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Application and Modeling of Stage Triggers to Enforce the Firm Capacity and Conditional Releases Rule for Flood Event Structure Operations as Part Of Kissimmee River Restoration Project Requirements

APPLICATION AND MODELING OF STAGE TRIGGERS TO ENFORCE THE FIRM CAPACITY AND CONDITIONAL RELEASES RULE FOR FLOOD EVENT STRUCTURE OPERATIONS AS PART OF KISSIMMEE RIVER RESTORATION PROJECT REQUIREMENTS

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The Kissimmee River Restoration Project (KRRP) was authorized by Congress in 1992 and includes modifications to the channel and water control structures to restore floodplain flow in the river (USACE 1992). In 2004, the South Florida Water Management District initiated the Kissimmee Basin Modeling and Operations Study (Study) to compliment restoration efforts. The Study goal is to assess how existing operating strategy for the 13 water control structures in the basin can be modified to provide a better balance between operating objectives, including flood control (AECOM 2012). To support evaluation of operating criteria modifications at these 13 water control structures, a fully integrated hydrologic and hydraulic watershed model was developed using MIKE SHE/MIKE 11 by DHI Water and Environment, Inc. (AECOM 2011a, 2011b). The KRRP includes backfilling of the C-38 canal which will reduce the conveyance, resulting in higher stages than witnessed as part of the channelized project. As a result, the State acquired lands and flowage easements along the river floodplain. Discharges from the Kissimmee Upper Basin are also limited to avoid conditions that may produce flooding conditions downstream. Releases from the Kissimmee Upper Basin are managed at the S-65 structure (Headwaters of the Kissimmee River). The design capacity of this structure is 11,000 cfs, however, the firm capacity is limited to 3,000 cfs (Loftin, 2010). The 8,000 cfs difference between the design and firm capacity is referred to as the 'conditional capacity.' Use of this conditional capacity is defined in an operational rule known as the "Firm Capacity and Conditional Releases rule." This rule relies on the relationship between flow and stages in the floodplain. It was developed to reduce discharges from the S-65 so that the cumulative flow at pre-determined locations in the floodplain does not exceed a specified peak rate. After downstream flow conditions subside, the discharge from S-65 can be increased to its design capacity provided such increases do not cause flooding impacts in the floodplain beyond the boundaries of project lands. The description of the rule was useful for modeling purposes but some data required for its application are not readily available within the modeling tools or in the real world monitoring network and it relied on a constant relationship between flow and stages in the floodplain. This relationship is not always constant since it is affected by vegetation cover and geomorphological conditions of the floodway. Therefore an alternative conceptualization of the rule was needed that met the intent of the application.

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An alternate definition of the rule was proposed to be able to meet the main objective of keeping maximum stages within the flowage easements acquired along the river floodplain, independently of a flow-stage relationship. The alternate definition was derived based on the fact that the critical trigger that allows discharge to exceed 3,000-cfs and utilize portions of the 8,000-cfs conditional discharge is simply whether water levels are below or within the boundaries of project lands in the Lower Basin. The portion of the conditional capacity available is a function of the remaining floodplain capacity within the boundaries of project lands. The simplified operational rule can be monitored remotely in the field by water managers and relies completely on the stages in the floodplain independently from the stage-flow relationship. The rule uses stage at six locations within the floodplain. When the stage at any one of these location reach a threshold elevation, the S-65 conditional capacity is gradually reduced. If the stage at any of the locations reaches the flowage easement line, the discharges at the S-65 Structure are limited to the firm-capacity. This rule was coded and simulated in the Study modeling tools.

Results of the early analyses executed with the Study's integrated model identified adequate performance, however an additional constraint was required to address downstream discharges (at the S-65D Structure) needed to manage stages in downstream floodplain areas.

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