

# Hydrologic and Hydraulic Modeling: Operations Model

## Pensacola Hydroelectric Project Project No. 1494

April 20, 2022

# Presentation Outline



1. Overview and Timeline
2. Operations Model Recap
3. Operations Model Historical Validation
4. Operations Model Discussion

# Operations Model

# Operations Model History

## TetraTech 2015 Model

vs.

## GRDA Operations Model

- Mass balance approach to flood operations:

“A limitation of the analysis is that it is not possible to predict how the gates would have been operated under the different scenarios. As a result, the same gate operations were used for each of the three starting water surface elevation conditions.” – Tetra Tech, 2016

- Daily historical hydropower flows only

- Stage-Storage (OWRB, 2009)

- Flood operations rules from RiverWare

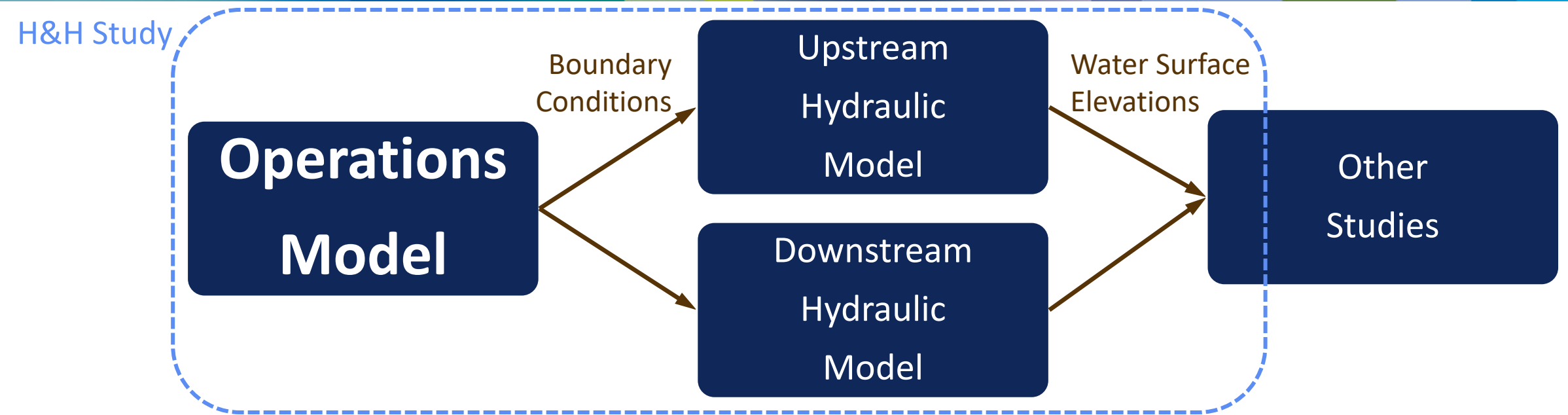
- operating balance levels
- regulated spill and induced surcharge
- ramping rate restrictions

- Detailed hydropower simulation

- turbine physical characteristics and operating limits
- hourly electricity price factors
- real-time additional and buy-back generation

- Updating to USGS, 2019

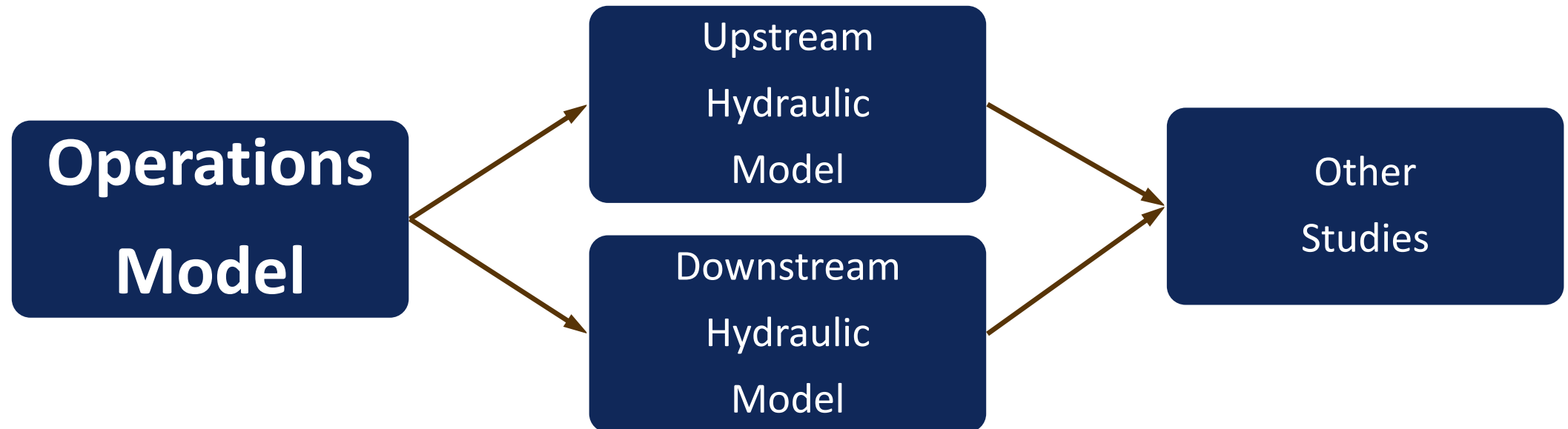
# Operations Model Overview



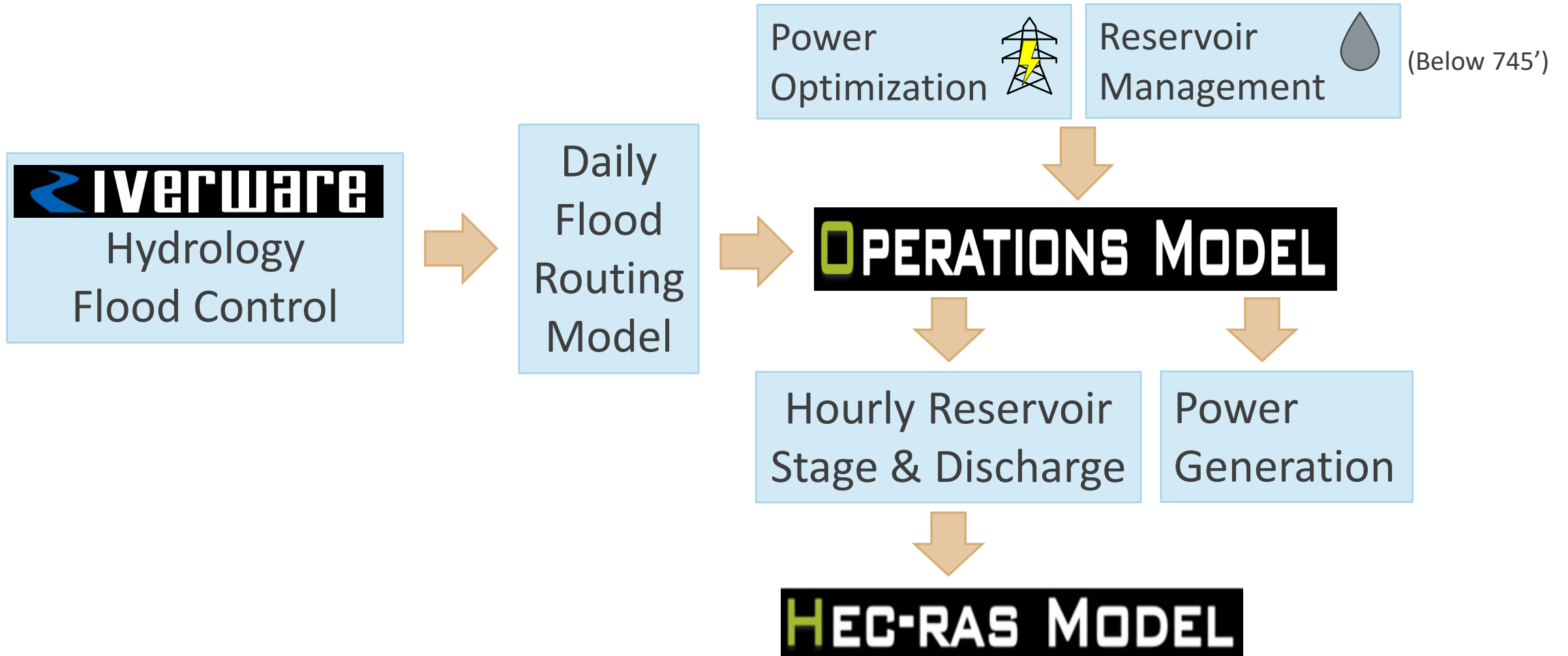
- March 30, 2021 Model Input Status Report (MISR) filed with FERC
- April 21, 2021 H&H Modeling Technical Conference
- October 12, 2021 Initial Study Report meeting
- April 6, 2022 Operations Model and supporting information made available
- April 20, 2022 Operations Model Technical Conference

# Operations Model Objectives

1. Validate results with USACE RiverWare model data - **COMPLETE**
2. Synthesize hypothetical events that inform and set boundary conditions of a Comprehensive Hydraulic Model (CHM) - **ONGOING**

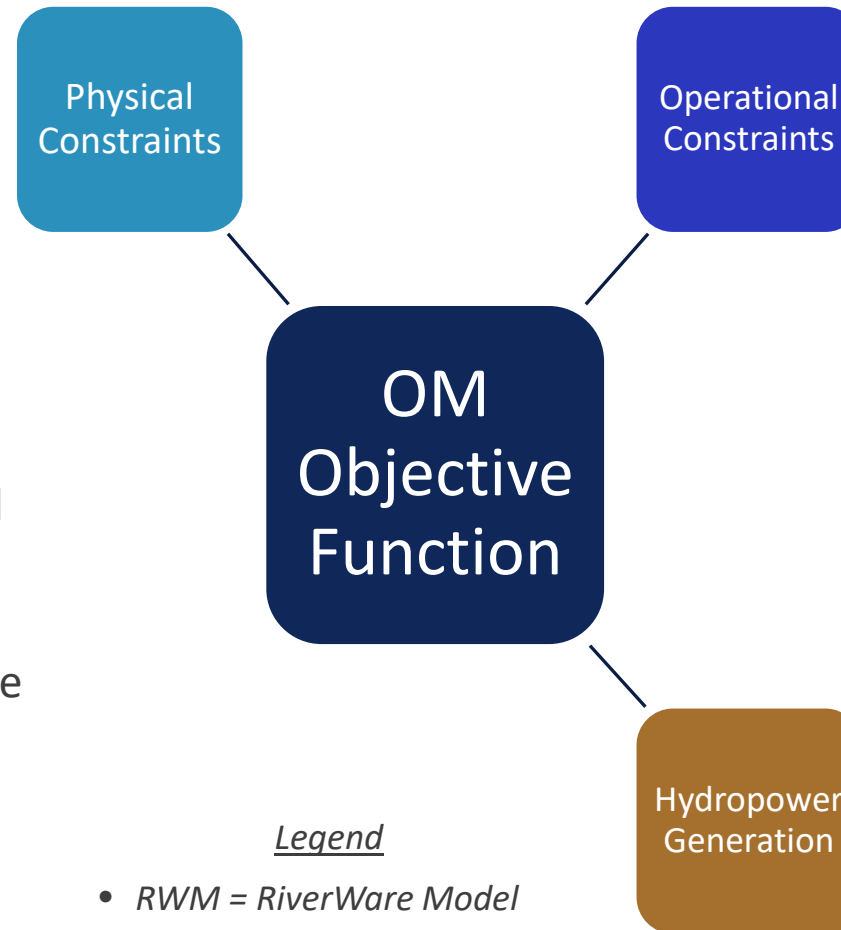


# Operations Model Process



# Operations Model Solution

- **Power**
  - Discharge, net head, and efficiency
- **Net head**
  - Reservoir elevation
  - Tailwater and friction loss
    - Discharge
- **Efficiency**
  - Turbine discharge, net head, and dissolved oxygen valve open/closed
- **Storage volume**
  - Inflow, turbine discharge, spillway discharge, evaporation, and seepage
- **Reservoir elevation**
  - Elevation vs. storage from RWM
- **Spillway capacity from RWM**
- **Hydrologic routing from RWM**



## Legend

- *RWM = RiverWare Model*
- *FRM = Flood Routing Model*
- *OM = Operations Model*

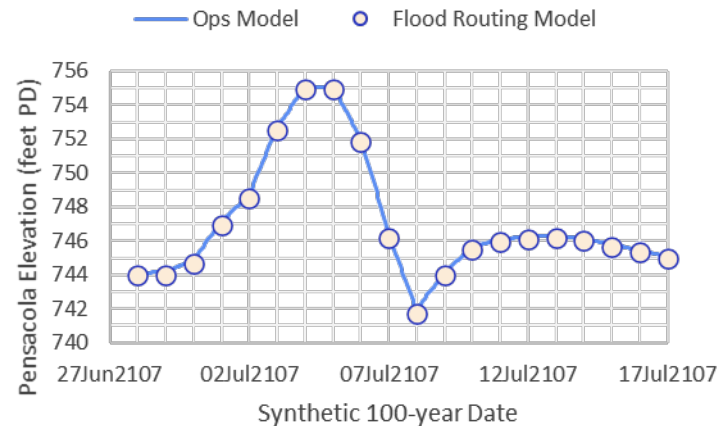
- **Total discharge from FRM**
- **Turbine discharge**
  - Best efficiency point, maximum discharge, storage volume/inflow, electricity price factors, production cost, units online
- **Target reservoir elevation**
  - Seasonal
- **Revenue**
  - Scheduled power
  - Electricity price factors
    - Day-ahead
    - Real-time



# Operations Model Improvements (in progress)

- FRM: Ramping Rates

- Synthetic 100-year event, pool drops below target on the falling limb (after peak)



- Solution: Add logical checks so target elevation takes precedence over Allowable Falling Release Change (AFRC)

- OM: Turbine Shutoff

- Real-time power price below production cost: generation buy-back
- Spillway discharge assumed constant for day
- Result: Less OM discharge than recommended by FRM, reservoir levels peak higher

- Solution: Adjust spillway discharge hourly in OM

- OM: FRM Stage Matching

- Within flood pool, OM matches total discharge from FRM
- Different initial elevations, different time of rule shift
- Result: Higher starting elevations may peak lower

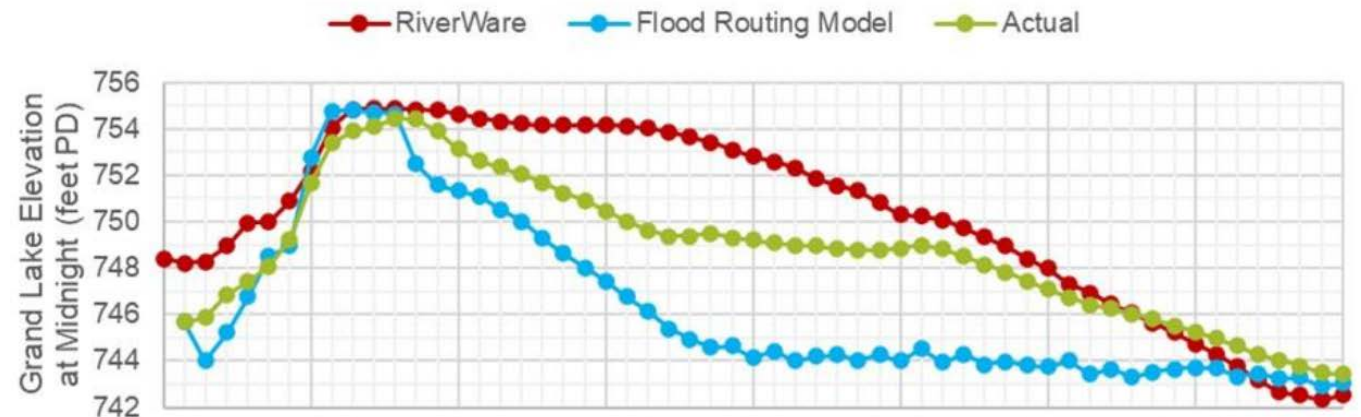
- Solution: Add criteria to blend both discharge and elevation matching to FRM in flood pool

# Operations Model Historical Validation

February 24, 2022 [FERC Determination](#):

1. “...compare water surface elevations observed at USGS gage...to the simulated HEC-RAS stage hydrographs for the December 2015 and October 2009 inflow events on the upstream side of the dam.”
2. “...provide a graphical comparison of the simulated and observed water surface elevations over a daily time step for the duration of the flood event.”

- RiverWare, Flood Routing Models do not reflect actual real-time decisions.
- Spillway gate opening records used to simulate realistic operations for [historical events only](#).



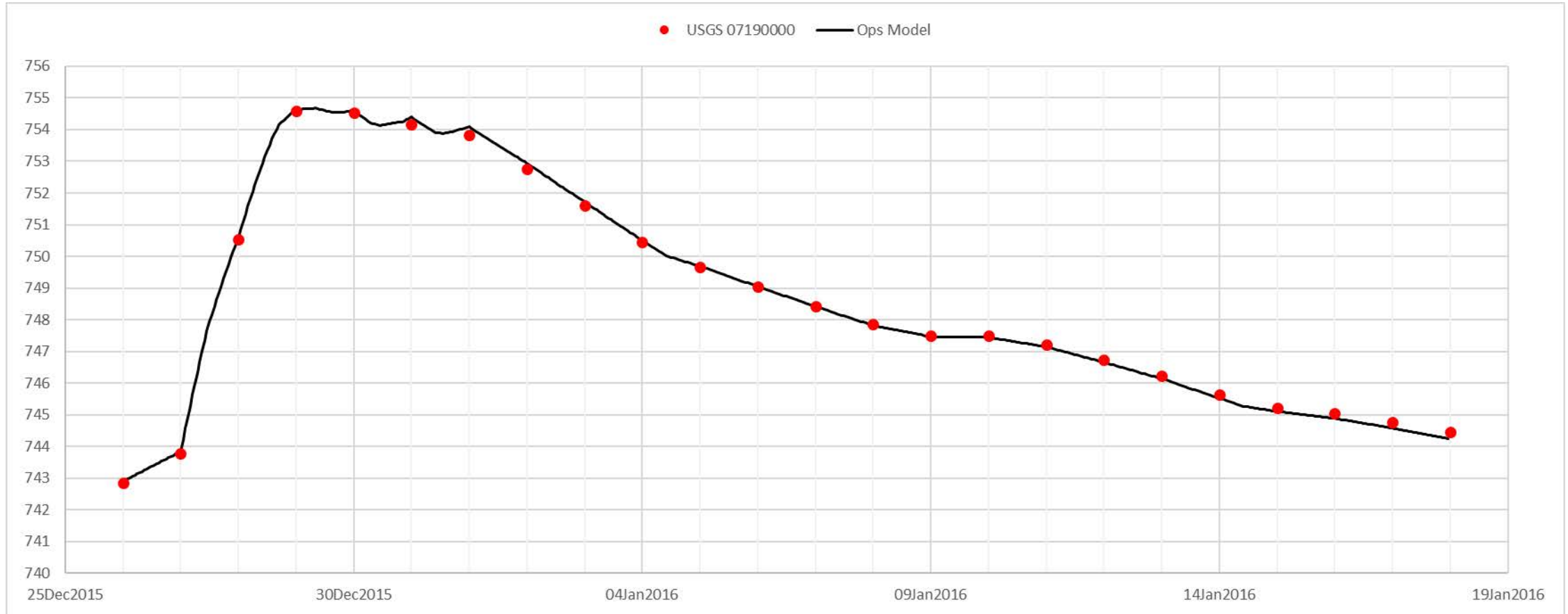
# Operations Model Historical Validation

1. **Reservoir Inflow**: GRDA Records of Discharge, Reservoir Elevation + 2019 USGS Bathy
2. **Spillway Operations**: GRDA Gate Opening/Closing Records
3. **Spillway Discharge**: USACE Discharge Rating
4. USGS Gage: [07190000 LAKE O' THE CHEROKEES AT LANGLEY, OK](#)

Operations Model simulated using spillway discharge based on gate opening records, shows very good agreement with observed USGS gage data.

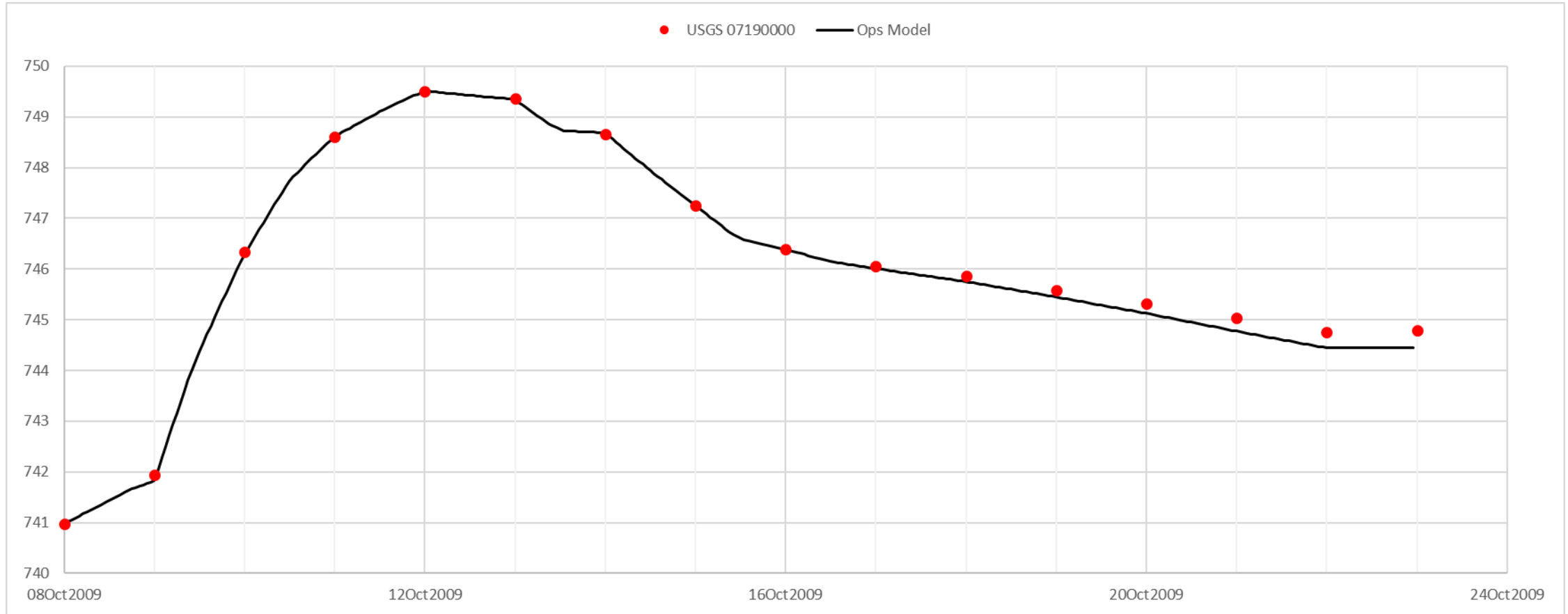
# Operations Model Historical Validation

December 2015



# Operations Model Historical Validation

## October 2009



# Questions?

**Thank you**