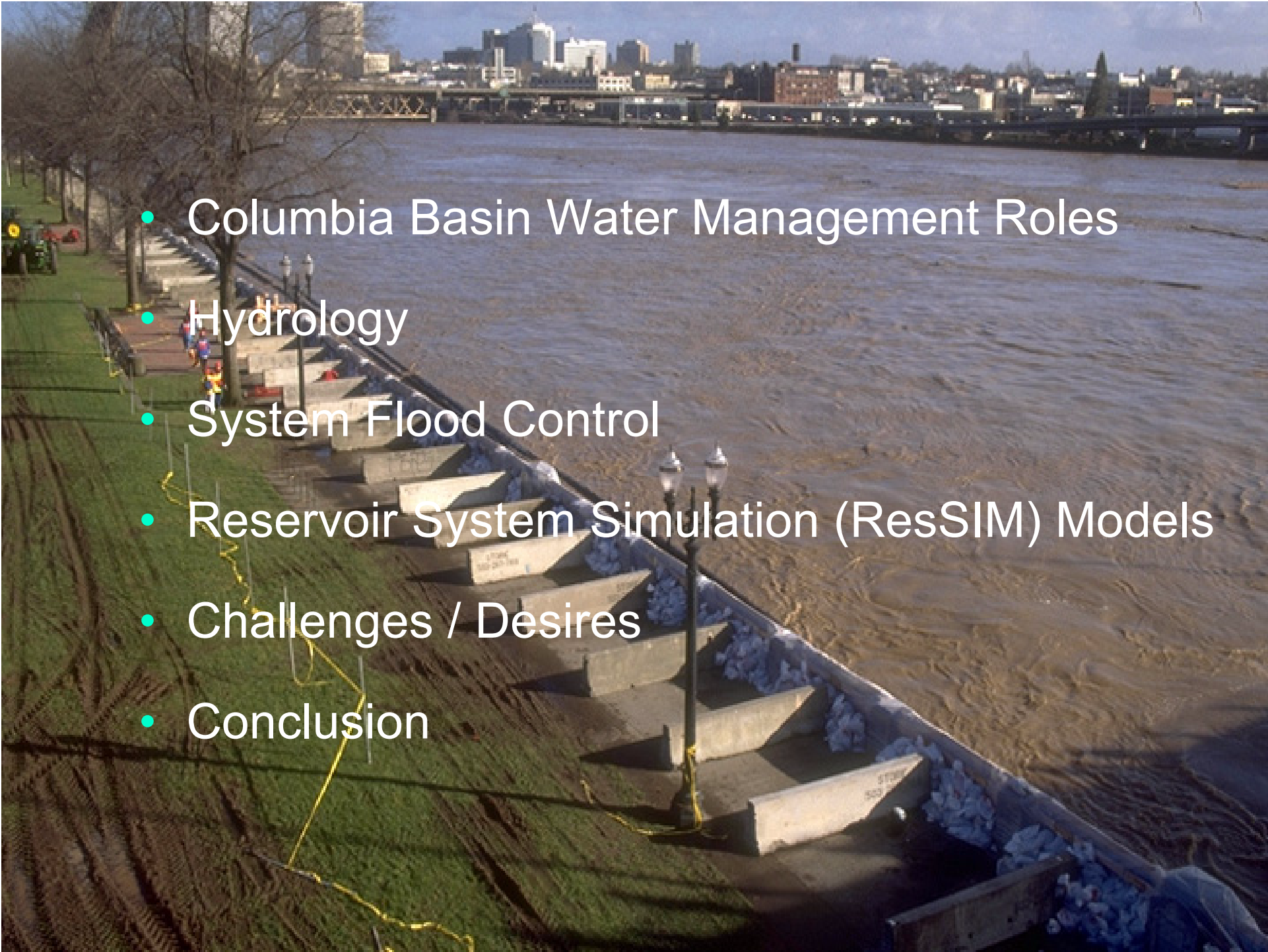


Columbia Basin Water Management
Northwestern Division

ResSIM Model Development for Columbia River System

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- 
- Columbia Basin Water Management Roles
 - Hydrology
 - System Flood Control
 - Reservoir System Simulation (ResSIM) Models
 - Challenges / Desires
 - Conclusion



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Columbia Basin Water Management Division Roles

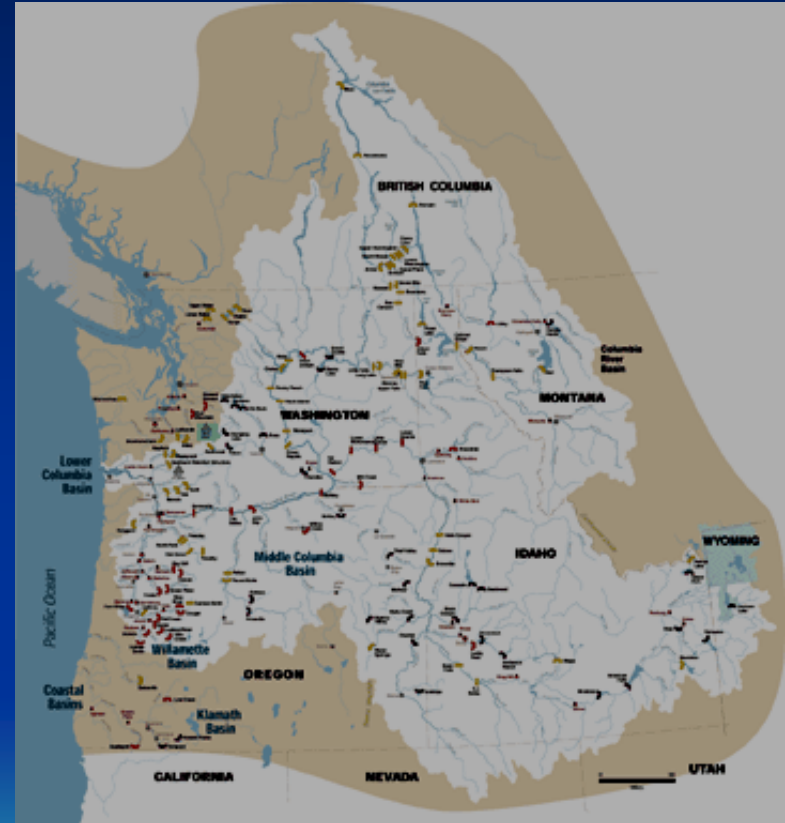
- Flood control studies, & Hydrologic investigations
- Real time operations
- Operational planning & Power system analyses (multi-purpose, Treaty ops.)



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Hydrology

- The 4th largest River in North America
- Entire Basin = 259,000 mi²
- Basin in Canada = 40,000 mi²
- Avg. Annual Runoff = 200 mil. acre-ft
- Storage Capacity = 39.5 mil. acre-ft
- Over 200 dams and projects
- Peak runoff in May – June period





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System Flood Control

- Columbia River is water rich. Only 20% of average annual runoff storage is available for flood control regulation.
- System flood control point is The Dalles (just below the dam) and is the focus of the coordinated system operation.
- Local flood control points are also considered.
- Design Flood is 1894 (1240 kcfs unregulated at The Dalles)
 - storage and levees provide the capability to regulate 800 kcfs



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Models Currently in use

- **Synthetic Streamflow and Reservoir Regulation** (SSARR) model for Un-regulated flow calculations for Columbia and Snake Rivers
- **AutoReg** (GUI for SSARR) for Planning and Flood Control studies
- **National Weather Service River Forecast System** (NWSRFS) for Real-time operations
- **Hydro System Seasonal Regulation** (HYSSR) for System Power Studies



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ResSIM Models in Development

- Real Time Operational ResSIM Model
 - Similar to NWSRFS model
 - Able to use RFC's ESP flows
- Un-Reg ResSIM Model
 - Replacing SSARR Model for Un-regulation of Columbia and Snake Rivers
- Study ResSIM Model
 - Replacing AutoReg Model
 - Will be used for planning and flood control studies



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Developing a ResSIM model

- Create Watershed
 - Define the projects and computation points
- Create Reservoir Network
 - Enter Physical Data
 - Define Reservoir Operations, & Rules
 - Setup Alternative Editor – mapping time-series
- Create Simulation
 - Define time window and time step
- Calibration or Verification



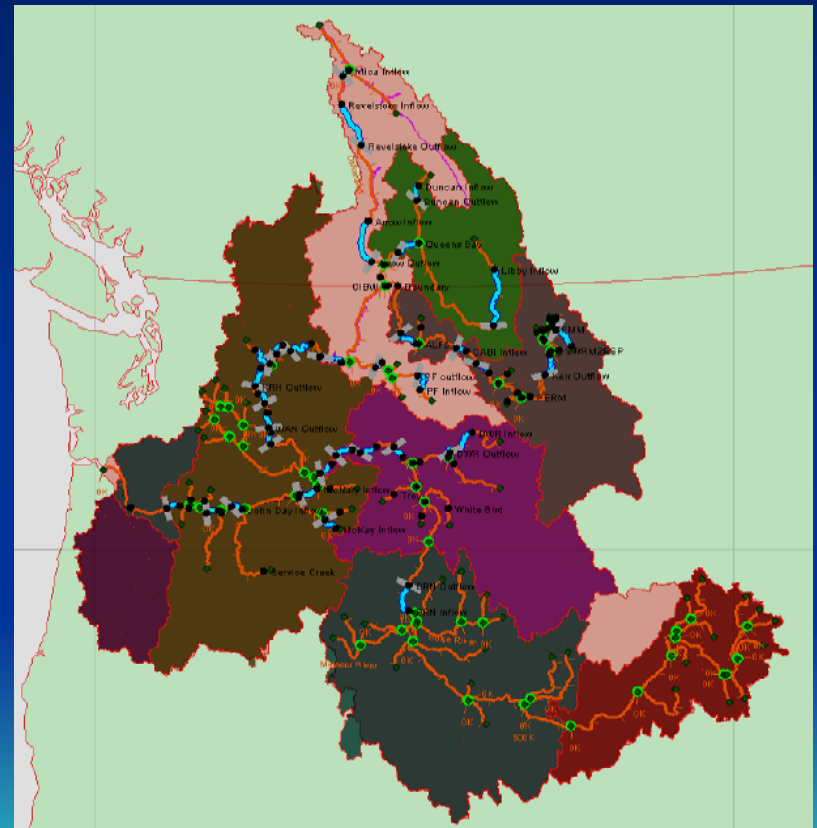
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Real Time ResSIM

Watershed

Based on NWSRFS, & SSARR

- Streamflow forecast points, Rivers, Reservoirs, Flood Control points
- Same naming convention for consistency
- Can be utilized for other CWMS models





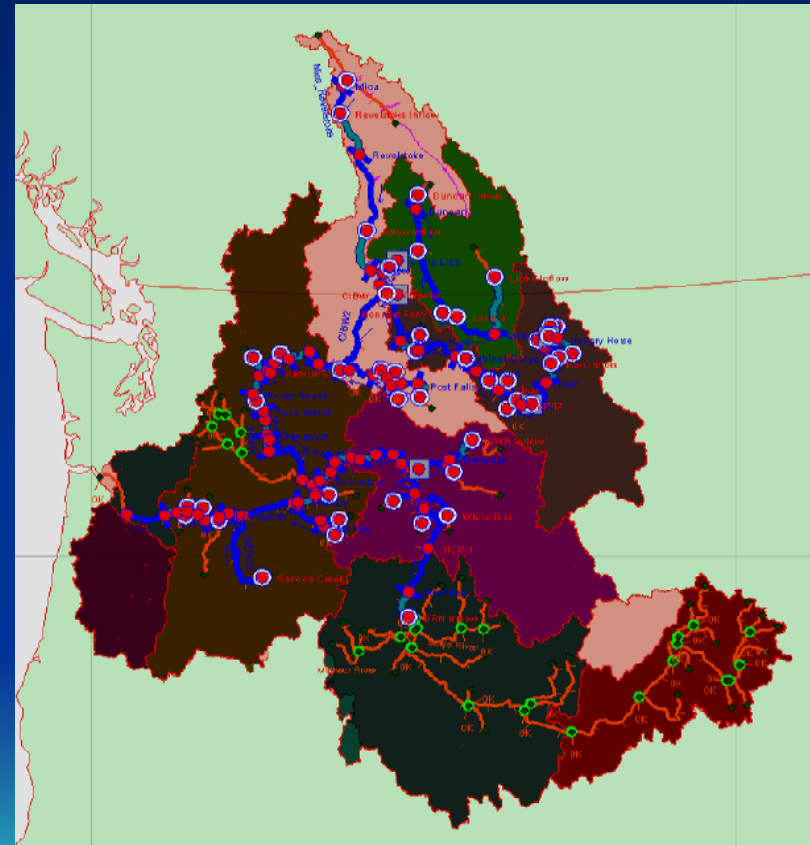
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Real Time ResSIM

Reservoir Network

Physical data

- Reservoir data
(Dam height, length)
- Rating curves
(Elevation Vs storage, & outlet capacity)
- Reach routing parameters
(SSARR, Lag-K)





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Real Time ResSIM

Reservoir Network

Operational data

- Flood control rule curves
 - Forecast based time-series in DSS format
- Min.& Max Flow @ D/S control point
- Project min.& max. flows
- Rate of changes (release, pool elevation)
- Other rules (if-then-else, state variables, script)



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Real Time ResSIM

Reservoir Network

Alternative Editor

- Mapping to all time-series data (in DSS)
 - ESP flow as inflow and local flow
 - Lookback data (initial conditions) from CROHMS database
 - Forecast Based Rule curves



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Real Time ResSIM

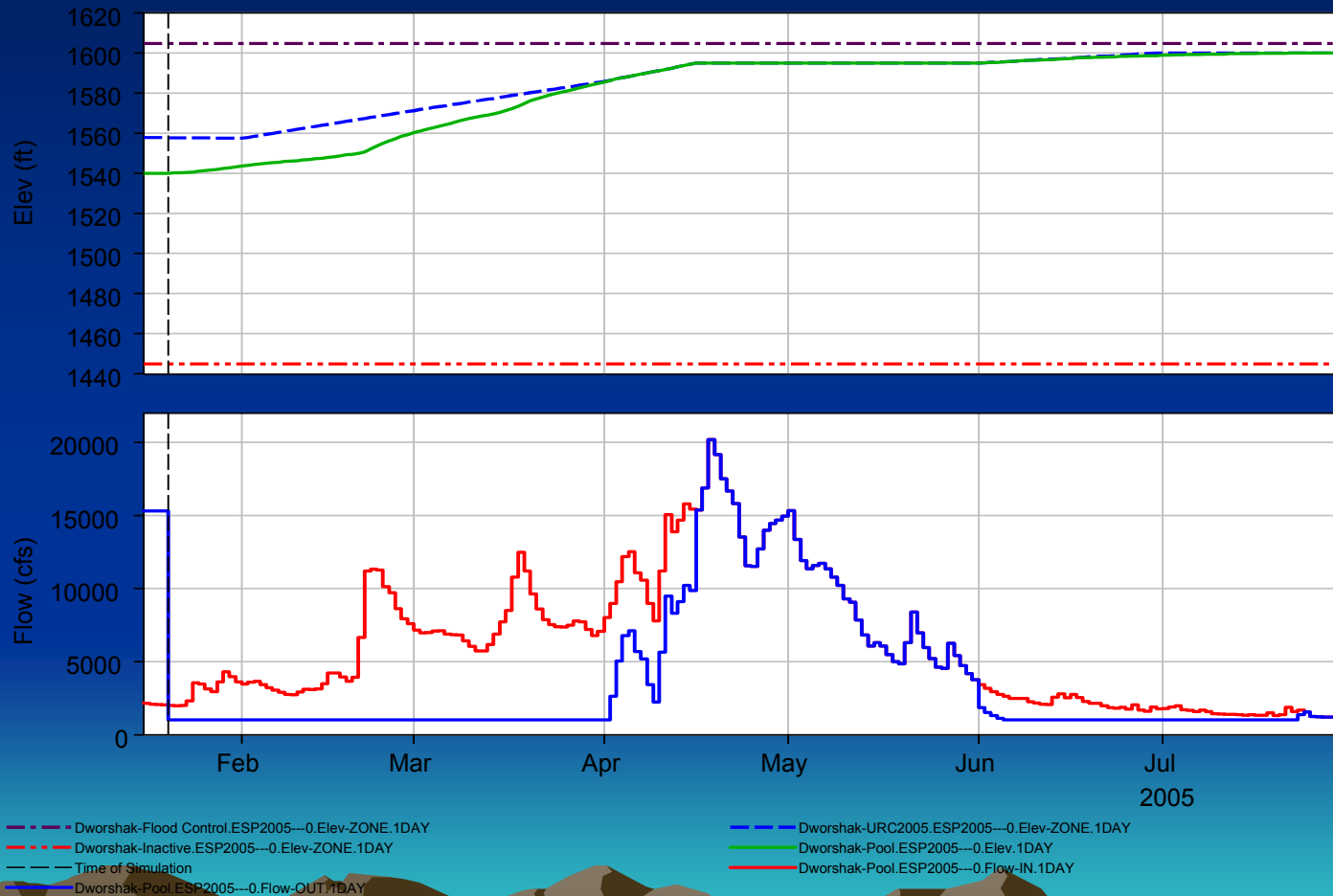
- Model Consists
 - 32 Reservoirs
 - 93 Channel reaches
 - 126 Computation points includes
 - Inflow and outflow
 - Stream junctions
 - Flood control points
- Future Work
 - Model calibration or verification
 - Incorporate more operational rules
(Treaty operating rules, 3-way rating, Lake routing)
 - Improve pre-and post-processing and customer products
 - Operational by water year 2007



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Dworshak Operation

Simulation Based on January 205 ESP Forecast

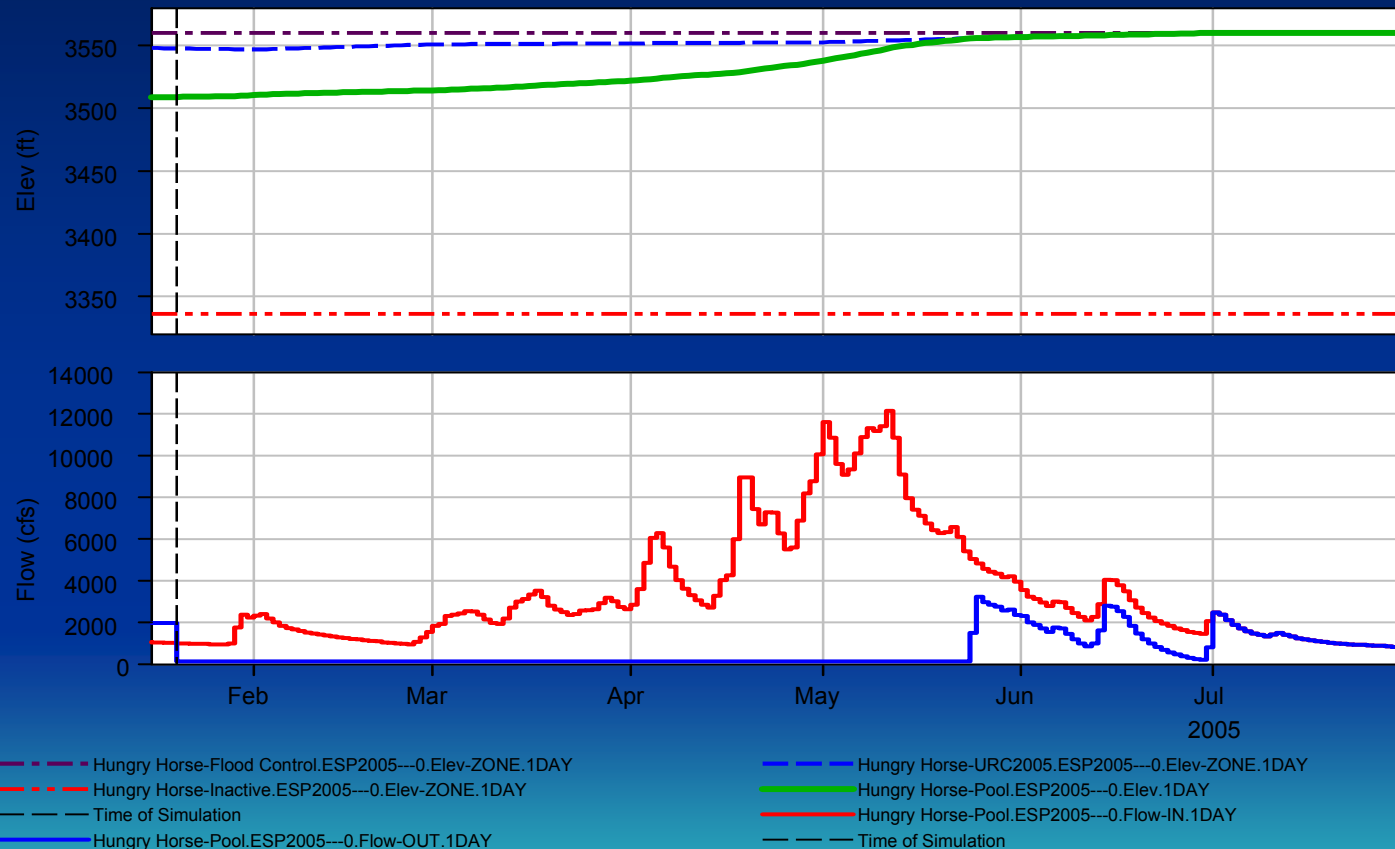




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Hungry Horse Operation

Simulation Based on January 2005 ESP Forecast

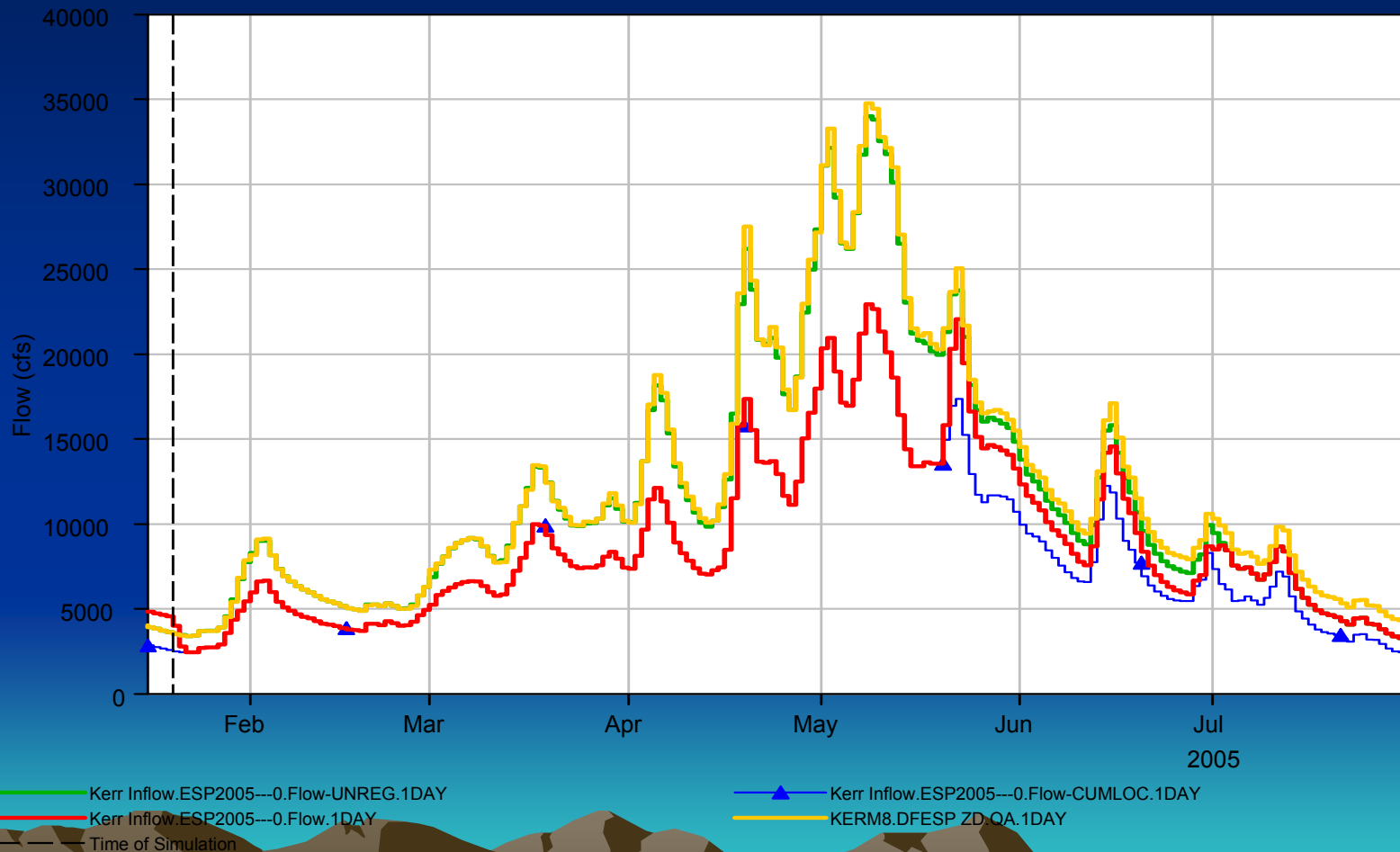




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Hydrograph Verification

NWSRFS Vs ResSIM @ Flathead River Simulation Based on January 2005 ESP Forecast

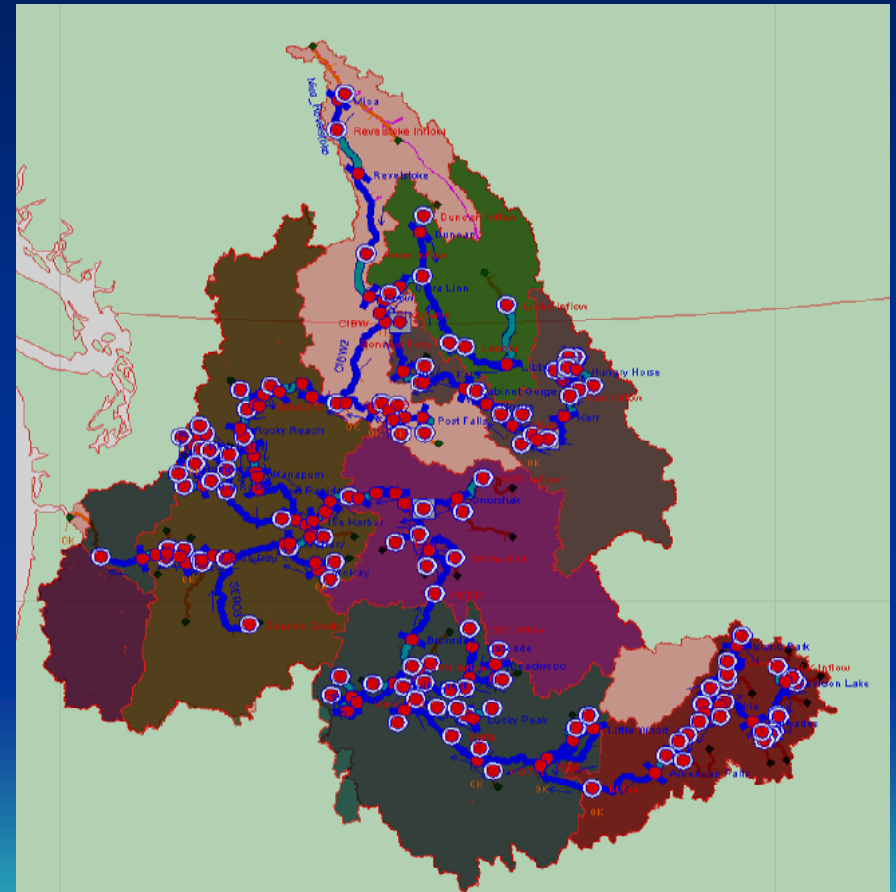




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Un-Reg ResSIM Model (Under Construction)

- Model Consists
 - 51 reservoirs
 - 165 channel reaches
 - 217 computation points
- Output product will be used for databases for flood control studies and public dissemination

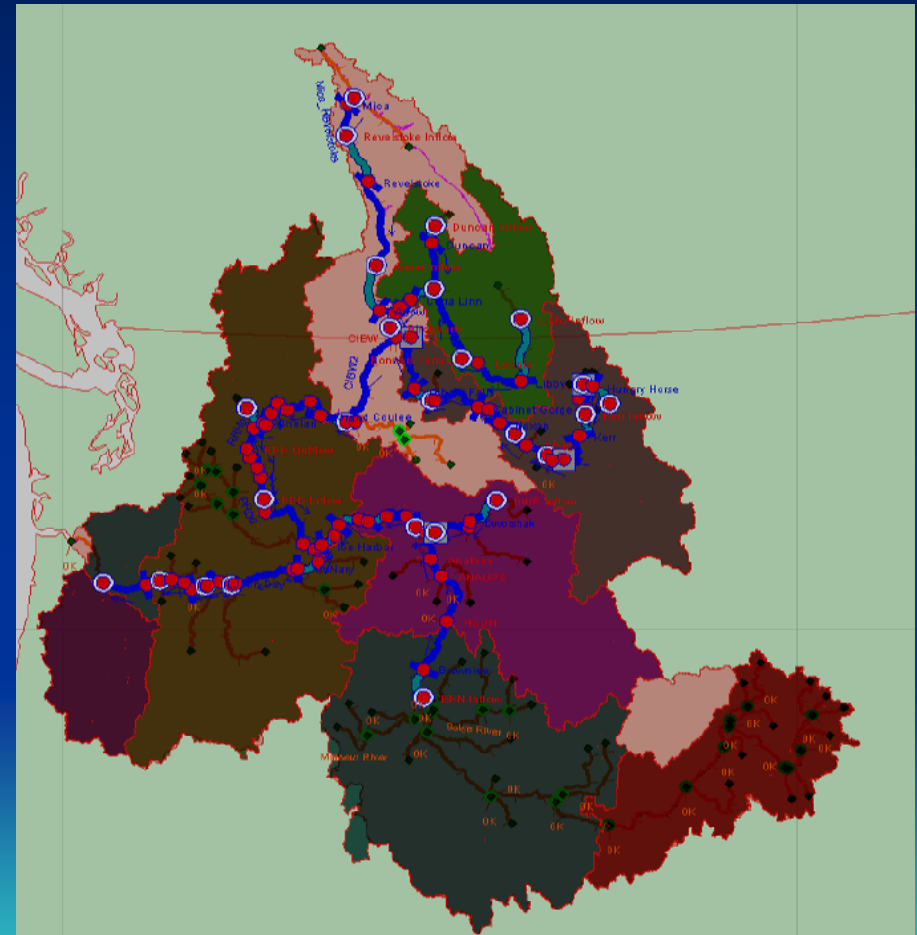




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Study ResSIM Model (Under Construction)

- Model Consists
 - 23 reservoirs
 - 67 channel reaches
 - 91 computation points
- Model will be used for flood control studies





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Challenges/Desires

1. Would like to have tool in ResSIM to deal with 3-way discharge table associated with forebay and lake elevations
2. Would like to have tool in ResSIM to deal with 3-way rating table at a control point based on backwater from a lake
3. Would like to have lake routing
4. Need ability to compute local flow from observed project data
5. Need to improve Process time (script and rules can increase computation time)



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CONCLUSION

- Columbia Basin Water Management Division will continue it's important role in the multi-purposes operation of the Columbia River System
- Collaboration with the HEC, by adding new tools to ResSIM will make the next generation Reservoir Regulation model for the Columbia River System.



Thank you !