two dams. Each dam will have a 20-foot-wide crest at EL 2890, with a vertical upstream face and a 0.8H:1V downstream slope.

Design of the two dams that will form the Upper Reservoir will require conformance to stringent design standards to meet the regulatory requirements of the Federal Energy Regulatory Commission (FERC) and the State of California Division of Safety of Dams (DSOD). The hydrologic design standard for the Upper Reservoir dams is the Probable Maximum Flood (PMF). Based upon FERC and DSOD requirements, we have assumed that the Upper Reservoir is full to its maximum normal pool level (El. 2485) at the onset of the Probable Maximum Precipitation (PMP), which will produce the PMF design flood. Dam design is also based upon an assumption that the large hydraulic capacity of the conveyance system between the two Project reservoirs is not available for flood management.

Consistent with FERC and DSOD guidance, the PMF for the Upper Reservoir was estimated using rainfall depths published in Hydrometerological Report No. 59 (HMR 59), and the USACE HEC-1 rainfall-runoff computer model. The 72-hour general storm PMP for the Upper Reservoir basin was estimated to be approximately 18.6 inches. The Upper Reservoir has a drainage basin area of approximately 1.74 square miles, with a maximum elevation of 3,535 feet to a minimum elevation of 2,230 feet. The USBR Flood Hydrology Manual was used to develop the unit hydrograph for the drainage basin assuming an average Manning’s (Kn)[1] value of 0.045 for the basin. Losses due to soil infiltration or depression storage were very conservatively assumed to be zero based on the high potential for desert crust formation that limits infiltration, as described earlier. This means that all of the rainfall on the basin was assumed to produce runoff rather than just that portion of rainfall not intercepted by depression storage and infiltration. The resulting PMF has a volume of 1,730 acre-feet and peak inflow of 4,640 cfs.

[1] Kn is a representation of “basin roughness”, which affects the rate at which runoff collects and flows to the outlet of a defined drainage basin.

There are two options for accommodating the PMF to prevent uncontrolled over-topping of the Upper Reservoir dams – (1) providing a spillway to safely pass the PMF or (2) providing adequate freeboard on the dam to store the PMF inflow.

Another factor that must be considered in Upper Reservoir design is an inadvertent “over-pumping” event from the Lower Reservoir to the Upper Reservoir. In a closed hydraulic system, such as the Eagle Mountain Project, this factor is less critical than in a system where the project’s lower reservoir has a source of water that is significantly larger than the Upper Reservoir (e.g. the situation at the Taum Sauk Project where an inadvertent over-pumping action resulted in overtopping and failure of the upper reservoir dam).

Over-pumping to the Upper Reservoir could occur if pumping were to continue when the Lower Reservoir is below El. 925 (minimum pool). The amount of storage below El. 925 in the Lower Reservoir is 4,200 acre-feet. The minimum pool level provides the amount of submergence over the Lower Reservoir intake structure required to avoid vortex formation and unwanted air entrainment during the pumping cycle. Should the air be entrained into the intake and tunnel, serious problems could result in the system. These may include cavitation of hydraulic equipment and unwanted pressure fluctuations. Operators will receive warnings from reservoir level sensors and alarms should the Lower Reservoir pool drop below El. 925 or the Upper Reservoir pool rise above El. 2485. If the alarms should fail, there remains a limit on how long over-pumping could occur because of fixed storage available in the closed system. Similar to the PMF design requirement, over-pumping to the Upper Reservoir could be accommodated by providing spillway capacity (there was no spillway at the Taum Sauk upper reservoir) or additional storage capacity.

Providing added storage capacity in the Upper Reservoir for both the PMF and over-pumping of the Lower Reservoir inactive storage would involve providing a maximum of 5,930 acre-feet of capacity above the normal maximum pool level. This would result in total storage capacity of 25,930 acre-feet below the nominal crest of the dam. Under this configuration, the two dam crests would be at El. 2511, and the normal freeboard between the normal maximum pool and the dam crest would be 26 feet at both dams.

Alternatively, a spillway could be provided to handle the PMF outflow or an over-pumping event. This is ECEC’s currently preferred configuration. The Upper Reservoir spillway in this configuration is planned to be a 100-foot-wide ogee crest at El. 2486, one-foot above normal maximum reservoir pool (20,000 acre-feet) to reduce potentials for water losses due to wave action. The ogee crest will be constructed integrally with Upper Reservoir Dam No.1. The peak PMF inflow to the Upper Reservoir is estimated to be about 4,640 cubic feet per second (cfs), with a peak reservoir stage of 2489.0 feet, providing one-foot of residual freeboard below the dam crest. The peak PMF outflow through the spillway is estimated to be about 2,060 cfs.

The ogee spillway crest will have an approach depth of 10-feet, and 4-foot high vertical side walls. The ogee crest will transition to the stepped downstream face of the dam where considerable energy dissipation will occur. At the toe of the dam a USBR Type III Stilling Basin will be constructed to dissipate the remaining excess energy of the flood flows. The stilling basin will be 100-feet wide, approximately 30-feet long, and have 12.5-feet high basin side walls. The basin floor will be set approximately at El. 2380, and transition to the spillway channel. The dam spillway and stilling basin plan, profile and section are shown on **Figure DLA5-2**.

The Upper Reservoir spillway will be able to discharge 3,120 cfs prior to over-topping the dam during an extreme worst-case scenario over-pumping event. As noted previously, the potential to overtop the Upper Reservoir dams by over-pumping from the Lower Reservoir is limited by the volume of storage in the Lower Reservoir. Spillway design capacity is about 8% greater than the pumping capacity of one pump-turbine unit.

A final decision on the preferred Upper Reservoir dam configuration for managing the PMF and unlikely over-pumping will be made during final design. The option of constructing taller dams for added storage would increase the height of the Upper Reservoir Dam No. 1 from 120 to 141 feet and the height of Dam No. 2 from 60 to 81 feet.

### Upper Reservoir Spillway Discharge Channel

The Upper Reservoir spillway will discharge to the spillway channel, which will convey the flows from the spillway to the ephemeral stream channel of Eagle Creek. The Upper Reservoir Spillway Channel will be about 4,230-feet long and descend from approximately El. 2380 to approximately El. 2200. The Upper Reservoir Spillway Channel was modeled using the USACE HEC-RAS computer program to estimate the required size and velocities within the channel. The Upper Reservoir Spillway Channel will transition from the 100-foot wide vertical side wall stilling basin at the dam toe to a 20-foot wide, 10-foot-high, 2H:1V side slope channel over a distance of approximately 500-feet. The first 500-feet will be concrete-lined channel, and the remaining portion of the channel will be provided with armoring to protect against high velocities, and/or with energy dissipation structures to reduce velocities and protect against scour and erosion. The Upper Spillway Channel will cross an existing road in two locations and then the spillway channel flows will be discharged into the Eagle Creek channel. The Upper Reservoir Spillway Channel plan, profile and sections are shown on **Figure DLA5-3**.

Aerial images indicate that downstream of the proposed channel and road crossings of the Upper Spillway Discharge Channel the natural Eagle Creek channel has been modified by mine road construction. Engineering surveys of the channel will verify dimensions and potential needs to increase its capacity. Releases from the Upper Reservoir will be smaller than the estimated 100-year flow from the 7.3 square mile Eagle Creek watershed, indicating that the natural channel should have adequate capacity.

## Lower Reservoir Spillway and Drainage Considerations

Once flows from the Upper Reservoir are discharged to the Eagle Creek channel, they will join flows generated from the remainder of the Eagle Creek watershed (7.3 square miles). With the current measures implemented at the mine to divert Eagle Creek flows into the East Pit, any spill from the Upper Reservoir will reach the Lower Reservoir. For purposes of this analysis, we conservatively estimated the PMF and 100-year flows generated from the Eagle Creek watershed and the Bald Eagle Creek watershed, which also drains into the Lower Reservoir, as shown on **Figure DLA5-1**.

One challenge in assessing the potential impacts of the Pumped Storage Project on flood flows from these watersheds is selecting appropriate assumptions for the amount of water storage present in the Project reservoirs during the flood events. As noted in the previous section entitled Upper Reservoir Hydrologic Design, it is appropriate for dam and spillway design to assume that the Upper Reservoir is at El. 2485 at the onset of the PMP. Although it is an extreme worst-case scenario, it is also appropriate, for purposes of dam design only, to assume that the large hydraulic capacity of the conveyance system between the two Project reservoirs is not available for flood management. However, if the Upper Reservoir is full to its normal maximum pool, the Lower Reservoir will have 17,700 acre-feet of empty storage space above El. 925 to store runoff from Eagle Creek and Bald Eagle Creek. Depending on the timing of the PMP event, the empty storage space may be split between the two reservoirs. The total active reservoir volume for pumped storage (17,700 acre-feet) can be shifted between the two reservoirs in 18 hours, in comparison to the 72-hour duration of the general storm PMP. With monitoring of inflows, it will be possible to space available in either reservoir, as it is needed for runoff storage, by shifting water through the tunnel interconnecting the reservoirs.

The PMF runoff volume from the entire Eagle Creek watershed (1.74 and 7.30 square miles as shown on **Figure DLA5-1**) is 9,000 acre-feet, assuming no infiltration or initial losses (i.e., all rainfall is converted to runoff). Similarly, the PMF runoff volume from Black Eagle Creek watershed (2.85 square miles) is 2,520 acre-feet. The sum of these volumes (11,520 acre-feet) could be stored in the Lower Reservoir during the PMF event, as long as the volume of water in storage in the Lower Reservoir for Pumped Storage Project power operations and intake submergence is less than 10,380 acre-feet. If there is more water in storage in the Lower Reservoir than that amount and a large flooding event is occurring, up to 11,600 cfs of pumping capacity could be used to convey water to the Upper Reservoir for temporary storage thereby creating storage space in the Lower Reservoir to store runoff entering from Eagle Creek and Black Eagle Creek.

Full operation of the Pumped Storage Project requires that adequate storage space be available in the reservoir system to cycle the 17,700 acre-feet of active water volume used for energy storage and subsequent on-peak energy generation. Therefore, after a flood event, in which runoff has been stored in the Lower Reservoir (or transferred to the Upper Reservoir temporarily), a period of time must be provided to release excess stored water from the system through a structure at the Lower Reservoir. During this period, pumped-storage operations would be altered and limited. Release of storm water stored in the reservoir system would be made at a measured rate to prevent downstream flooding. If the 100-year, 24-hour storm event is considered, the storm-water runoff entering the reservoir system is estimated to be 2,630 acre-feet.

The release system from the Lower Reservoir is proposed to be an overflow spillway and a channel from the southeast rim of the Lower Reservoir across mine property and the Colorado River Aqueduct. This channel would terminate at the location shown on **Figure DLA5-1.** From that location flows would spread laterally at shallow depths over the alluvial fan as they naturally would have prior to channel modifications and diversions to the lower pit made during previous mining operations.

For Project planning, the Lower Reservoir spillway has been assumed to be 15 feet wide, with an ogee crest at EL. 1094. The ogee crest will have an approach depth of 5.6 feet, and varying height sloped side walls. With the reservoir at El.1098, the spillway will discharge a maximum of approximately 460 cfs.

The ogee crest will discharge to the spillway channel, which would convey the flows from the spillway to an area on the east side of the CRA. The layout of this channel is presented on **Figure DLA5-4**.The Lower Reservoir Spillway Channel will be about 6,670 feet long and descend from approximately El. 1088 to approximately El. 985. The Lower Reservoir Spillway Channel was modeled using the USACE HEC-RAS computer program to estimate the required size and velocities within the channel. The Lower Reservoir Spillway Channel will transition from the 15-foot wide ogee crest with vertical side walls to a 10-foot wide, minimum 5-foot-high, 2H:1V side slope channel over a distance of approximately 250 feet. The first 250 feet will be a concrete-lined channel, and the remaining portion of the channel will be lined with riprap. The Lower Reservoir Spillway Channel will terminate at the location shown on **Figure DLA5-6**.

If the PMF flood volume (11,520 acre-feet) is stored in addition to the water used for energy storage, it will be necessary to change the normal pumped-storage operating procedures to cause this excess water to be spilled. With the small Lower Reservoir spillway described above, the excess PMF volume could be released over a period of 305 hours (13 days). The excess storage from the 100-year storm (2,630 acre-feet) could be released over a period of 70 hours ( 3 days).

### Landfill Compatibility

This Pumped Storage Project drainage plan was intentionally developed to be compatible with the proposed Eagle Mountain Landfill Drainage Plan, as shown on **Figure DLA5-5**. For the permitted landfill development, the East Pit (Lower Reservoir) is planned to be used for storage of storm-water runoff. With the Pumped Storage Project in operation, the East Pit will be used for water storage and its flood storage capacity will be reduced depending on the pumping and generating cycles. However, the ability to move large volumes of water between the two reservoirs when the Pumped Storage Project is completed and the fact that 17,700 acre-feet of storage will remain available, means that the flood management benefits of the mine pits will not be lost.

The dams creating additional storage at the Upper Reservoir are required to be designed to withstand all extreme loading conditions including the PMF and the maximum credible earthquake, and will pose no risk to the landfill,. Two regulatory agencies, FERC and DSOD, will assure that the Upper Reservoir dams meet very stringent design standards. The flood and earthquake design standards for all features of the Pumped Storage Project proposed by ECEC will meet or exceed those that govern final design of the landfill.

Because the Pumped Storage Project would be developed prior to the landfill, and drainage facilities constructed for the Pumped Storage Project will be designed with future landfill construction in mind, the cost of major portions of the drainage facilities at the site will therefore be borne by the Pumped Storage Project and not the landfill project.

## References

CM Engineering Associates, Inc., 1991. Eagle Mountain Project -- Drainage Report. Prepared for: Mine Reclamation Corporation, Palm Springs, CA.

GeoSyntec Consultants, 1992. Report of Waste Discharge. Eagle Mountain Landfill and Recycling Center. Mine Reclamation Corporation, Palm Springs, CA.

Weisbrod, Naom. Water/Science and Issues, 2003, Gale Group. Discussion on Desert Soils.

## Summary of Flood Estimates for the Eagle Mountain Project

10/22/2009

| | | Rainfall Depth | | Runoff Volume | | Peak Inflow | |
|---|---|---|---|---|---|---|---|
| | Area | 100-Yr 24-hr | PMP 72-hr | 100-Yr | PMP | 100-Yr | PMP |
| Basin | $mi^2$ | in. | in. | AF | AF | cfs | cfs |
| Above Upper Reservoir | 1.74 | 4.15 | 18.59 | 385 | 1,725 | 2,789 | 4,640 |
| Eagle Creek to Lower Reservoir | 7.3 | 4.15 | 18.68 | 1,616 | 7,273 | 6,455 | 15,320 |
| Bald Eagle Creek to Lower Reservoir | 2.85 | 4.15 | 16.60 | 631 | 2,523 | 4,410 | 6,900 |

In compliance with 18 C.F.R. § 4.39(e), ECE is filing any maps and drawings "showing project location information and details of project structures" as CEII, not for public disclosure. Figures DLA 5-1 through DLA 5-6 have been file under separate cover as CEII.

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1****************************************                                     ***************************************
 *                                      *                                     *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1L)  *                                     *    U.S. ARMY CORPS OF ENGINEERS     *
 *             JULY   1998              *                                     *    HYDROLOGIC ENGINEERING CENTER    *
 *           VERSION 4.1(L)             *                                     *          609 SECOND STREET          *
 *                                      *                                     *       DAVIS, CALIFORNIA 95616       *
 *  RUN DATE   21AUG09  TIME  10:30:46   *                                     *           (916) 756-1104            *
 *                                      *                                     *                                     *
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                              X     X  XXXXXXX   XXXXX          X
                              X     X  X         X     X       XX
                              X     X  X         X              X
                              XXXXXXX  XXXX      X      XXXXX   X
                              X     X  X         X              X
                              X     X  X         X     X        X
                              X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                             HEC-1L INPUT                                                   PAGE  1

         LINE         ID.......1.......2.......3.......4.......5,.......6.......7.......8.......9......10

           1           ID   PROJECT: Eagle Mountain
           2           ID   CLIENT: Eagle Crest Engergy
           3           ID   FILE NAME: EMURPMF.HC1 [Eagle Mountain, Upper Res., PMF storm]
           4           ID   HISTORY: Created 8/19/09 by NDM
           5           ID   PURPOSE: Estimate PMF-Storm for Upper Reservoir
           6           ID
           7           ID   PRECIPITATION: HMR 59 PMP
           8           ID   TEMPORAL DISTRIBUTION: 2/3 end weighted
           9           ID   SUB-BASINS: none
          10           ID   LOSS RATE: zero
          11           ID
          12           ID   BASE FLOW: Zero
          13           ID   UH (OVERLAND): USBR Synthetic, Southwest Desert, Kn = 0.045, 1-min duration
          14           ID
          15           ID
          16           ID   ****************************************************************************
                       *
          17           IT       1              0    4500
          18           IO       1       2
                       *

          19           KK  Inflow --> OVERLAND INFLOW TO RESERVOIR (excludes direct rainfall on reservoir
                       * SUB-BASIN AREA (sq. mi)
          20           BA   1.736
                       *
          21           IN      60
                       * ALL-SEASON GENERAL STORM PMP - BASIN B1
                       * (1-hr incr.; Mid-End Wt, FERC/HMR 59 alt. 6-hr Blocks; EXCESS RAINFALL ONLY)
                       * Applied HSG loss rates(A,B,C,D   0.000   0.000   0.000   0.000(in/hr)
          22           PI   0.061   0.061   0.061   0.061   0.061   0.061   0.068   0.068   0.068   0.068
          23           PI   0.071   0.071   0.078   0.078   0.078   0.078   0.078   0.078   0.112   0.112
          24           PI   0.112   0.112   0.119   0.119   0.137   0.137   0.137   0.138   0.138   0.138
          25           PI   0.559   0.638   0.643   0.645   0.645   0.645   0.651   0.652   0.689   0.689
          26           PI   1.673   4.354   0.207   0.207   0.207   0.195   0.195   0.195   0.119   0.119
          27           PI   0.119   0.119   0.119   0.119   0.112   0.112   0.112   0.112   0.078   0.078
          28           PI   0.071   0.071   0.071   0.071   0.071   0.071   0.068   0.068   0.068   0.068
          29           PI   0.061   0.061   0.000
                       *
                       * BASEFLOW (SET TO ZERO)
          30           BF    00.0     0.0     1.0
                       *
                       * UNIFORM LOSS RATE, ZERO INIT. BUDGET (SAT'D). ZERO IMPERMIABLE.
          31           LU     0.0   0.000     0.0
                       *
          32           IN       1
                       *       Eagle Mountain Upper Reservoir, Kn = 0.045, 1-min UH
                       * USBR UH, Kn =    0.045, duration =   1min.
          33           UI      15      27      39      52      73     107     150     201     267     349
          34           UI     463     624     863    1189    1516    1833    2158    2443    2739    2984
          35           UI    3081    3015    2901    2750    2570    2357    2143    1923    1700    1547
          36           UI    1413    1285    1164    1079    1000     928     860     792     742     695
          37           UI     653     623     594     566     541     516     494     472     453     436
          38           UI     417     401     385     368     353     338     324     310     295     285
          39           UI     273     261     249     240     231     221     212     203     195     187
          40           UI     179     171     164     158     152     146     140     134     128     123
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          LINE          ID.......1.......2.......3.......4.......5,.......6.......7.......8.......9......10

            41           UI     118     113     108     104      99      95      91      88      84      81
            42           UI      78      74      71      69      66      63      60      58      55      53
            43           UI      51      49      47      44      43      41      40      38      36      35
            44           UI      34      31      30      29      28      27      26      25      24      23
            45           UI      22      21      21      20      19      18      17      17      16      16
            46           UI      15      13      13      13      12       6
                         *
                         *
                         *
                         *

            47           KK  PMFout --> PMF OUTFLOW THROUGH SPILLWAY
            48           KP       1
            49           KO       0       2
                         *
                         * INITIAL RESERVOIR ELEVATION
            50           RS       1    ELEV    2485
                         *
                         * ELEV-CAP TABLE
            51           SV   20000   20220   20604   20991   21380   21771   22164   22559   22956
            52           SE    2485    2486    2488    2490    2492    2494    2496    2498    2500
                         *
                         * SPILLWAY CREST ELEVATION: EL, L, C, Exp
            53           SS    2486     100     3.9     1.5
                         *
                         * DAM OVERTOPPING SUMMARY: EL, L (w/o spillway), C, EXP
                         * ST  2490  1200     3.0     1.5
                         *
                         *DIAGRAM
                         *
            54           ZZ
1
               SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING         (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR       (<---) RETURN OF DIVERTED OR PUMPED FLOW

    19      Inflow
                 V
                 V
    47      PMFout


   31 LU         UNIFORM LOSS RATE
                       STRTL        0.00  INITIAL LOSS
                       CNSTL        0.00  UNIFORM LOSS RATE
                       RTIMP        0.00  PERCENT IMPERVIOUS AREA

   33 UI         INPUT UNITGRAPH, 136 ORDINATES,  VOLUME = 1.00
                      15.0      27.0      39.0      52.0      73.0     107.0     150.0     201.0     267.0     349.0
                     463.0     624.0     863.0    1189.0    1516.0    1833.0    2158.0    2443.0    2739.0    2984.0
                    3081.0    3015.0    2901.0    2750.0    2570.0    2357.0    2143.0    1923.0    1700.0    1547.0
                    1413.0    1285.0    1164.0    1079.0    1000.0     928.0     860.0     792.0     742.0     695.0
                     653.0     623.0     594.0     566.0     541.0     516.0     494.0     472.0     453.0     436.0
                     417.0     401.0     385.0     368.0     353.0     338.0     324.0     310.0     295.0     285.0
                     273.0     261.0     249.0     240.0     231.0     221.0     212.0     203.0     195.0     187.0
                     179.0     171.0     164.0     158.0     152.0     146.0     140.0     134.0     128.0     123.0
                     118.0     113.0     108.0     104.0      99.0      95.0      91.0      88.0      84.0      81.0
                      78.0      74.0      71.0      69.0      66.0      63.0      60.0      58.0      55.0      53.0
                      51.0      49.0      47.0      44.0      43.0      41.0      40.0      38.0      36.0      35.0
                      34.0      31.0      30.0      29.0      28.0      27.0      26.0      25.0      24.0      23.0
                      22.0      21.0      21.0      20.0      19.0      18.0      17.0      17.0      16.0      16.0
                      15.0      13.0      13.0      13.0      12.0       6.0

                                                 ***


                                                                RUNOFF SUMMARY
                                                        FLOW IN CUBIC FEET PER SECOND
                                                     TIME IN HOURS,  AREA IN SQUARE MILES

                                         PEAK    TIME OF     AVERAGE FLOW FOR MAXIMUM PERIOD       BASIN     MAXIMUM     TIME OF
          OPERATION       STATION        FLOW     PEAK                                              AREA      STAGE     MAX STAGE
+                                                             6-HOUR     24-HOUR     72-HOUR

          HYDROGRAPH AT
+                          Inflow       4636.   42.10        1563.        677.        289.         1.74

          ROUTED TO
+                          PMFout       2059.   42.47        1263.        630.        243.         1.74
+                                                                                                          2489.02       42.47


 *** NORMAL END OF HEC-1 ***
```

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1****************************************                                              ***************************************
 *                                       *                                              *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1L)  *                                              *   U.S. ARMY CORPS OF ENGINEERS      *
 *             JULY   1998               *                                              *   HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1(L)              *                                              *         609 SECOND STREET           *
 *                                       *                                              *      DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   22OCT09  TIME  11:08:20   *                                              *          (916) 756-1104             *
 *                                       *                                              *                                     *
 ****************************************                                              ***************************************


                              X     X  XXXXXXX   XXXXX          X
                              X     X  X        X     X        XX
                              X     X  X        X               X
                              XXXXXXX  XXXX     X       XXXXX   X
                              X     X  X        X               X
                              X     X  X        X     X         X
                              X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM
```



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          LINE          ID.......1.......2.......3.......4.......5,.......6.......7.......8.......9......10

            1            ID   PROJECT: Eagle Mountain
            2            ID   CLIENT: Eagle Crest Engergy
            3            ID   FILE NAME: EMUR100YR.HC1 [Eagle Mountain, Upper Res., 100-YR storm]
            4            ID   HISTORY: Created 8/19/09 by NDM  Revised 9/25/2009 by NJN
            5            ID   PURPOSE: Estimate 100 YR-Storm for Upper Reservoir
            6            ID
            7            ID   PRECIPITATION: 100 YR
            8            ID   TEMPORAL DISTRIBUTION: Center weighted
            9            ID   SUB-BASINS: none
           10            ID   LOSS RATE: zero
           11            ID
           12            ID   BASE FLOW: Zero
           13            ID   UH (OVERLAND): USBR Synthetic, Southwest Desert, Kn = 0.045, 1-min duration
           14            ID
           15            ID
           16            ID   ***************************************************************************
                         *
           17            IT       1               0    4500
           18            IO       1       2
                         *

           19            KK  Inflow --> OVERLAND INFLOW TO RESERVOIR (excludes direct rainfall on reservoir
                         * SUB-BASIN AREA (sq. mi)
           20            BA   1.736
                         *
                         * 100-YR STORM, (CENTER-WEIGHTED, SEO GUIDELINES, IT or IN time step)
           21            PH            0.01   0.490    0.90    1.56    1.86    2.08    2.55    3.35    4.15
                         *
                         * BASEFLOW (SET TO ZERO)
           22            BF    00.0     0.0     1.0
                         *
                         * UNIFORM LOSS RATE, ZERO INIT. BUDGET (SAT'D). ZERO IMPERMIABLE.
           23            LU     0.0   0.000     0.0
                         *
           24            IN       1
                         *       Eagle Mountain Upper Reservoir, Kn = 0.045, 1-min UH
                         * USBR UH, Kn =    0.045, duration =   1min.
           25            UI      15      27      39      52      73     107     150     201     267     349
           26            UI     463     624     863    1189    1516    1833    2158    2443    2739    2984
           27            UI    3081    3015    2901    2750    2570    2357    2143    1923    1700    1547
           28            UI    1413    1285    1164    1079    1000     928     860     792     742     695
           29            UI     653     623     594     566     541     516     494     472     453     436
           30            UI     417     401     385     368     353     338     324     310     295     285
           31            UI     273     261     249     240     231     221     212     203     195     187
           32            UI     179     171     164     158     152     146     140     134     128     123
           33            UI     118     113     108     104      99      95      91      88      84      81
           34            UI      78      74      71      69      66      63      60      58      55      53
           35            UI      51      49      47      44      43      41      40      38      36      35
           36            UI      34      31      30      29      28      27      26      25      24      23
           37            UI      22      21      21      20      19      18      17      17      16      16
           38            UI      15      13      13      13      12       6
                         *
                         *
                         *
                         *
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          LINE          ID.......1.......2.......3.......4.......5,.......6.......7.......8.......9......10


           39            KK  PMFout --> PMF OUTFLOW THROUGH SPILLWAY
           40            KP       1
           41            KO       0       2
                         *
                         * INITIAL RESERVOIR ELEVATION
           42            RS       1    ELEV    2485
                         *
```

```
                     * ELEV-CAP TABLE
            43       SV   20000   20220   20604   20991   21380   21771   22164   22559   22956
            44       SE    2485    2486    2488    2490    2492    2494    2496    2498    2500
                     *
                     * SPILLWAY CREST ELEVATION: EL, L, C, Exp
            45       SS    2486     100     3.9     1.5
                     *
                     * DAM OVERTOPPING SUMMARY: EL, L (w/o spillway), C, EXP
                     * ST  2490  1200     3.0     1.5
                     *
                     *DIAGRAM
                     *
            46       ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    19      Inflow
                 V
                 V
    39      PMFout

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
                 PRECIPITATION DATA

   21 PH                             DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
                 ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
                 5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                  0.49    0.90    1.56    1.86    2.08    2.55    3.35    4.15    0.00    0.00    0.00    0.00

                                          STORM AREA =    0.01

   23 LU         UNIFORM LOSS RATE
                       STRTL       0.00  INITIAL LOSS
                       CNSTL       0.00  UNIFORM LOSS RATE
                       RTIMP       0.00  PERCENT IMPERVIOUS AREA

   25 UI         INPUT UNITGRAPH, 136 ORDINATES,  VOLUME = 1.00
                     15.0      27.0      39.0      52.0      73.0     107.0     150.0     201.0     267.0     349.0
                    463.0     624.0     863.0    1189.0    1516.0    1833.0    2158.0    2443.0    2739.0    2984.0
                   3081.0    3015.0    2901.0    2750.0    2570.0    2357.0    2143.0    1923.0    1700.0    1547.0
                   1413.0    1285.0    1164.0    1079.0    1000.0     928.0     860.0     792.0     742.0     695.0
                    653.0     623.0     594.0     566.0     541.0     516.0     494.0     472.0     453.0     436.0
                    417.0     401.0     385.0     368.0     353.0     338.0     324.0     310.0     295.0     285.0
                    273.0     261.0     249.0     240.0     231.0     221.0     212.0     203.0     195.0     187.0
                    179.0     171.0     164.0     158.0     152.0     146.0     140.0     134.0     128.0     123.0
                    118.0     113.0     108.0     104.0      99.0      95.0      91.0      88.0      84.0      81.0
                     78.0      74.0      71.0      69.0      66.0      63.0      60.0      58.0      55.0      53.0
                     51.0      49.0      47.0      44.0      43.0      41.0      40.0      38.0      36.0      35.0
                     34.0      31.0      30.0      29.0      28.0      27.0      26.0      25.0      24.0      23.0
                     22.0      21.0      21.0      20.0      19.0      18.0      17.0      17.0      16.0      16.0
                     15.0      13.0      13.0      13.0      12.0       6.0

                                                          ***







                                                                     RUNOFF SUMMARY
                                                             FLOW IN CUBIC FEET PER SECOND
                                                          TIME IN HOURS,  AREA IN SQUARE MILES

                                                PEAK    TIME OF       AVERAGE FLOW FOR MAXIMUM PERIOD        BASIN      MAXIMUM     TIME OF
          OPERATION       STATION               FLOW     PEAK                                                 AREA       STAGE     MAX STAGE
+                                                                  6-HOUR      24-HOUR      72-HOUR

          HYDROGRAPH AT
+                          Inflow         2789.   12.37          478.         193.          65.       1.74

          ROUTED TO
+                          PMFout          116.   18.37          109.          70.          27.       1.74
+                                                                                                               2486.44       18.28


 *** NORMAL END OF HEC-1L ***
```

```
1****************************************                                                      ***************************************
 *                                       *                                                      *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1L)  *                                                      *    U.S. ARMY CORPS OF ENGINEERS     *
 *            JULY   1998                *                                                      *    HYDROLOGIC ENGINEERING CENTER    *
 *          VERSION 4.1(L)               *                                                      *         609 SECOND STREET           *
 *                                       *                                                      *      DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   24AUG09  TIME  14:03:08   *                                                      *          (916) 756-1104             *
 *                                       *                                                      *                                     *
 *****************************************                                                      ***************************************


                                        X     X  XXXXXXX   XXXXX          X
                                        X     X  X        X     X        XX
                                        X     X  X        X               X
                                        XXXXXXX  XXXX     X       XXXXX   X
                                        X     X  X        X               X
                                        X     X  X        X     X         X
                                        X     X  XXXXXXX   XXXXX         XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                            HEC-1L INPUT                                              PAGE  1

         LINE          ID.......1.......2.......3.......4.......5,.......6.......7.......8.......9......10

           1            ID   PROJECT: Eagle Mountain
           2            ID   CLIENT: Eagle Crest Engergy
           3            ID   FILE NAME: EMLRPMF.HC1 [Eagle Mountain, Lower Res., PMF storm]
           4            ID   HISTORY: Created 8/19/09 by NDM
           5            ID   PURPOSE: Estimate PMF-Storm for Lower Reservoir
           6            ID
           7            ID   PRECIPITATION: HMR 59 PMP
           8            ID   TEMPORAL DISTRIBUTION: 2/3 end weighted
           9            ID   SUB-BASINS: none
          10            ID   LOSS RATE: zero
          11            ID
          12            ID   BASE FLOW: Zero
          13            ID   UH (OVERLAND): USBR Synthetic, Southwest Desert, Kn = 0.045, 1-min duration
          14            ID
          15            ID
          16            ID   ****************************************************************************
                        *
          17            IT       1              0    4500
          18            IO       1       2
                        *

          19            KK  Inflow --> OVERLAND INFLOW TO RESERVOIR (excludes direct rainfall on reservoir
                        * SUB-BASIN AREA (sq. mi)
          20            BA   2.850
                        *
          21            IN      60
                        * ALL-SEASON GENERAL STORM PMP - BASIN B1
                        * (1-hr incr.; Mid-End Wt, FERC/HMR 59 alt. 6-hr Blocks; EXCESS RAINFALL ONLY)
                        * Applied HSG loss rates(A,B,C,D   0.000   0.000   0.000   0.000(in/hr)
          22            PI   0.046   0.046   0.046   0.046   0.046   0.046   0.061   0.061   0.061   0.061
          23            PI   0.076   0.076   0.080   0.080   0.080   0.080   0.080   0.080   0.091   0.091
          24            PI   0.091   0.091   0.113   0.113   0.116   0.116   0.116   0.159   0.159   0.159
          25            PI   0.529   0.545   0.577   0.587   0.613   0.620   0.657   0.660   0.665   0.735
          26            PI   1.288   4.005   0.180   0.180   0.180   0.168   0.168   0.168   0.113   0.113
          27            PI   0.113   0.113   0.113   0.113   0.091   0.091   0.091   0.091   0.080   0.080
          28            PI   0.076   0.076   0.076   0.076   0.076   0.076   0.061   0.061   0.061   0.061
          29            PI   0.046   0.046   0.000
                        *
                        * BASEFLOW (SET TO ZERO)
          30            BF    00.0     0.0     1.0
                        *
                        * UNIFORM LOSS RATE, ZERO INIT. BUDGET (SAT'D). ZERO IMPERMIABLE.
          31            LU     0.0   0.000     0.0
                        *
          32            IN       1
                        *       Eagle Mountain Lower Reservoir, Kn = 0.045, 1-min UH
                        * USBR UH, Kn =    0.045, duration =   1min.
          33            UI      22      40      56      74     102     142     196     265     350     449
          34            UI     571     758    1012    1354    1833    2303    2756    3222    3642    4057
          35            UI    4497    4660    4727    4571    4374    4137    3867    3561    3255    2938
          36            UI    2615    2395    2199    2016    1833    1702    1585    1475    1377    1279
          37            UI    1188    1121    1054     996     953     911     872     835     799     767
          38            UI     736     706     681     655     629     607     583     560     538     517
          39            UI     496     476     455     440     424     406     389     375     362     348
          40            UI     335     322     309     297     286     274     264     253     243     235
1                                            HEC-1L INPUT                                              PAGE  2
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          LINE          ID.......1.......2.......3.......4.......5,.......6.......7.......8.......9......10

            41           UI     227     218     209     201     193     186     178     171     164     159
            42           UI     152     145     140     135     130     126     121     115     111     107
            43           UI     104      99      95      92      88      85      81      78      75      72
            44           UI      69      67      64      62      60      57      55      54      51      48
            45           UI      46      45      43      42      40      38      37      36      35      34
            46           UI      32      31      30      29      28      27      25      25      25      23
            47           UI      21      20      20      19      16       3
                         *
                         *
                         *

            48           KK  PMFout --> PMF OUTFLOW THROUGH SPILLWAY
            49           KP       1
            50           KO       0       2
                         *
                         * INITIAL RESERVOIR ELEVATION
            51           RS       1    ELEV    1094
                         *
                         * ELEV-CAP TABLE
            52           SV    4200    5891   10400   10400   15917   19438   21900   23244   25210
            53           SE     925     950    1000    1025    1050    1076    1092    1100    1110
                         *
                         * SPILLWAY CREST ELEVATION: EL, L, C, Exp
            54           SS    1094     100     2.9     1.5
                         *
                         *
                         *DIAGRAM
                         *
            55           ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING         (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR       (<---) RETURN OF DIVERTED OR PUMPED FLOW

    19      Inflow
                 V
                 V
    48      PMFout

   31 LU          UNIFORM LOSS RATE
                        STRTL        0.00  INITIAL LOSS
                        CNSTL        0.00  UNIFORM LOSS RATE
                        RTIMP        0.00  PERCENT IMPERVIOUS AREA

   33 UI          INPUT UNITGRAPH, 146 ORDINATES,  VOLUME = 1.00
                          22.0      40.0      56.0      74.0     102.0     142.0     196.0     265.0     350.0     449.0
                         571.0     758.0    1012.0    1354.0    1833.0    2303.0    2756.0    3222.0    3642.0    4057.0
                        4497.0    4660.0    4727.0    4571.0    4374.0    4137.0    3867.0    3561.0    3255.0    2938.0
                        2615.0    2395.0    2199.0    2016.0    1833.0    1702.0    1585.0    1475.0    1377.0    1279.0
                        1188.0    1121.0    1054.0     996.0     953.0     911.0     872.0     835.0     799.0     767.0
                         736.0     706.0     681.0     655.0     629.0     607.0     583.0     560.0     538.0     517.0
                         496.0     476.0     455.0     440.0     424.0     406.0     389.0     375.0     362.0     348.0
                         335.0     322.0     309.0     297.0     286.0     274.0     264.0     253.0     243.0     235.0
                         227.0     218.0     209.0     201.0     193.0     186.0     178.0     171.0     164.0     159.0
                         152.0     145.0     140.0     135.0     130.0     126.0     121.0     115.0     111.0     107.0
                         104.0      99.0      95.0      92.0      88.0      85.0      81.0      78.0      75.0      72.0
                          69.0      67.0      64.0      62.0      60.0      57.0      55.0      54.0      51.0      48.0
                          46.0      45.0      43.0      42.0      40.0      38.0      37.0      36.0      35.0      34.0
                          32.0      31.0      30.0      29.0      28.0      27.0      25.0      25.0      25.0      23.0
                          21.0      20.0      20.0      19.0      16.0       3.0

                                                    ***


                                                  RUNOFF SUMMARY
                                          FLOW IN CUBIC FEET PER SECOND
                                       TIME IN HOURS,  AREA IN SQUARE MILES

                                         PEAK   TIME OF    AVERAGE FLOW FOR MAXIMUM PERIOD      BASIN    MAXIMUM     TIME OF
          OPERATION       STATION        FLOW     PEAK                                          AREA      STAGE     MAX STAGE
+                                                             6-HOUR     24-HOUR     72-HOUR

          HYDROGRAPH AT
+                          Inflow       6902.   42.13         2345.       1022.        436.       2.85

          ROUTED TO
+                          PMFout       3185.   42.50         1930.        995.        424.       2.85
+                                                                                                         1098.94       42.50


 *** NORMAL END OF HEC-1 ***
```

```
1*****************************************                                  ***************************************
 *                                       *                                  *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1L)  *                                  *   U.S. ARMY CORPS OF ENGINEERS      *
 *             JULY   1998               *                                  *   HYDROLOGIC ENGINEERING CENTER     *
 *          VERSION 4.1(L)               *                                  *         609 SECOND STREET           *
 *                                       *                                  *      DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   22OCT09  TIME  11:04:16   *                                  *          (916) 756-1104             *
 *                                       *                                  *                                     *
 *****************************************                                  ***************************************


                    X     X  XXXXXXX   XXXXX           X
                    X     X  X        X     X         XX
                    X     X  X        X                X
                    XXXXXXX  XXXX     X        XXXXX   X
                    X     X  X        X                X
                    X     X  X        X     X          X
                    X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                          HEC-1L INPUT                                              PAGE  1

          LINE         ID.......1.......2.......3.......4.......5,.......6.......7.......8.......9......10

            1           ID   PROJECT: Eagle Mountain
            2           ID   CLIENT: Eagle Crest Engergy
            3           ID   FILE NAME: EMLR100YR.HC1 [Eagle Mountain, Lower Res., 100 YR storm]
            4           ID   HISTORY: Created 8/19/09 by NDM Revised 9/25/2009 by NJN
            5           ID   PURPOSE: Estimate 100 YR-Storm for Lower Reservoir
            6           ID
            7           ID   PRECIPITATION: 100 YR
            8           ID   TEMPORAL DISTRIBUTION: Center weighted
            9           ID   SUB-BASINS: none
           10           ID   LOSS RATE: zero
           11           ID
           12           ID   BASE FLOW: Zero
           13           ID   UH (OVERLAND): USBR Synthetic, Southwest Desert, Kn = 0.045, 1-min duration
           14           ID
           15           ID
           16           ID   ***************************************************************************
                        *
           17           IT       1               0    4500
           18           IO       1       2
                        *

           19           KK  Inflow --> OVERLAND INFLOW TO RESERVOIR (excludes direct rainfall on reservoir
                        * SUB-BASIN AREA (sq. mi)
           20           BA   2.850
                        *
                        * 100-YR STORM, (CENTER-WEIGHTED, SEO GUIDELINES, IT or IN time step)
           21           PH            0.01   0.490   0.90    1.56    1.86    2.08    2.55    3.35    4.15
                        *
                        * BASEFLOW (SET TO ZERO)
           22           BF    00.0     0.0     1.0
                        *
                        * UNIFORM LOSS RATE, ZERO INIT. BUDGET (SAT'D). ZERO IMPERMIABLE.
           23           LU     0.0   0.000     0.0
                        *
           24           IN       1
                        *       Eagle Mountain Lower Reservoir, Kn = 0.045, 1-min UH
                        * USBR UH, Kn =    0.045, duration =   1min.
           25           UI      22      40      56      74     102     142     196     265     350     449
           26           UI     571     758    1012    1354    1833    2303    2756    3222    3642    4057
           27           UI    4497    4660    4727    4571    4374    4137    3867    3561    3255    2938
           28           UI    2615    2395    2199    2016    1833    1702    1585    1475    1377    1279
           29           UI    1188    1121    1054     996     953     911     872     835     799     767
           30           UI     736     706     681     655     629     607     583     560     538     517
           31           UI     496     476     455     440     424     406     389     375     362     348
           32           UI     335     322     309     297     286     274     264     253     243     235
           33           UI     227     218     209     201     193     186     178     171     164     159
           34           UI     152     145     140     135     130     126     121     115     111     107
           35           UI     104      99      95      92      88      85      81      78      75      72
           36           UI      69      67      64      62      60      57      55      54      51      48
           37           UI      46      45      43      42      40      38      37      36      35      34
           38           UI      32      31      30      29      28      27      25      25      25      23
           39           UI      21      20      20      19      16       3
                        *
                        *
                        *
1                                          HEC-1L INPUT                                              PAGE  2

          LINE         ID.......1.......2.......3.......4.......5,.......6.......7.......8.......9......10


           40           KK  PMFout --> PMF OUTFLOW THROUGH SPILLWAY
           41           KP       1
           42           KO       0       2
                        *
                        * INITIAL RESERVOIR ELEVATION
           43           RS       1    ELEV    1094
```

```
                    *
                    * ELEV-CAP TABLE
      44            SV    4200    5891   10400   10400   15917   19438   21900   23244   25210
      45            SE     925     950    1000    1025    1050    1076    1092    1100    1110
                    *
                    * SPILLWAY CREST ELEVATION: EL, L, C, Exp
      46            SS    1094     100     2.9     1.5
                    *
                    *
                    *DIAGRAM
                    *
      47            ZZ
1
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

```
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR        (<---) RETURN OF DIVERTED OR PUMPED FLOW

    19      Inflow
                V
                V
    40      PMFout

 (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
```

PRECIPITATION DATA

21 PH — DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

| ..... HYDRO-35 ...... | | | ............... TP-40 ............... | | | | | ........... TP-49 ........... | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5-MIN | 15-MIN | 60-MIN | 2-HR | 3-HR | 6-HR | 12-HR | 24-HR | 2-DAY | 4-DAY | 7-DAY | 10-DAY |
| 0.49 | 0.90 | 1.56 | 1.86 | 2.08 | 2.55 | 3.35 | 4.15 | 0.00 | 0.00 | 0.00 | 0.00 |

STORM AREA = 0.01

```
   23 LU         UNIFORM LOSS RATE
                       STRTL        0.00  INITIAL LOSS
                       CNSTL        0.00  UNIFORM LOSS RATE
                       RTIMP        0.00  PERCENT IMPERVIOUS AREA
```

25 UI — INPUT UNITGRAPH, 146 ORDINATES, VOLUME = 1.00

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 22.0 | 40.0 | 56.0 | 74.0 | 102.0 | 142.0 | 196.0 | 265.0 | 350.0 | 449.0 |
| 571.0 | 758.0 | 1012.0 | 1354.0 | 1833.0 | 2303.0 | 2756.0 | 3222.0 | 3642.0 | 4057.0 |
| 4497.0 | 4660.0 | 4727.0 | 4571.0 | 4374.0 | 4137.0 | 3867.0 | 3561.0 | 3255.0 | 2938.0 |
| 2615.0 | 2395.0 | 2199.0 | 2016.0 | 1833.0 | 1702.0 | 1585.0 | 1475.0 | 1377.0 | 1279.0 |
| 1188.0 | 1121.0 | 1054.0 | 996.0 | 953.0 | 911.0 | 872.0 | 835.0 | 799.0 | 767.0 |
| 736.0 | 706.0 | 681.0 | 655.0 | 629.0 | 607.0 | 583.0 | 560.0 | 538.0 | 517.0 |
| 496.0 | 476.0 | 455.0 | 440.0 | 424.0 | 406.0 | 389.0 | 375.0 | 362.0 | 348.0 |
| 335.0 | 322.0 | 309.0 | 297.0 | 286.0 | 274.0 | 264.0 | 253.0 | 243.0 | 235.0 |
| 227.0 | 218.0 | 209.0 | 201.0 | 193.0 | 186.0 | 178.0 | 171.0 | 164.0 | 159.0 |
| 152.0 | 145.0 | 140.0 | 135.0 | 130.0 | 126.0 | 121.0 | 115.0 | 111.0 | 107.0 |
| 104.0 | 99.0 | 95.0 | 92.0 | 88.0 | 85.0 | 81.0 | 78.0 | 75.0 | 72.0 |
| 69.0 | 67.0 | 64.0 | 62.0 | 60.0 | 57.0 | 55.0 | 54.0 | 51.0 | 48.0 |
| 46.0 | 45.0 | 43.0 | 42.0 | 40.0 | 38.0 | 37.0 | 36.0 | 35.0 | 34.0 |
| 32.0 | 31.0 | 30.0 | 29.0 | 28.0 | 27.0 | 25.0 | 25.0 | 25.0 | 23.0 |
| 21.0 | 20.0 | 20.0 | 19.0 | 16.0 | 3.0 | | | | |

***

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

| | OPERATION | STATION | PEAK FLOW | TIME OF PEAK | AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR | 24-HOUR | 72-HOUR | BASIN AREA | MAXIMUM STAGE | TIME OF MAX STAGE |
|---|---|---|---|---|---|---|---|---|---|---|
| + | HYDROGRAPH AT | Inflow | 4410. | 12.38 | 786. | 317. | 106. | 2.85 | | |
| + | ROUTED TO | PMFout | 749. | 13.42 | 581. | 279. | 105. | 2.85 | | |
| + | | | | | | | | | 1095.88 | 13.40 |

*** NORMAL END OF HEC-1 ***

```
1***************************************                                        ***************************************
 *                                     *                                        *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1L)  *                                      *   U.S. ARMY CORPS OF ENGINEERS      *
 *            JULY   1998              *                                        *   HYDROLOGIC ENGINEERING CENTER     *
 *          VERSION 4.1(L)             *                                        *         609 SECOND STREET           *
 *                                     *                                        *      DAVIS, CALIFORNIA 95616        *
 * RUN DATE   25SEP09  TIME  16:45:03  *                                        *          (916) 756-1104             *
 *                                     *                                        *                                     *
***************************************                                        ***************************************


                                        X     X  XXXXXXX   XXXXX           X
                                        X     X  X        X     X         XX
                                        X     X  X        X                X
                                        XXXXXXX  XXXX     X        XXXXX   X
                                        X     X  X        X                X
                                        X     X  X        X     X          X
                                        X     X  XXXXXXX   XXXXX          XXX


          THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

          THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
          THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
          NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
          DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
          KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1                                                    HEC-1L INPUT                                               PAGE  1

          LINE          ID.......1.......2.......3.......4.......5,.......6.......7.......8.......9......10

            1            ID   PROJECT: Eagle Mountain
            2            ID   CLIENT: Eagle Crest Engergy
            3            ID   FILE NAME: EMECPMF.HC1 [Eagle Mountain, Eagle Creek, PMF storm]
            4            ID   HISTORY: Created 8/19/09 by NDM Revised 9/24/09 by NJN
            5            ID   PURPOSE: Estimate PMF-Storm for Eagle Creek Watershed w/o project
            6            ID
            7            ID   PRECIPITATION: HMR 59 PMP
            8            ID   TEMPORAL DISTRIBUTION: 2/3 end weighted
            9            ID   SUB-BASINS: none
           10            ID   LOSS RATE: zero
           11            ID
           12            ID   BASE FLOW: Zero
           13            ID   UH (OVERLAND): USBR Synthetic, Southwest Desert, Kn = 0.045, 1-min duration
           14            ID
           15            ID
           16            ID   ***************************************************************************
                         *
           17            IT       5               0     900
           18            IO       1       2
                         *

           19            KK  Inflow --> OVERLAND INFLOW TO RESERVOIR (excludes direct rainfall on reservoir
                         * SUB-BASIN AREA (sq. mi)
           20            BA   7.07
                         *
           21            IN      60
                         * ALL-SEASON GENERAL STORM PMP - BASIN B1
                         * (1-hr incr.; Mid-End Wt, FERC/HMR 59 alt. 6-hr Blocks; EXCESS RAINFALL ONLY)
                         * Applied HSG loss rates(A,B,C,D   0.000   0.000   0.000   0.000(in/hr)
           22            PI   0.048   0.048   0.048   0.048   0.048   0.048   0.068   0.068   0.068   0.068
           23            PI   0.085   0.085   0.090   0.090   0.090   0.090   0.090   0.090   0.109   0.109
           24            PI   0.109   0.109   0.111   0.111   0.149   0.149   0.149   0.165   0.165   0.165
           25            PI   0.597   0.625   0.638   0.640   0.644   0.650   0.663   0.697   0.699   0.704
           26            PI   1.614   4.377   0.197   0.197   0.197   0.170   0.170   0.170   0.111   0.111
           27            PI   0.111   0.111   0.111   0.111   0.109   0.109   0.109   0.109   0.090   0.090
           28            PI   0.085   0.085   0.085   0.085   0.085   0.085   0.068   0.068   0.068   0.068
           29            PI   0.048   0.048   0.000
                         *
                         * BASEFLOW (SET TO ZERO)
           30            BF    00.0     0.0     1.0
                         *
                         * UNIFORM LOSS RATE, ZERO INIT. BUDGET (SAT'D). ZERO IMPERMEABLE.
           31            LU     0.0   0.000     0.0
                         *
           32            IN       5
                         *       Eagle Mountain Eagle Creek Reservoir, Kn = 0.045, 1-min UH
                         * USBR UH, Kn =    0.045, duration =   5min.
           33            UI      42      79     156     291     503     863    1615    2611    3572    4463
           34            UI    4848    4525    4006    3357    2680    2241    1854    1602    1385    1195
           35            UI    1052     957     874     799     734     679     627     577     531     488
           36            UI     450     413     381     353     325     300     276     254     236     217
           37            UI     200     184     169     156     143     133     123     113     105      96
           38            UI      89      82      76      69      64      59      56      49      46      43
           39            UI      39      37      34      32      29      27      25      22      20      19
                         *
                         *
                         *
                         *
                         *
                         *DIAGRAM
                         *
1                                                    HEC-1 INPUT                                                PAGE  2
1
```

33 UI INPUT UNITGRAPH, 70 ORDINATES, VOLUME = 1.00

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 42.0 | 79.0 | 156.0 | 291.0 | 503.0 | 863.0 | 1615.0 | 2611.0 | 3572.0 | 4463.0 |
| 4848.0 | 4525.0 | 4006.0 | 3357.0 | 2680.0 | 2241.0 | 1854.0 | 1602.0 | 1385.0 | 1195.0 |
| 1052.0 | 957.0 | 874.0 | 799.0 | 734.0 | 679.0 | 627.0 | 577.0 | 531.0 | 488.0 |
| 450.0 | 413.0 | 381.0 | 353.0 | 325.0 | 300.0 | 276.0 | 254.0 | 236.0 | 217.0 |
| 200.0 | 184.0 | 169.0 | 156.0 | 143.0 | 133.0 | 123.0 | 113.0 | 105.0 | 96.0 |
| 89.0 | 82.0 | 76.0 | 69.0 | 64.0 | 59.0 | 56.0 | 49.0 | 46.0 | 43.0 |
| 39.0 | 37.0 | 34.0 | 32.0 | 29.0 | 27.0 | 25.0 | 22.0 | 20.0 | 19.0 |

***

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

| | OPERATION | STATION | PEAK FLOW | TIME OF PEAK | AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR | 24-HOUR | 72-HOUR | BASIN AREA | MAXIMUM STAGE | TIME OF MAX STAGE |
|---|---|---|---|---|---|---|---|---|---|---|
| + | HYDROGRAPH AT | Inflow | 15319. | 42.50 | 6046. | 2768. | 1182. | 7.07 | | |

*** NORMAL END OF HEC-1 ***

```
1*****************************************                                      ***************************************
 *                                       *                                      *                                     *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1L)  *                                      *   U.S. ARMY CORPS OF ENGINEERS      *
 *            JULY   1998                *                                      *   HYDROLOGIC ENGINEERING CENTER     *
 *           VERSION 4.1(L)              *                                      *         609 SECOND STREET           *
 *                                       *                                      *      DAVIS, CALIFORNIA 95616        *
 *  RUN DATE   22OCT09  TIME  11:12:09   *                                      *          (916) 756-1104             *
 *                                       *                                      *                                     *
 *****************************************                                      ***************************************




                                  X     X  XXXXXXX   XXXXX           X
                                  X     X  X        X     X         XX
                                  X     X  X        X                X
                                  XXXXXXX  XXXX     X        XXXXX   X
                                  X     X  X        X                X
                                  X     X  X        X     X          X
                                  X     X  XXXXXXX   XXXXX          XXX



           THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

           THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
           THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
           NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
           DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL   LOSS RATE:GREEN AND AMPT INFILTRATION
           KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


1                                          HEC-1 INPUT                                            PAGE  1

          LINE          ID.......1.......2.......3.......4.......5,.......6.......7.......8.......9......10

            1            ID   PROJECT: Eagle Mountain
            2            ID   CLIENT: Eagle Crest Engergy
            3            ID   FILE NAME: EMEC100YR.HC1 [Eagle Mountain, Eagle Creek, 100 YR storm]
            4            ID   HISTORY: Created 8/19/09 by NDM Revised 9/24/09 by NJN
            5            ID   PURPOSE: Estimate 100 YR-Storm for Eagle Creek Watershed w/o project
            6            ID
            7            ID   PRECIPITATION: 100-YR
            8            ID   TEMPORAL DISTRIBUTION: 2/3 end weighted
            9            ID   SUB-BASINS: none
           10            ID   LOSS RATE: zero
           11            ID
           12            ID   BASE FLOW: Zero
           13            ID   UH (OVERLAND): USBR Synthetic, Southwest Desert, Kn = 0.045, 1-min duration
           14            ID
           15            ID
           16            ID   ******************************************************************************
                         *
           17            IT       5               0     900
           18            IO       1       2
                         *

           19            KK  Inflow --> OVERLAND INFLOW TO RESERVOIR (excludes direct rainfall on reservoir
                         * SUB-BASIN AREA (sq. mi)
           20            BA   7.07
                         *
                         * 100-YR STORM, (CENTER-WEIGHTED, SEO GUIDELINES, IT or IN time step)
           21            PH             0.01  0.490    0.90    1.56    1.86    2.08    2.55    3.35    4.15
                         *
                         * BASEFLOW (SET TO ZERO)
           22            BF    00.0     0.0     1.0
                         *
                         * UNIFORM LOSS RATE, ZERO INIT. BUDGET (SAT'D). ZERO IMPERMEABLE.
           23            LU     0.0  0.000     0.0
                         *
           24            IN       5
                         *       Eagle Mountain Eagle Creek Reservoir, Kn = 0.045, 1-min UH
                         * USBR UH, Kn =    0.045, duration =    5min.
           25            UI      42      79     156     291     503     863    1615    2611    3572    4463
           26            UI    4848    4525    4006    3357    2680    2241    1854    1602    1385    1195
           27            UI    1052     957     874     799     734     679     627     577     531     488
           28            UI     450     413     381     353     325     300     276     254     236     217
           29            UI     200     184     169     156     143     133     123     113     105      96
           30            UI      89      82      76      69      64      59      56      49      46      43
           31            UI      39      37      34      32      29      27      25      22      20      19
                         *
                         *
                         *
                         *
                         *
                         *DIAGRAM
                         *
           32            ZZ
```

PRECIPITATION DATA

21 PH DEPTHS FOR 0-PERCENT HYPOTHETICAL STORM

| ..... HYDRO-35 ...... | | | ............... TP-40 ............... | | | | | ........... TP-49 ........... | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 5-MIN | 15-MIN | 60-MIN | 2-HR | 3-HR | 6-HR | 12-HR | 24-HR | 2-DAY | 4-DAY | 7-DAY | 10-DAY |
| 0.49 | 0.90 | 1.56 | 1.86 | 2.08 | 2.55 | 3.35 | 4.15 | 0.00 | 0.00 | 0.00 | 0.00 |

STORM AREA = 0.01

25 UI INPUT UNITGRAPH, 70 ORDINATES, VOLUME = 1.00

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 42.0 | 79.0 | 156.0 | 291.0 | 503.0 | 863.0 | 1615.0 | 2611.0 | 3572.0 | 4463.0 |
| 4848.0 | 4525.0 | 4006.0 | 3357.0 | 2680.0 | 2241.0 | 1854.0 | 1602.0 | 1385.0 | 1195.0 |
| 1052.0 | 957.0 | 874.0 | 799.0 | 734.0 | 679.0 | 627.0 | 577.0 | 531.0 | 488.0 |
| 450.0 | 413.0 | 381.0 | 353.0 | 325.0 | 300.0 | 276.0 | 254.0 | 236.0 | 217.0 |
| 200.0 | 184.0 | 169.0 | 156.0 | 143.0 | 133.0 | 123.0 | 113.0 | 105.0 | 96.0 |
| 89.0 | 82.0 | 76.0 | 69.0 | 64.0 | 59.0 | 56.0 | 49.0 | 46.0 | 43.0 |
| 39.0 | 37.0 | 34.0 | 32.0 | 29.0 | 27.0 | 25.0 | 22.0 | 20.0 | 19.0 |

***

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

| | OPERATION | STATION | PEAK FLOW | TIME OF PEAK | AVERAGE FLOW FOR MAXIMUM PERIOD | | | BASIN AREA | MAXIMUM STAGE | TIME OF MAX STAGE |
|---|---|---|---|---|---|---|---|---|---|---|
| + | | | | | 6-HOUR | 24-HOUR | 72-HOUR | | | |
| | HYDROGRAPH AT | | | | | | | | | |
| + | | Inflow | 6455. | 12.92 | 1935. | 783. | 263. | 7.07 | | |

*** NORMAL END OF HEC-1 ***

Dimensionless Unit Hydrograph (select from menu) = **Southwest Desert, Great Basin, Colorado Plateau** 27-Aug-09

# Eagle Mountain Upper Reservoir, Kn = 0.045, 1-min UH

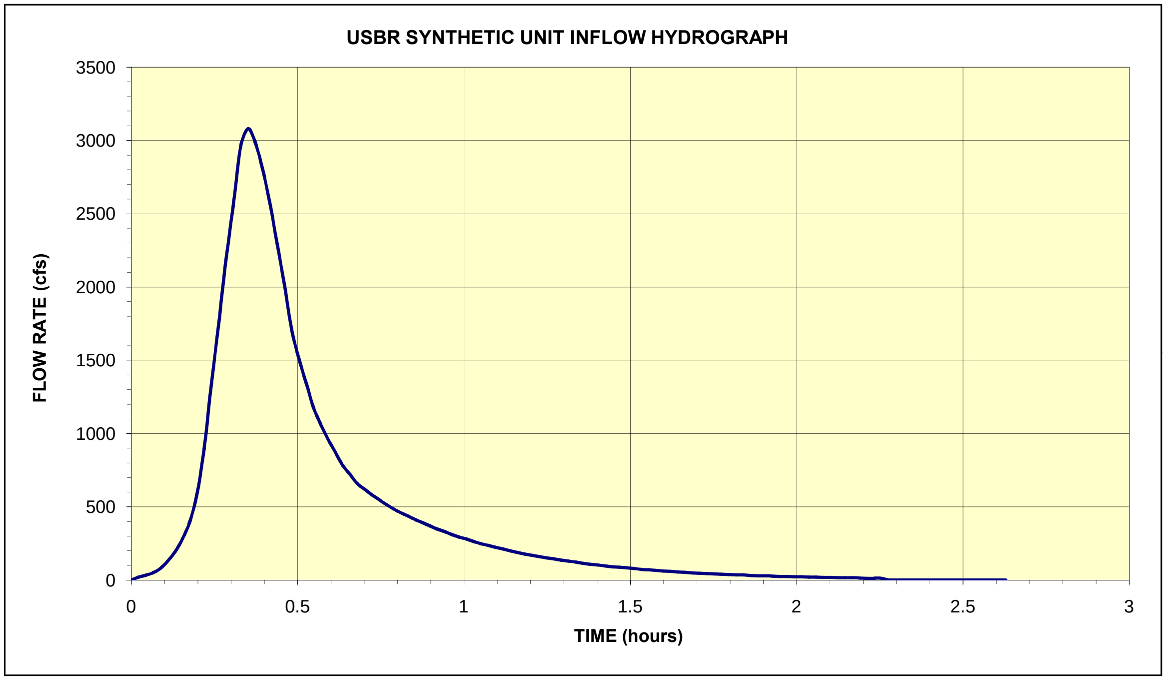
| | | | | | |
|---|---|---|---|---|---|
| Lag Reduction to Peak UH (%) = | 0% | | | | |
| Drainage Area, **A** = | 1.74 | sq. miles | **Lg+D/2** = | 0.44 | Hours |
| Basin Slope, **S** = | 430.2 | ft/mile | Basin Factor = | 0.05 | **(L*Lca/S^0.5)** |
| Length of Watercourse, **L** = | 2.22 | miles | (Vol. 1" rain, $ft^3$)*(days/sec), **V'** = | 46.68 | cfs*day |
| Length to Centroid, **Lca** = | 0.45 | miles | Quotient X for X*q = $Q_s$; X = | 106.6 | **V'/(Lg+D/2)** |
| **Kn** = | 0.045 | * avg. Manning's "n" (weighted by stream length for principle watercourses) | | | |

**Estimated:** Lag Time, **Lg** = 0.43 Hours

*Lg = 26*Kn*(L*Lca/S^0.5)^0.33*

Duration of Unit Rainfall to define peak, D = 5 minutes
Minimum Timestep (D) for < 120 UH increments* = 1 minutes
Minimum Timestep (D) for < 200 UH increments* = 1 minutes

**For UH:** Duration of Unit Rainfall, **D** = **1** minutes, round down to nearest: 5, 10, 15, 30, 60, 120, 180, 360
D must equal time step used for converting precipitation to runoff.




**HEC-1 UI RECORDS** 1 -min Duration Unit Rainfall Peak UI (cfs) = 3081

***ITERATE PEAK TO TARGET 1.000 -------->*** Unit Runoff (inch) = 0.99987 Absolute Peak (cfs) = 3081

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| UI | 15 | 27 | 39 | 52 | 73 | 107 | 150 | 201 | 267 | 349 |
| UI | 463 | 624 | 863 | 1189 | 1516 | 1833 | 2158 | 2443 | 2739 | 2984 |
| UI | 3081 | 3015 | 2901 | 2750 | 2570 | 2357 | 2143 | 1923 | 1700 | 1547 |
| UI | 1413 | 1285 | 1164 | 1079 | 1000 | 928 | 860 | 792 | 742 | 695 |
| UI | 653 | 623 | 594 | 566 | 541 | 516 | 494 | 472 | 453 | 436 |
| UI | 417 | 401 | 385 | 368 | 353 | 338 | 324 | 310 | 295 | 285 |
| UI | 273 | 261 | 249 | 240 | 231 | 221 | 212 | 203 | 195 | 187 |
| UI | 179 | 171 | 164 | 158 | 152 | 146 | 140 | 134 | 128 | 123 |
| UI | 118 | 113 | 108 | 104 | 99 | 95 | 91 | 88 | 84 | 81 |
| UI | 78 | 74 | 71 | 69 | 66 | 63 | 60 | 58 | 55 | 53 |
| UI | 51 | 49 | 47 | 44 | 43 | 41 | 40 | 38 | 36 | 35 |
| UI | 34 | 31 | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23 |
| UI | 22 | 21 | 21 | 20 | 19 | 18 | 17 | 17 | 16 | 16 |
| UI | 15 | 13 | 13 | 13 | 12 | 6 | | | | |

Dimensionless Unit Hydrograph (select from menu) = **Southwest Desert, Great Basin, Colorado Plateau** 27-Aug-09

# Eagle Mountain Lower Reservoir, Kn = 0.045, 1-min UH

Lag Reduction to Peak UH (%) = 0%

Drainage Area, **A** = 2.85 sq. miles | **Lg+D/2** = 0.47 Hours

Basin Slope, **S** = 912.7 ft/mile | Basin Factor = 0.06 **(L*Lca/S^0.5)**

Length of Watercourse, **L** = 2.46 miles | (Vol. 1" rain, $ft^3$)*(days/sec), **V'** = 76.64 cfs*day

Length to Centroid, **Lca** = 0.73 miles | Quotient X for X*q = $Q_s$; X = 163.5 **V'/(Lg+D/2)**

**Kn** = 0.045 * avg. Manning's "n" (weighted by stream length for principle watercourses)

**Estimated:** Lag Time, **Lg** = 0.46 Hours

*Lg = 26*Kn*(L*Lca/S^0.5)^0.33*

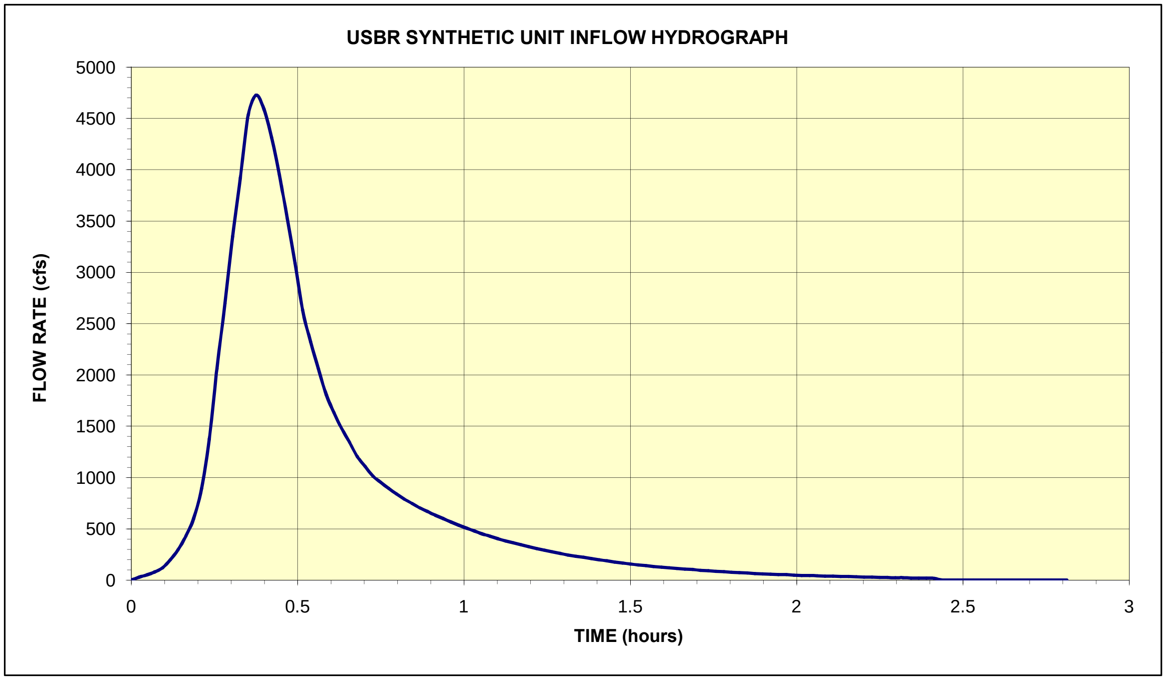
Duration of Unit Rainfall to define peak, D = 5 minutes

Minimum Timestep (D) for < 120 UH increments* = 1 minutes

Minimum Timestep (D) for < 200 UH increments* = 1 minutes

**For UH:** Duration of Unit Rainfall, **D** = **1** minutes, round down to nearest: 5, 10, 15, 30, 60, 120, 180, 360

D must equal time step used for converting precipitation to runoff.




**HEC-1 UI RECORDS** 1 -min Duration Unit Rainfall Peak UI (cfs) = 4727

***ITERATE PEAK TO TARGET 1.000 -------->*** Unit Runoff (inch) = 1.00020 Absolute Peak (cfs) = 4727

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| UI | 22 | 40 | 56 | 74 | 102 | 142 | 196 | 265 | 350 | 449 |
| UI | 571 | 758 | 1012 | 1354 | 1833 | 2303 | 2756 | 3222 | 3642 | 4057 |
| UI | 4497 | 4660 | 4727 | 4571 | 4374 | 4137 | 3867 | 3561 | 3255 | 2938 |
| UI | 2615 | 2395 | 2199 | 2016 | 1833 | 1702 | 1585 | 1475 | 1377 | 1279 |
| UI | 1188 | 1121 | 1054 | 996 | 953 | 911 | 872 | 835 | 799 | 767 |
| UI | 736 | 706 | 681 | 655 | 629 | 607 | 583 | 560 | 538 | 517 |
| UI | 496 | 476 | 455 | 440 | 424 | 406 | 389 | 375 | 362 | 348 |
| UI | 335 | 322 | 309 | 297 | 286 | 274 | 264 | 253 | 243 | 235 |
| UI | 227 | 218 | 209 | 201 | 193 | 186 | 178 | 171 | 164 | 159 |
| UI | 152 | 145 | 140 | 135 | 130 | 126 | 121 | 115 | 111 | 107 |
| UI | 104 | 99 | 95 | 92 | 88 | 85 | 81 | 78 | 75 | 72 |
| UI | 69 | 67 | 64 | 62 | 60 | 57 | 55 | 54 | 51 | 48 |
| UI | 46 | 45 | 43 | 42 | 40 | 38 | 37 | 36 | 35 | 34 |
| UI | 32 | 31 | 30 | 29 | 28 | 27 | 25 | 25 | 25 | 23 |
| UI | 21 | 20 | 20 | 19 | 16 | 3 | | | | |

Dimensionless Unit Hydrograph (select from menu) = **Southwest Desert, Great Basin, Colorado Plateau** 22-Oct-09

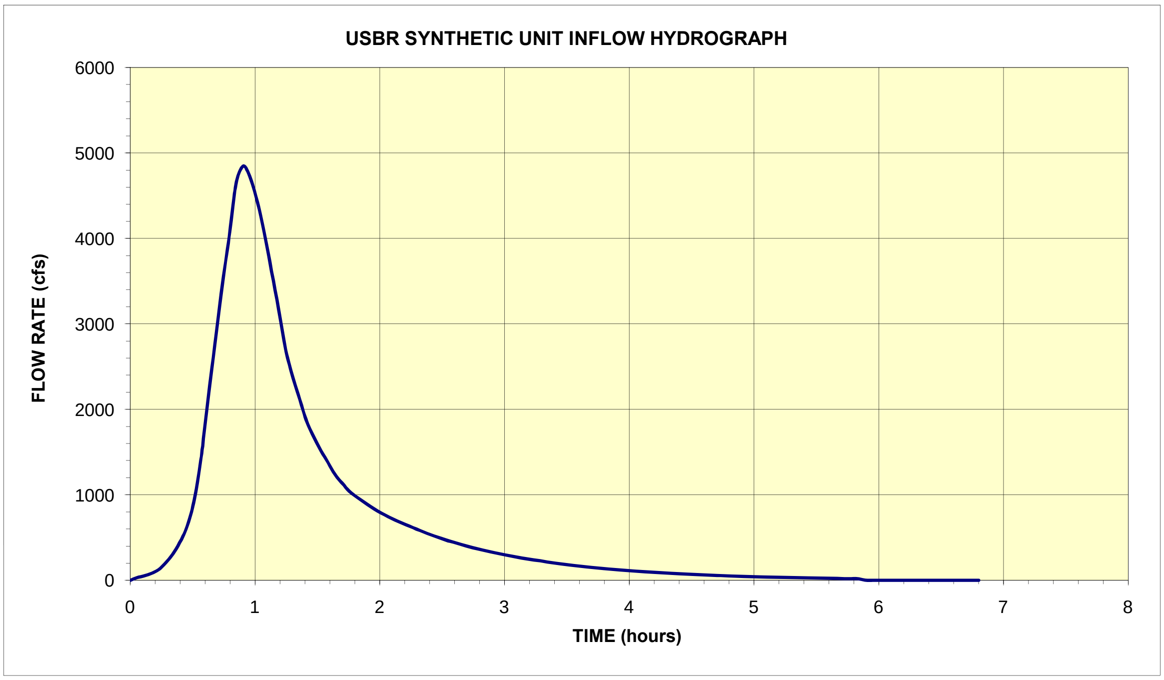
# Eagle Mountain Eagle Creek Reservoir, Kn = 0.045, 1-min UH

| | | | | | |
|---|---|---|---|---|---|
| Lag Reduction to Peak UH (%) = | 0% | | | | |
| Drainage Area, **A** = | 7.07 | sq. miles | **Lg+D/2** = | 1.13 | Hours |
| Basin Slope, **S** = | 313.9 | ft/mile | Basin Factor = | 0.81 | **(L*Lca/S^0.5)** |
| Length of Watercourse, **L** = | 5.51 | miles | (Vol. 1" rain, $ft^3$)*(days/sec), **V'** = | 190.11 | cfs*day |
| Length to Centroid, **Lca** = | 2.61 | miles | Quotient X for X*q = $Q_s$; X = | 167.7 | **V'/(Lg+D/2)** |
| **Kn** = | 0.045 | * avg. Manning's "n" (weighted by stream length for principle watercourses) | | | |

**Estimated:** Lag Time, **Lg** = 1.09 Hours
*Lg = 26*Kn*(L*Lca/S^0.5)^0.33*

Duration of Unit Rainfall to define peak, D = 12 minutes
Minimum Timestep (D) for < 120 UH increments* = 3 minutes
Minimum Timestep (D) for < 200 UH increments* = 2 minutes

**For UH:** Duration of Unit Rainfall, **D** = **5** minutes, round down to nearest: 5, 10, 15, 30, 60, 120, 180, 360
D must equal time step used for converting precipitation to runoff.




**HEC-1 UI RECORDS** 5 -min Duration Unit Rainfall Peak UI (cfs) = 4848
***ITERATE PEAK TO TARGET 1.000 -------->*** Unit Runoff (inch) = 1.00001 Absolute Peak (cfs) = 4848

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| UI | 42 | 79 | 156 | 291 | 503 | 863 | 1615 | 2611 | 3572 | 4463 |
| UI | 4848 | 4525 | 4006 | 3357 | 2680 | 2241 | 1854 | 1602 | 1385 | 1195 |
| UI | 1052 | 957 | 874 | 799 | 734 | 679 | 627 | 577 | 531 | 488 |
| UI | 450 | 413 | 381 | 353 | 325 | 300 | 276 | 254 | 236 | 217 |
| UI | 200 | 184 | 169 | 156 | 143 | 133 | 123 | 113 | 105 | 96 |
| UI | 89 | 82 | 76 | 69 | 64 | 59 | 56 | 49 | 46 | 43 |
| UI | 39 | 37 | 34 | 32 | 29 | 27 | 25 | 22 | 20 | 19 |

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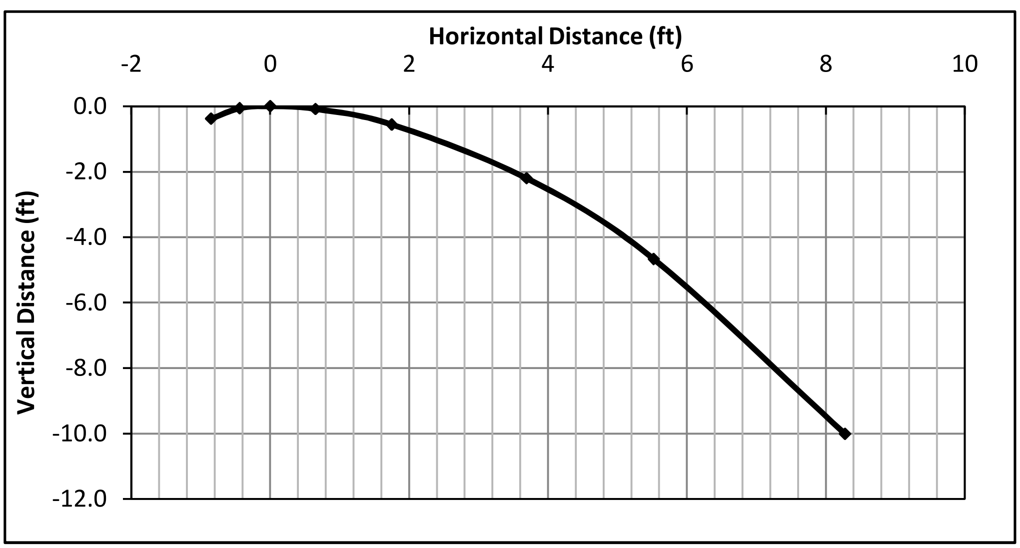
**Schedule A: Deficiency of License Application**
**8/18/2009**
**NDM**

## UPPER RESERVOIR OGEE CREST GEOMETRY

| | |
|---|---|
| Design Head, Ho: | 3 ft |
| Approach Depth, P: | 10 ft |
| Is P > 0.5Ho: | YES |
| Use USBR Fig. 9.22: | YES |

| X Points | | Y Points | |
|---|---|---|---|
| -X2 = | -0.852 ft | -Y2 = | -0.381 ft |
| -X1 = | -0.441 ft | -Y1 = | -0.063 ft |
| X Origin = | 0 ft | Y Origin = | 0 ft |
| X1 = | 0.651 ft | Y1 = | -0.087 ft |
| X2 = | 1.749 ft | Y2 = | -0.561 ft |
| X3 = | 3.69 ft | Y3 = | -2.202 ft |
| X4 = | 5.52 ft | Y4 = | -4.668 ft |
| X5 = | 8.274 ft | Y5 = | -10.008 ft |

| RADIUS LENGTHS | | RADIUS CENTER POINT | | | |
|---|---|---|---|---|---|
| R1 = | 0.705 ft | X1 = | -0.246 ft | Y1 = | -0.741 ft |
| R2 = | 1.59 ft | X2 = | 0 ft | Y2 = | -1.59 ft |
| R3 = | 2.475 ft | X3 = | 0 ft | Y3 = | -2.475 ft |
| R4 = | 4.23 ft | X4 = | -0.462 ft | Y4 = | -4.167 ft |
| R5 = | 8.4 ft | X5 = | -2.64 ft | Y5 = | -7.725 ft |
| R6 = | 19.5 ft | X6 = | -11.004 ft | Y6 = | -15.021 ft |
| R7 = | 36 ft | X7 = | -24.987 ft | Y7 = | -23.781 ft |



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**UPPER RESERVOIR OGEE CREST GEOMETRY**

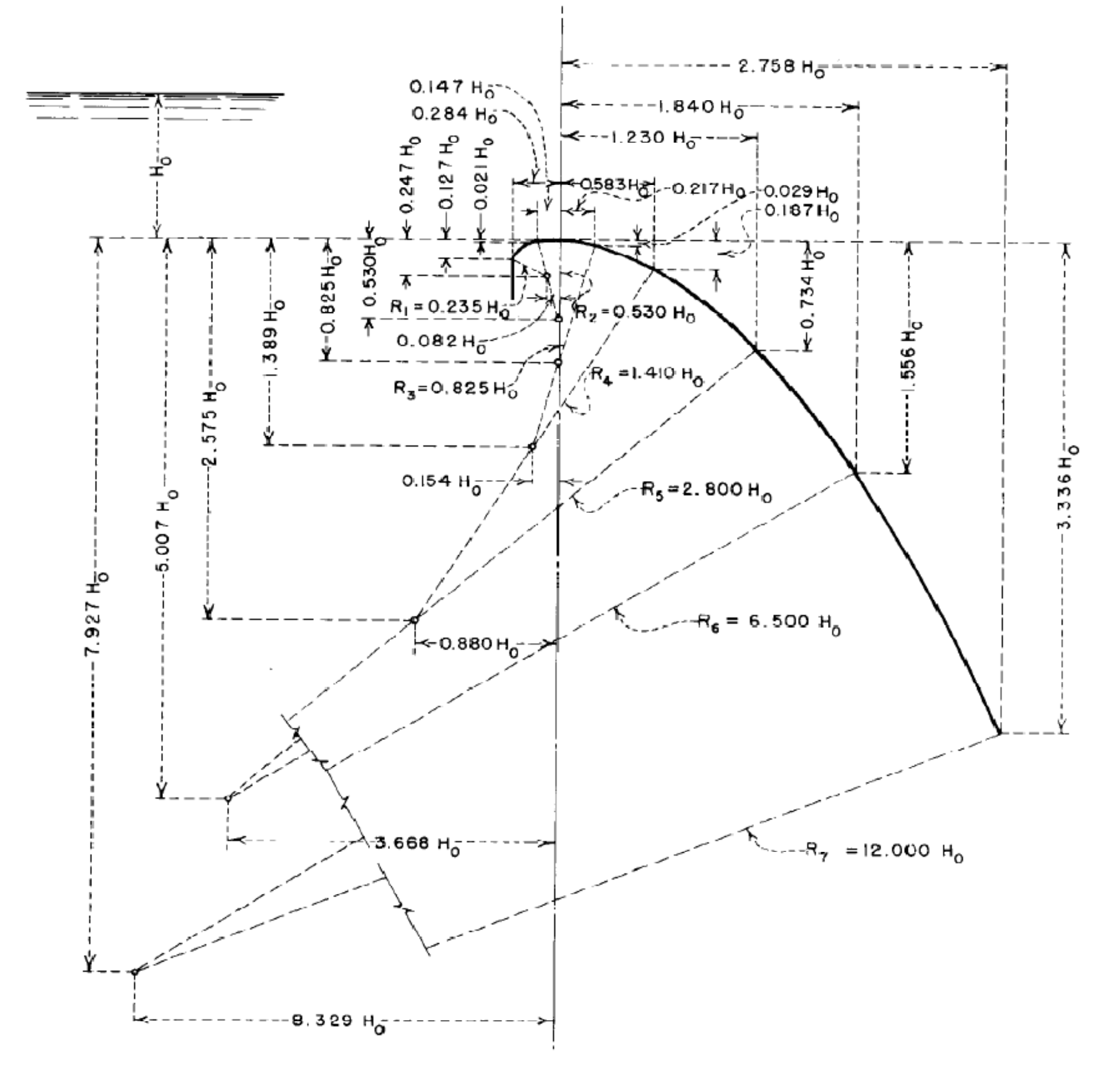



Figure 9-22.—Ogee crest shape defined by compound curves. 288-D-2408.

GEI Consultants

| | | | |
|---|---|---|---|
| CLIENT: | Eagle Crest Energy Company | | |
| PROJECT: | Eagle Mountain Pumped Storage Project | Project: 80474 | Pages: 2 |
| SUBJECT: | Stilling Basin Design | Date: 8/24/2009 | By: NDM |
| | | Checked: | By: |
| | | Approved: | By: |

**Purpose:** Estimate minimum dimensions for the chute and Type III stilling basin structure required at Eagle Mountain Upper Reservoir.

**Procedure:** Follow design steps presented in *Design of Small Canals - Ch. II Conveyance Structures - F. Chutes*.

**References:** USBR (1978). Design of Small Canal Structures.
USBR (1984). Engineering Monograph No. 25, Hydraulic Design of Stilling Basins and Energy Dissipators.

**Input Variables:**

| | | |
|---|---|---|
| Start El.: | 2490.0 | ft |
| Initial Basin Floor El.: | 2380.0 | ft |
| Difference: | 110.0 | ft |
| Chute Slope: | 0.8 | H:1V |
| Chute Width, B: | 100.00 | ft |

Assume 50% of energy is dissipated on chute slope

| | | |
|---|---|---|
| Head at toe: | 55 | ft |
| Assumed Depth: | 0.53 | ft |
| Velocity at Toe: | 59.2 | ft/sec |

# TYPE III STILLING BASIN

## Step 1: Inflow Variables.

| Discharge, Q (cfs) | Upstream Depth, D1 (ft) | Upstream Velocity, V1 (ft/sec) | Upstream Froude #, F1 | Unit Discharge, q (cfs/ft) | Downstream Depth, D2 (ft) | Velocity Downstream, V2 (ft/sec) |
|---|---|---|---|---|---|---|
| 3120 | 0.53 | 59.2 | 14.3 | 31.20 | 10.48 | 2.98 |

## Step 2: Determine Basin Length, L.

| | | |
|---|---|---|
| Maximum Froude #, Fr1: | 14.3 | |
| Maximum D2: | 10.48 | ft |
| Ratio L/D2: | **2.8** | (from chart) |
| Calculated Basin Length: | 29.4 | ft |
| **Use Basin Length:** | **30.0** | **ft** |

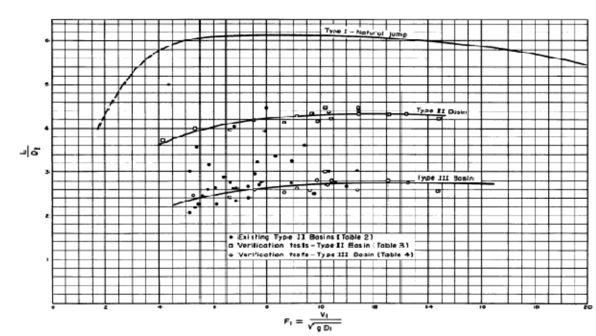



FIGURE 12—Length of jump on horizontal floor (Basins I, II, and III).

## Step 3: Determine Chute Blocks and Baffle Pier Dimensions.

Chute Blocks:

| | | | |
|---|---|---|---|
| **Height:** | **8.0** | **inches** | =D1 at max. flow, Min. = 8" |
| **Width:** | **8.0** | **inches** | =D1 at max. flow, Min. = 8" |
| **Spacing:** | **8.0** | **inches** | =D1 at max. flow, Min. = 8" |
| # of Full Blocks: | 75.0 | | |
| Partial Blocks: | 0.0 | | |

Baffle Piers:

| | | | |
|---|---|---|---|
| Maximum Froude #, Fr1: | 14.3 | | |
| Maximum D1: | 0.53 | ft | |
| Ratio H3/D1: | **3.0** | (from chart) | |
| Baffle Piers Height, H3: | 19.1 | inches | |
| **Use Baffle Peir Height, H3:** | **20.0** | **inches** | |
| **Baffle Peir Width, Pw:** | **15.0** | **inches** | =0.75(H3) |
| **Top Width:** | **4.0** | **inches** | =0.20(H3) |
| **Spacing, Ps:** | **15.0** | **inches** | =0.75(H3) |
| # of Blocks: | 40.0 | | |
| **Distance to Baffle Face:** | **8.39** | **ft** | =0.8(D2) |

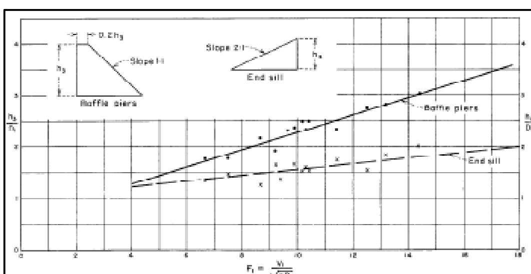
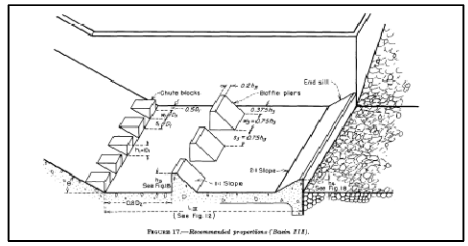



FIGURE 18.—Height of baffle piers and end sill (Basin III).

| | | | |
|---|---|---|---|
| CLIENT: | Eagle Crest Energy Company | | |
| PROJECT: | Eagle Mountain Pumped Storage Project | Project: 80474 | Pages: 2 |
| SUBJECT: | Stilling Basin Design | Date: 8/24/2009 | By: NDM |
| | | Checked: | By: |
| | | Approved: | By: |

## Step 4: Determine End Sill Dimensions.




| | | | |
|---|---|---|---|
| Maximum Froude #, Fr1: | 14.3 | | |
| Maximum D1: | 0.53 | ft | |
| Ratio H4/D1: | 1.8 | (from chart) | |
| End Sill Minimum Height, H4: | 11.4 | inches | |
| Top Width: | 12.0 | inches | |
| US Slope of Sill: | **2.0** | H:1V | |
| **Use End Sill Height,H4:** | **1.0** | **ft** | |
| **Drop to DS Channel:** | **1.0** | **ft** | |
| **Final Basin Floor El.:** | **2380.00** | ft | =(Int El.)-H4+Drop |

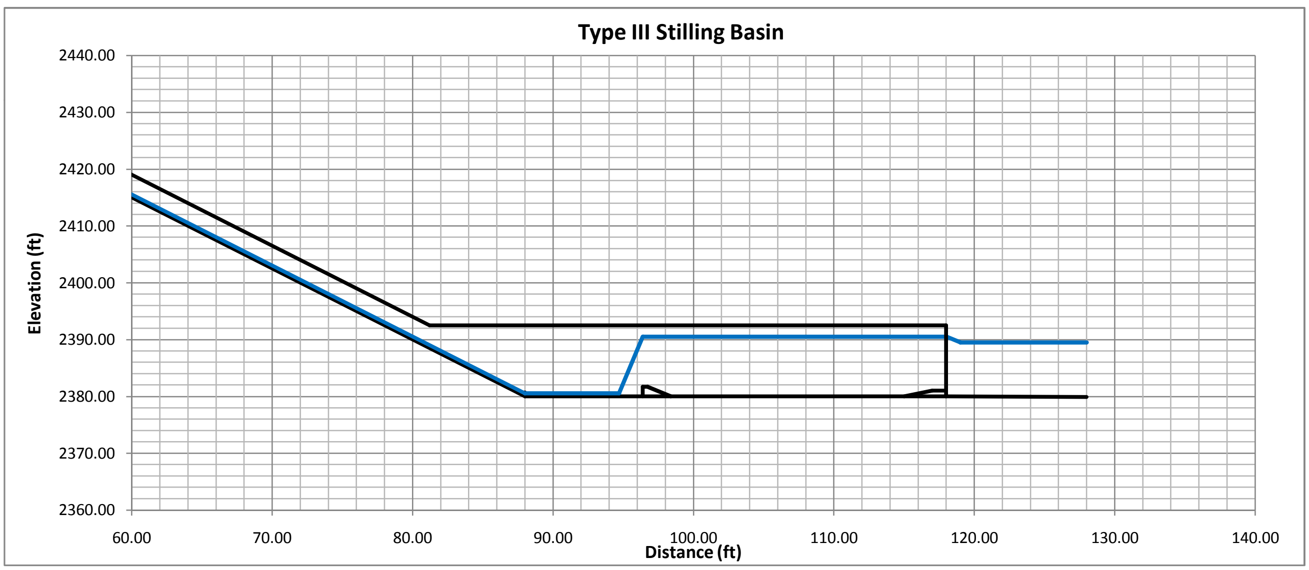
## Step 5: Wall Heights

| | | | |
|---|---|---|---|
| Inlet Structure Wall Height: | 4 | ft | |
| **Chute Wall Height:** | **4** | **ft** | |
| Basin Freeboard: | **2.0** | **ft** | |
| **Basin Wall Height:** | **12.5** | **ft** | |
| **Wing Wall Length:** | **9.0** | **ft** | =0.75*(basin wall height) |
| **Wall Thickness:** | **1.0** | **ft** | |
| **Floor Thickness:** | **1.5** | ft | |

## Concrete Volume

**Structure Volume:** **1019** **CY**

## Type III Basin Plots



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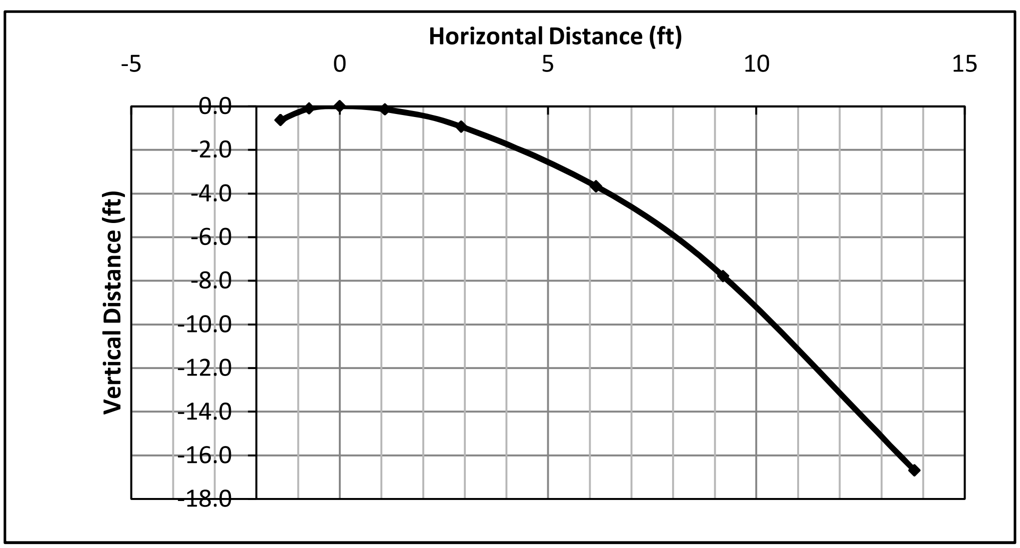
**8/18/2009**
**NDM**

## LOWER RESERVOIR OGEE CREST GEOMETRY

| | |
|---|---|
| Design Head, Ho: | 5 ft |
| Approach Depth, P: | 5 ft |
| Is P > 0.5Ho: | YES |
| Use USBR Fig. 9.22: | YES |

| X Points | | Y Points | |
|---|---|---|---|
| -X2 = | -1.42 ft | -Y2 = | -0.635 ft |
| -X1 = | -0.735 ft | -Y1 = | -0.105 ft |
| X Origin = | 0 ft | Y Origin = | 0 ft |
| X1 = | 1.085 ft | Y1 = | -0.145 ft |
| X2 = | 2.915 ft | Y2 = | -0.935 ft |
| X3 = | 6.15 ft | Y3 = | -3.67 ft |
| X4 = | 9.2 ft | Y4 = | -7.78 ft |
| X5 = | 13.79 ft | Y5 = | -16.680 ft |

| RADIUS LENGTHS | | RADIUS CENTER POINT | | | |
|---|---|---|---|---|---|
| R1 = | 1.175 ft | X1 = | -0.41 ft | Y1 = | -1.235 ft |
| R2 = | 2.65 ft | X2 = | 0 ft | Y2 = | -2.65 ft |
| R3 = | 4.125 ft | X3 = | 0 ft | Y3 = | -4.125 ft |
| R4 = | 7.05 ft | X4 = | -0.77 ft | Y4 = | -6.945 ft |
| R5 = | 14 ft | X5 = | -4.4 ft | Y5 = | -12.875 ft |
| R6 = | 32.5 ft | X6 = | -18.34 ft | Y6 = | -25.035 ft |
| R7 = | 60 ft | X7 = | -41.645 ft | Y7 = | -39.635 ft |



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**NDM**

**LOWER RESERVOIR OGEE CREST GEOMETRY**

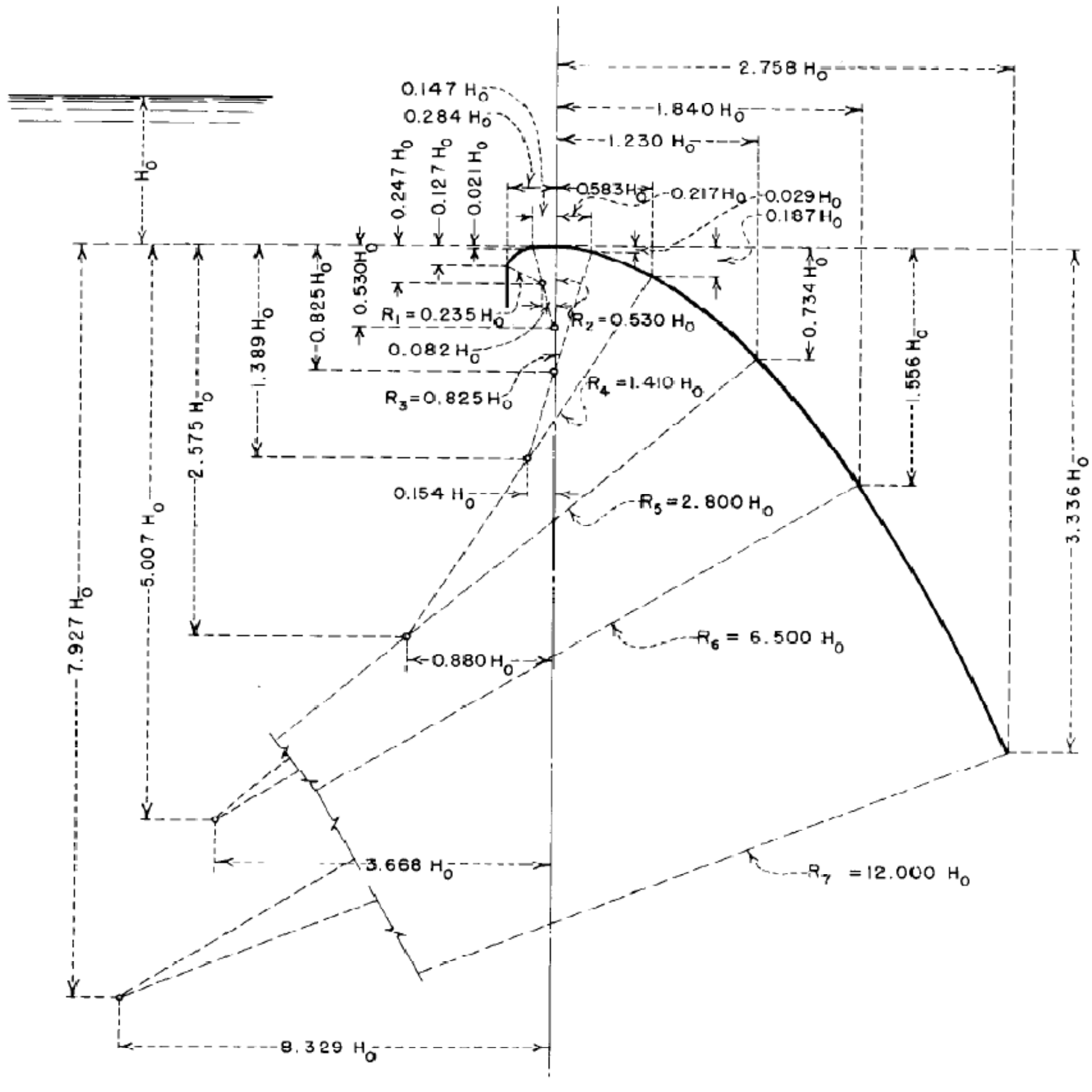
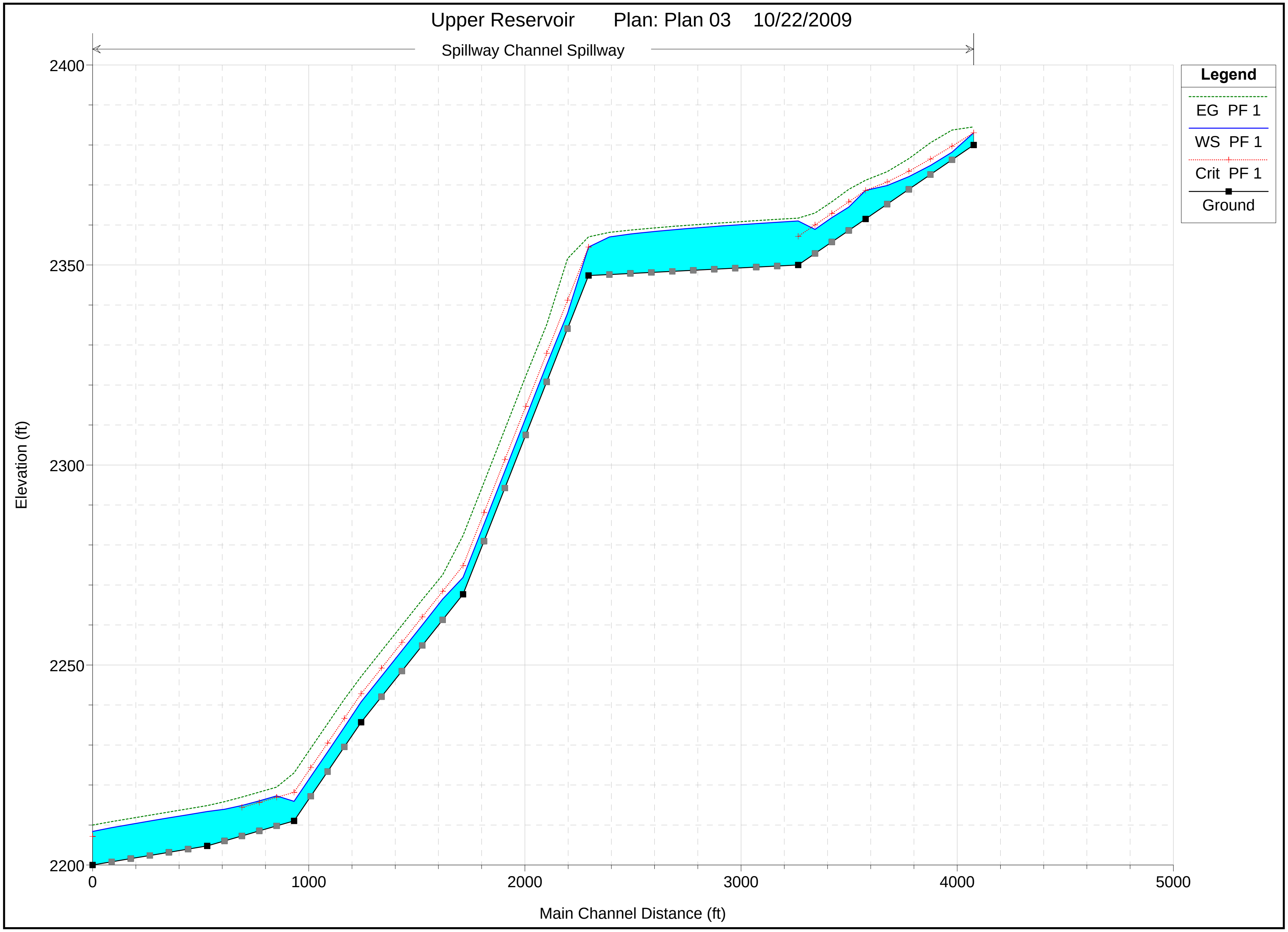
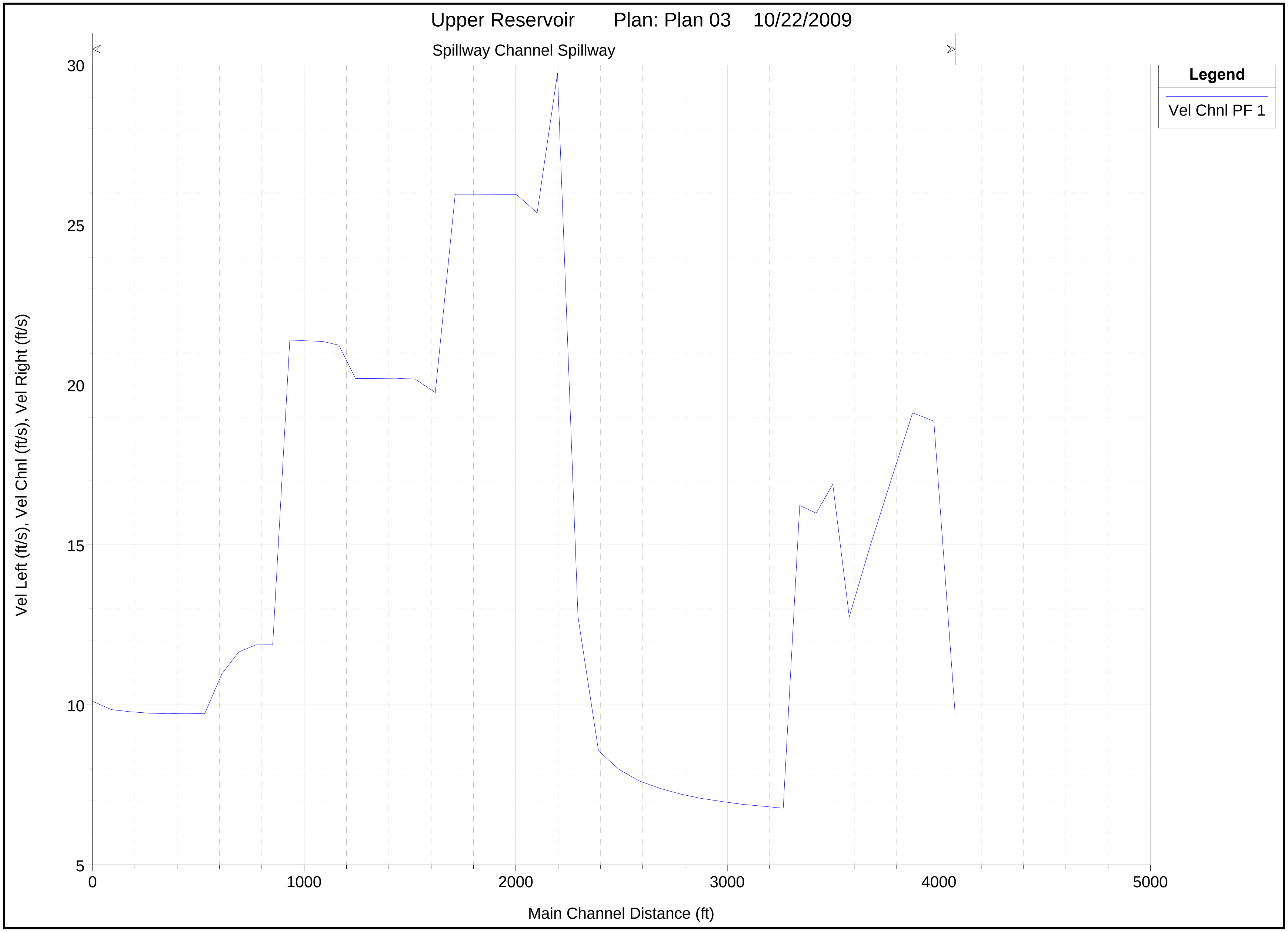


Figure 9-22.—Ogee crest shape defined by compound curves. 288-D-2408.



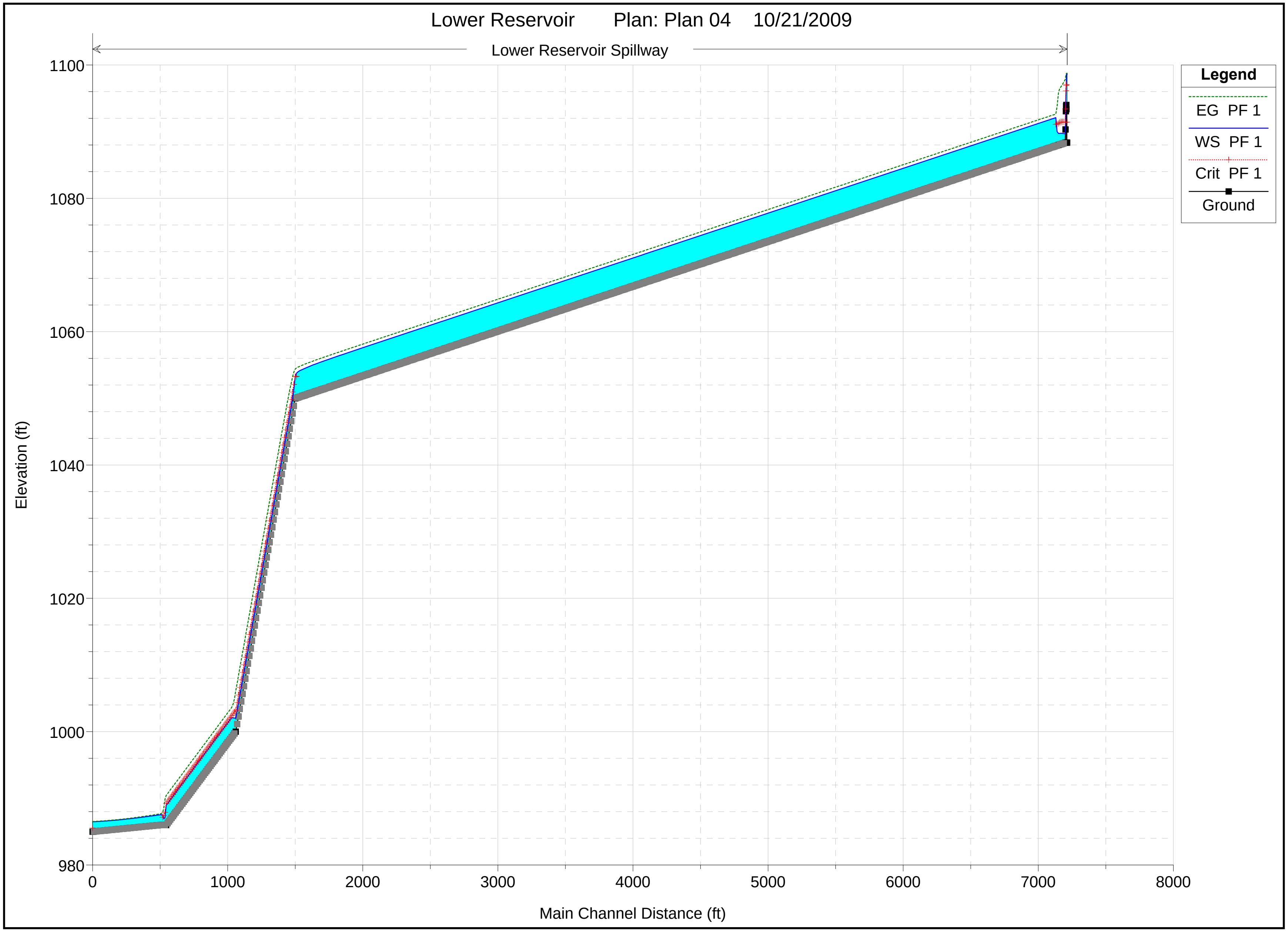
Upper Reservoir Plan: Plan 03 10/22/2009
Spillway Channel Spillway
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
2400
2350
2300
2250
2200
0
1000
2000
3000
4000
5000
Main Channel Distance (ft)

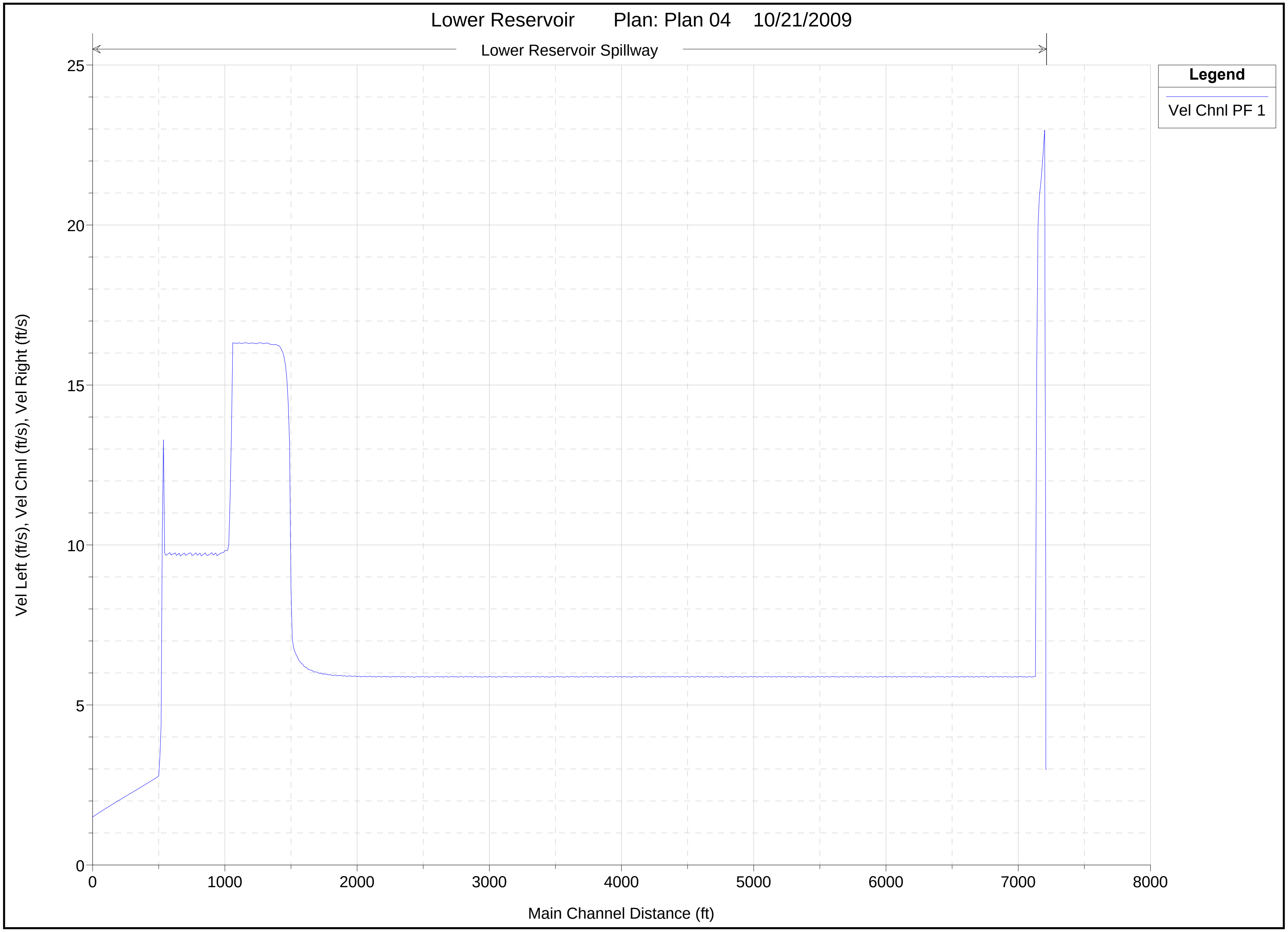


Upper Reservoir Plan: Plan 03 10/22/2009
Spillway Channel Spillway
Legend
Vel Chnl PF 1
Vel Left (ft/s), Vel Chnl (ft/s), Vel Right (ft/s)
30
25
20
15
10
5
0
1000
2000
3000
4000
5000
Main Channel Distance (ft)

HEC-RAS Plan: Plan 03 River: Spillway Channel Reach: Spillway Profile: PF 1

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Max Chl Dpth | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl | Power Chan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | | (lb/ft s) |
| Spillway | 0 | PF 1 | 3120.00 | 2380.00 | 2383.05 | 3.05 | 2383.05 | 2384.53 | 0.001518 | 9.75 | 320.13 | 109.77 | 1.01 | 2.65 |
| Spillway | -500 | PF 1 | 3120.00 | 2361.52 | 2368.66 | 7.14 | 2368.66 | 2371.18 | 0.018903 | 12.76 | 244.55 | 48.54 | 1.00 | 70.93 |
| Spillway | -812 | PF 1 | 3120.00 | 2350.00 | 2361.01 | 11.01 | 2357.14 | 2361.72 | 0.003205 | 6.78 | 460.50 | 60.00 | 0.43 | 9.35 |
| Spillway | -1782 | PF 1 | 3120.00 | 2347.36 | 2354.50 | 7.14 | 2354.50 | 2357.02 | 0.018903 | 12.76 | 244.55 | 48.54 | 1.00 | 70.93 |
| Spillway | -2362 | PF 1 | 3120.00 | 2267.68 | 2271.90 | 4.22 | 2274.82 | 2282.37 | 0.137373 | 25.96 | 120.17 | 36.90 | 2.54 | 688.02 |
| Spillway | -2834 | PF 1 | 3120.00 | 2235.68 | 2240.79 | 5.11 | 2242.82 | 2247.13 | 0.067782 | 20.21 | 154.41 | 40.44 | 1.82 | 308.11 |
| Spillway | -3144 | PF 1 | 3120.00 | 2211.02 | 2215.91 | 4.89 | 2218.16 | 2223.03 | 0.079672 | 21.40 | 145.76 | 39.57 | 1.97 | 370.51 |
| Spillway | -3545 | PF 1 | 3120.00 | 2204.76 | 2213.38 | 8.62 | | 2214.85 | 0.008977 | 9.73 | 320.80 | 54.46 | 0.71 | 29.87 |
| Spillway | -4075 | PF 1 | 3120.00 | 2200.00 | 2208.39 | 8.39 | 2207.13 | 2209.98 | 0.010001 | 10.12 | 308.38 | 53.54 | 0.74 | 33.88 |


Lower Reservoir Plan: Plan 04 10/21/2009
Lower Reservoir Spillway
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
1100
1080
1060
1040
1020
1000
980
0
1000
2000
3000
4000
5000
6000
7000
8000
Main Channel Distance (ft)


Lower Reservoir Plan: Plan 04 10/21/2009
Lower Reservoir Spillway
Legend
Vel Chnl PF 1
Vel Left (ft/s), Vel Chnl (ft/s), Vel Right (ft/s)
0
5
10
15
20
25
0
1000
2000
3000
4000
5000
6000
7000
8000
Main Channel Distance (ft)

HEC-RAS Plan: Plan 04 River: Lower Reservoir Reach: Spillway Profile: PF 1

| Reach | River Sta | Profile | Q Total | Min Ch El | W.S. Elev | Max Chl Dpth | Crit W.S. | E.G. Elev | E.G. Slope | Vel Chnl | Flow Area | Top Width | Froude # Chl | Power Chan |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | (cfs) | (ft) | (ft) | (ft) | (ft) | (ft) | (ft/ft) | (ft/s) | (sq ft) | (ft) | | (lb/ft s) |
| Spillway | 0 | PF 1 | 460.00 | 1088.36 | 1098.62 | 10.26 | 1091.43 | 1098.76 | 0.000082 | 2.99 | 153.95 | 15.00 | 0.16 | 0.07 |
| Spillway | -5 | PF 1 | 460.00 | 1088.36 | 1098.62 | 10.26 | | 1098.76 | 0.000082 | 2.99 | 153.95 | 15.00 | 0.16 | 0.07 |
| Spillway | -5.1 | PF 1 | 460.00 | 1093.36 | 1098.04 | 4.68 | | 1098.71 | 0.000682 | 6.55 | 70.25 | 15.00 | 0.53 | 0.80 |
| Spillway | -5.7 | PF 1 | 460.00 | 1093.47 | 1097.99 | 4.52 | | 1098.70 | 0.000754 | 6.79 | 67.77 | 15.00 | 0.56 | 0.90 |
| Spillway | -6.43 | PF 1 | 460.00 | 1094.00 | 1097.07 | 3.07 | 1097.07 | 1098.62 | 0.002305 | 9.99 | 46.05 | 15.00 | 1.00 | 3.13 |
| Spillway | -7.51 | PF 1 | 460.00 | 1093.85 | 1096.53 | 2.68 | 1096.92 | 1098.57 | 0.003460 | 11.46 | 40.15 | 15.00 | 1.23 | 4.88 |
| Spillway | -9.34 | PF 1 | 460.00 | 1093.06 | 1095.18 | 2.12 | 1096.13 | 1098.43 | 0.007002 | 14.48 | 31.77 | 15.00 | 1.75 | 10.45 |
| Spillway | -12.58 | PF 1 | 460.00 | 1090.33 | 1091.86 | 1.53 | 1093.40 | 1098.10 | 0.019020 | 20.04 | 22.96 | 15.00 | 2.85 | 30.24 |
| Spillway | -14.18 | PF 1 | 460.00 | 1088.33 | 1089.67 | 1.34 | 1091.40 | 1097.85 | 0.029096 | 22.96 | 20.03 | 15.00 | 3.50 | 47.29 |
| Spillway | -65 | PF 1 | 460.00 | 1088.00 | 1089.72 | 1.72 | 1091.22 | 1095.89 | 0.202178 | 19.94 | 23.06 | 16.87 | 3.01 | 328.43 |
| Spillway | -2700 | PF 1 | 460.00 | 1050.00 | 1053.22 | 3.22 | 1053.22 | 1054.39 | 0.019483 | 8.69 | 52.94 | 22.88 | 1.01 | 22.93 |
| Spillway | -3140 | PF 1 | 460.00 | 1000.00 | 1002.01 | 2.01 | 1003.22 | 1006.14 | 0.113915 | 16.32 | 28.19 | 18.04 | 2.30 | 172.25 |
| Spillway | -3655 | PF 1 | 460.00 | 986.00 | 988.96 | 2.96 | 989.22 | 990.44 | 0.026844 | 9.75 | 47.16 | 21.85 | 1.17 | 33.16 |
| Spillway | -3700 | PF 1 | 460.00 | 986.00 | 987.56 | 1.56 | | 987.68 | 0.003373 | 2.78 | 165.29 | 112.45 | 0.40 | 0.86 |
| Spillway | -3800 | PF 1 | 460.00 | 985.00 | 986.49 | 1.49 | 985.54 | 986.52 | 0.001000 | 1.50 | 306.50 | 211.91 | 0.22 | 0.14 |