Yuba River Development Project
FERC Project 2246 Relicensing

Operations and Water Temperature Modeling

Wednesday, September 22, 2010

Agenda

- Background
- Operations/Water Balance Model
  - Intended Use
  - Model Coverage
  - Hydrology
  - Platform Selection
  - Model Basics
  - Special Considerations
- Water Temperature Model
  - Intended Use
  - Input Data
  - Model Basics

Background

- Introductions
- Meeting Objectives
  - Inform stakeholders about Operations/Water Balance Model and Water Temperature Model Study Plan
  - Obtain general agreement on Study Plans

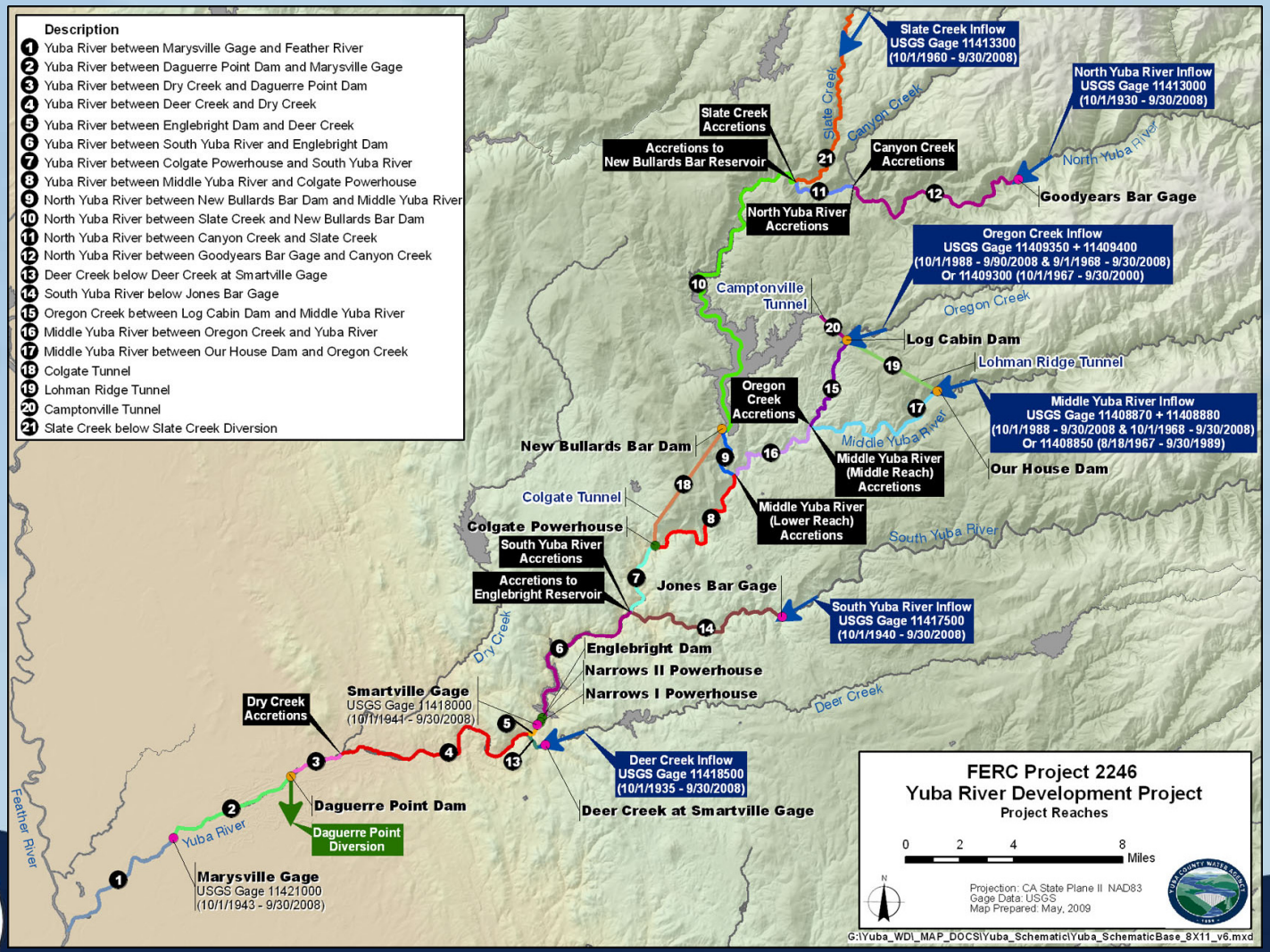
Operations/Water Balance Model

Model Intended Use

- Accurately represent Project operations including the following:
  - Reservoir levels
  - Reservoir releases
  - Hydropower generation
  - Resulting Yuba River flows
- Provide output to inform other studies, analyses, and models.
- Allow simulation of changes in Project operations to determine effects on reservoir levels, reservoir releases, hydropower generation, and resulting Yuba River flows.

Operations/Water Balance Model

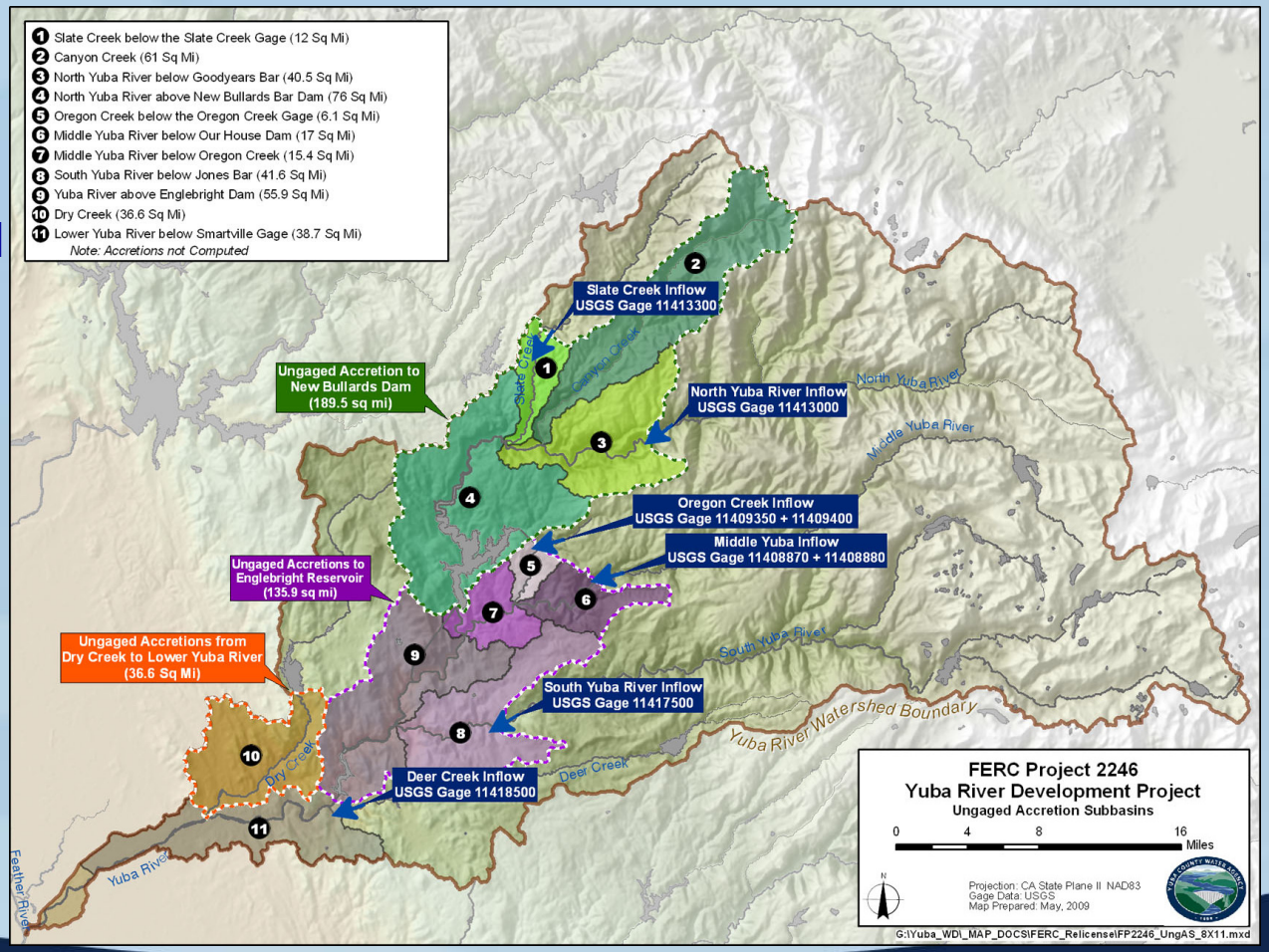
Model Coverage



Operations/Water Balance Model

Hydrology

- Daily Inflows
- 39-Year Period of Record (10/1/1969-9/30/2008)
- Based on historical gaged hydrology
- Inflows to major tributaries and to Project Reaches
- Synthesized accretions below uppermost gage locations
- All hydrology stored in HEC-DSS file



Operations/Water Balance Model

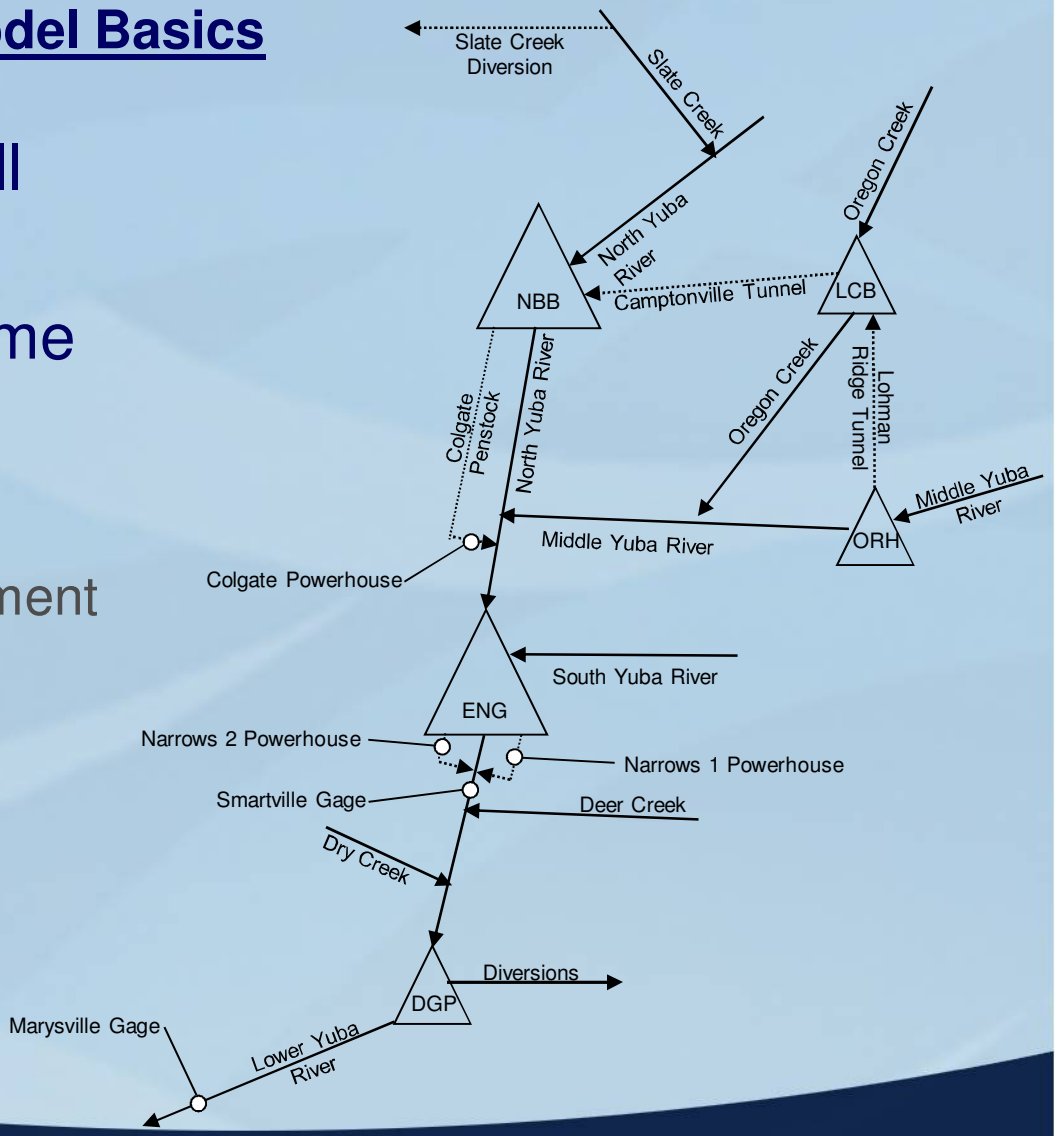
Hydrology

- Why do we use historical gaged inflows rather than simulated flows from upstream projects?
  - Complete period of record for inflows from gages is available
  - Gage inflow record is extremely accurate
  - Eliminates dependency on other projects
  - Eliminates inherited error from other models
- How will we incorporate changes in upstream project operations?
  - Intend to use a “Delta” term to represent change in operations relative to their respective baseline operations
  - Will be evaluated as sensitivity studies to accommodate differing periods of record

Operations/Water Balance Model

Model Basics

- Developed in MS Excel, all logic in VBA
- Solves for one year at a time
- Operations are driven by:
  - Reservoir levels
    - Including flood management
  - Flow requirements
  - Agricultural diversions
  - Power generation



Operations/Water Balance Model

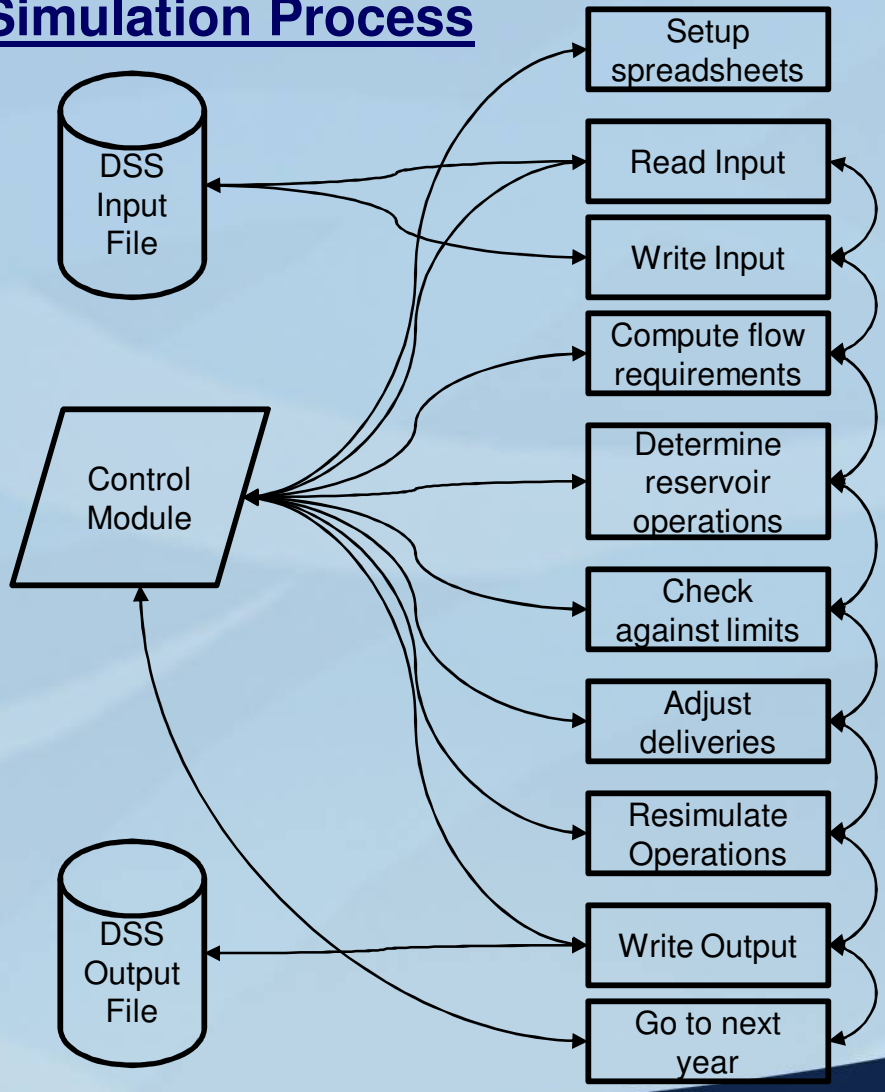
Model Basics – Model Platform

- Evaluated several potential model platforms including:
  - HEC-ResSim
  - RiverWare
  - WEAP
  - MS Excel/VBA
- Selected MS Excel/VBA
  - Best able to represent Yuba Project and its operations
  - Most familiar amongst stakeholders
  - Most flexible and expandable

Operations/Water Balance Model

Model Basics – Simulation Process

- Model consists of 40 modules handling all processes and logic
- Processed by a central module
- Capable of starting on any date, always runs through September 30
- Iterates for several processes:
  - Determining agricultural diversions
  - Computing Slate Creek diversions
  - Distributing weekly generation



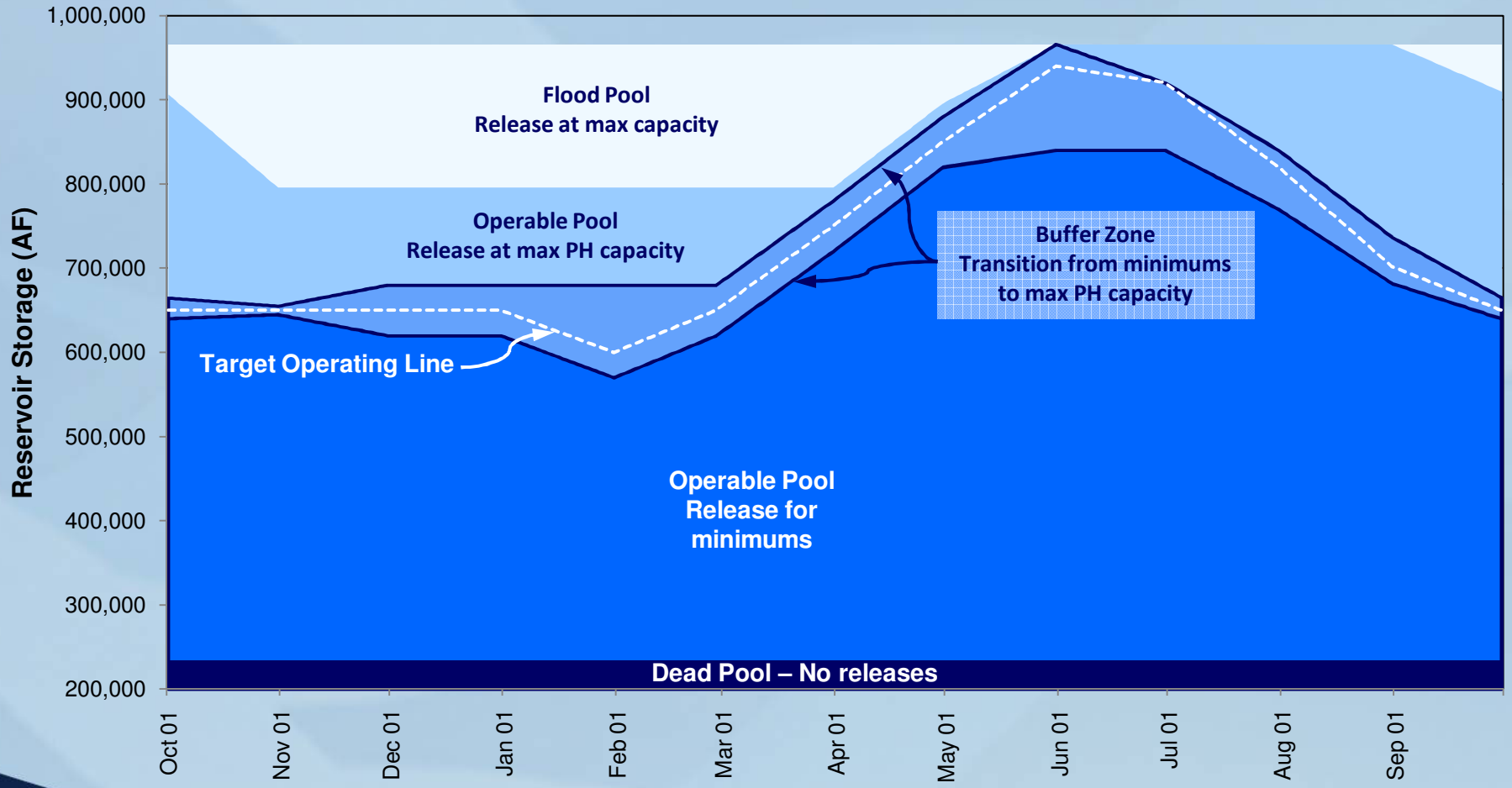
Operations/Water Balance Model

Model Basics – Operational Drivers – Reservoir Levels

- Used to manage storage levels during relatively wet periods (not operating for minimums)
- Used to simulate power generation operations
- New Bullards Bar Reservoir
  - Flood control envelope
  - Target operating line with buffers (target zone)
  - Dead pool
  - End-of-September carry-over target
- Englebright
  - Minimum, maximum elevation
  - Target elevation

Operations/Water Balance Model

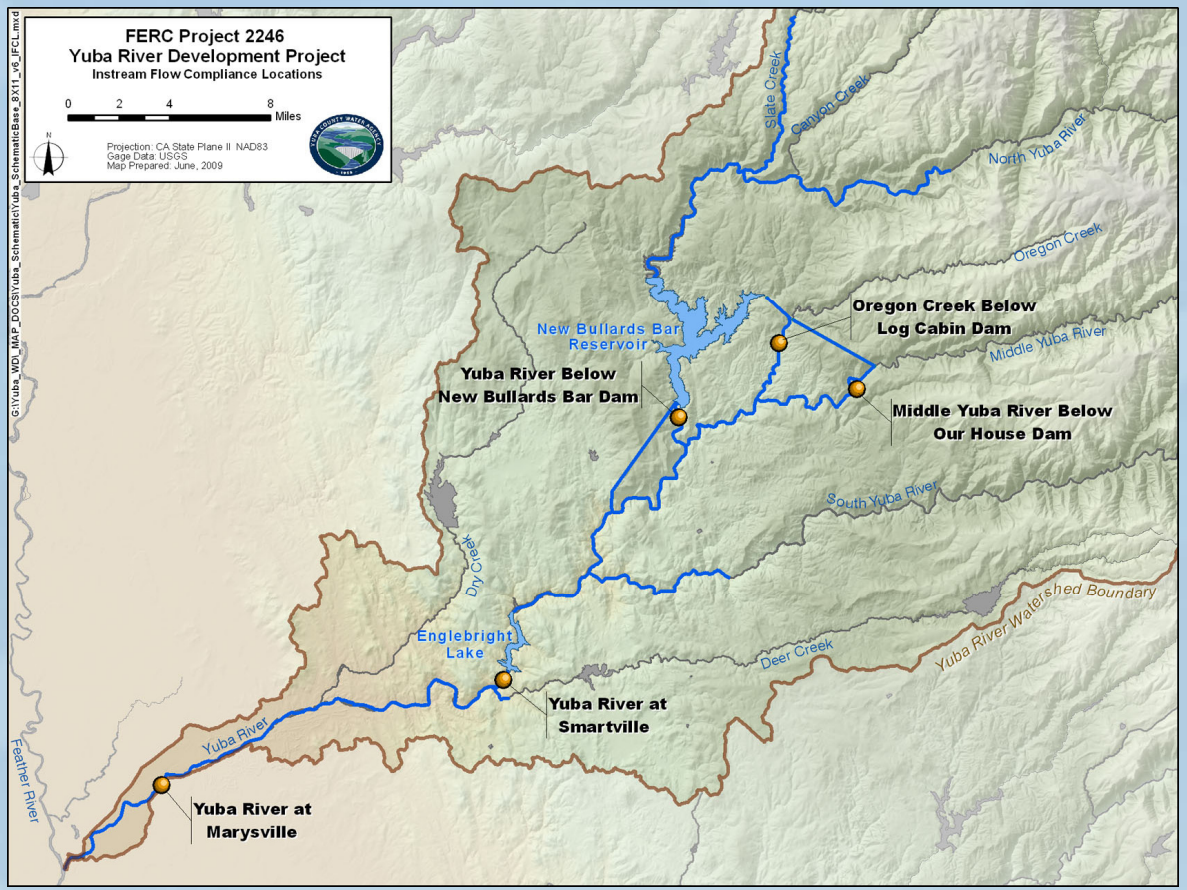
Model Basics – Operational Drivers – Reservoir Levels



Operations/Water Balance Model

Model Basics – Operational Drivers – Minimum Flows

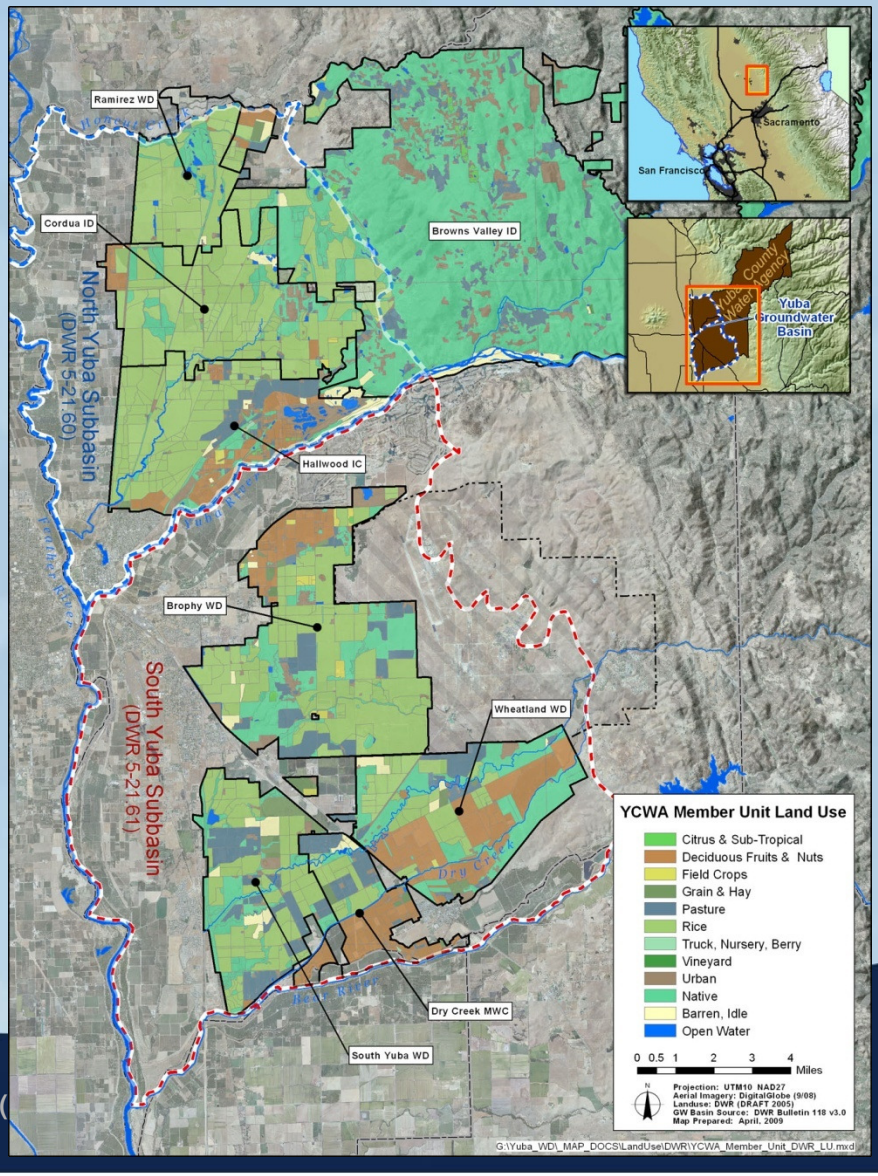
- Defined by:
  - Lower Yuba River Accord
  - RD-1644
  - FERC License
- For:
  - Below Our House Dam
  - Below Log Cabin Dam
  - Below New Bullards Bar Dam
  - At Smartville
  - At Marysville Gage
- Also includes ramping rates



Operations/Water Balance Model

Model Basics – Operational Drivers – Agricultural Diversions

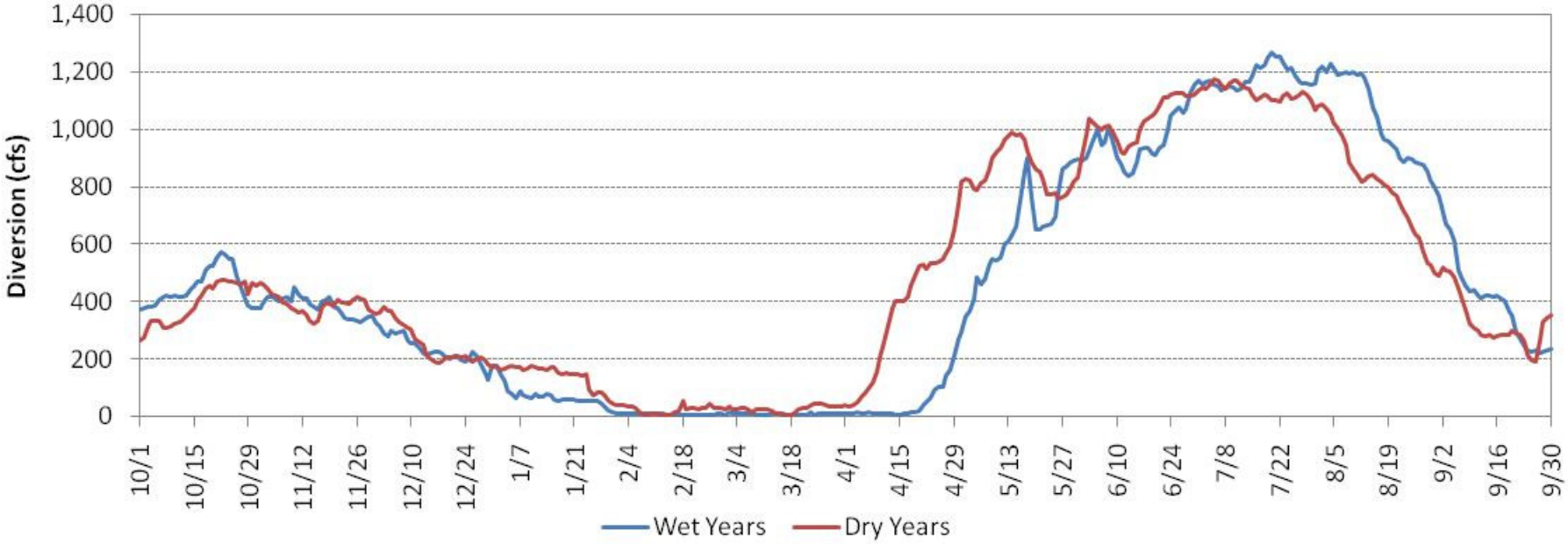
- YCWA delivers surface water to 8 Member Units
- Deliveries made from Daguerre Point Dam
- Synthetic demands developed for modeling
  - Land-use based annual volume
  - Historically based daily pattern
  - Future Level of Development
    - Wet Year: 331 TAF/yr
    - Dry Year: 348 TAF/yr
  - Present Level of Development
    - Wet Year: 295 TAF/yr
    - Dry Year: 311 TAF/yr
- Subject to reductions due to low reservoir storage – max 50% shortage



Operations/Water Balance Model

Model Basics – Operational Drivers – Agricultural Diversions

(Full Agricultural Development)



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Wet (AF)	27,583	22,934	14,345	4,200	407	495	2,873	39,615	57,257	72,791	64,225	24,194	330,919
Dry (AF)	24,000	23,289	15,421	8,659	1,295	1,533	21,110	52,696	61,339	69,448	49,833	19,670	348,292

Operations/Water Balance Model

Special Consideration

- Colgate Power Generation
  - Model iterates to determine required weekly release volume
  - Second pass distributes releases according to desired pattern
  - Third pass correct Englebright levels for target storage
- Englebright Spill Avoidance
  - Uses 4-day perfect forecast for high inflows that would surcharge Englebright Dam.
  - Reduces Colgate flow to draw Englebright storage down to desired level.
  - Captures as much flow as possible to reduce or eliminate spills
  - Narrows 1 and 2 powerhouses release up to maximum release rate.
- Yuba River Index Calculation
  - Dynamically calculated using previous year's End-of-September storage and current year New Bullards Bar Reservoir inflow
  - Assumes perfect foresight for inflows
- Carryover Storage in New Bullards Bar Reservoir
  - Designed to protect against prolonged drought
  - Current-year diversions are reduced to ensure supplies for following year

Operations/Water Balance Model

Simulation Output

- New Bullards Bar Reservoir
  - Storage
  - Flood pool
  - Target operating lines
  - Elevation
  - Total release
    - Colgate release
    - Fish hydro release
    - Spill
  - Evaporation
- Colgate
  - Generation
- Englebright Reservoir
  - Storage
  - Elevation
  - Storage Target
  - Total Release
    - Narrows 1 and 2 Releases
    - Spill
  - Evaporation
- Narrows 1 and 2
  - Generation

Operations/Water Balance Model

Simulation Output

- Slate Creek
  - Diversions
  - Flow below Slate Creek Diversion Dam
- Middle Yuba River
  - Flow below Our House Dam
  - Minimum instream flow requirement
- Oregon Creek
  - Flow below Log Cabin Dam
  - Minimum instream flow requirement
- Lohman Ridge Tunnel flow
- Camptonville Tunnel flow
- Yuba River flow at Smartville
  - Minimum instream flow requirement
  - Flow at Smartville
- Yuba River flow at Marysville
  - Minimum instream flow requirement
  - Flow at Marysville
- Daguerre Point Dam
  - Demand
  - Delivery
  - Allocation

Operations/Water Balance Model

Requested Study Plan Changes

From 6/9/2010 Relicensing Participants' meeting

- Add detail about collaboration
- Add detail about approach to modeling critical project elements
  - Carryover storage
  - Yuba River Accord index and schedule determination
  - Systematic changes in inflow hydrology due to changes in upstream project operations
  - Intra-day peaking operations of Colgate
  - Englebright coordinated operations

Water Temperature Model

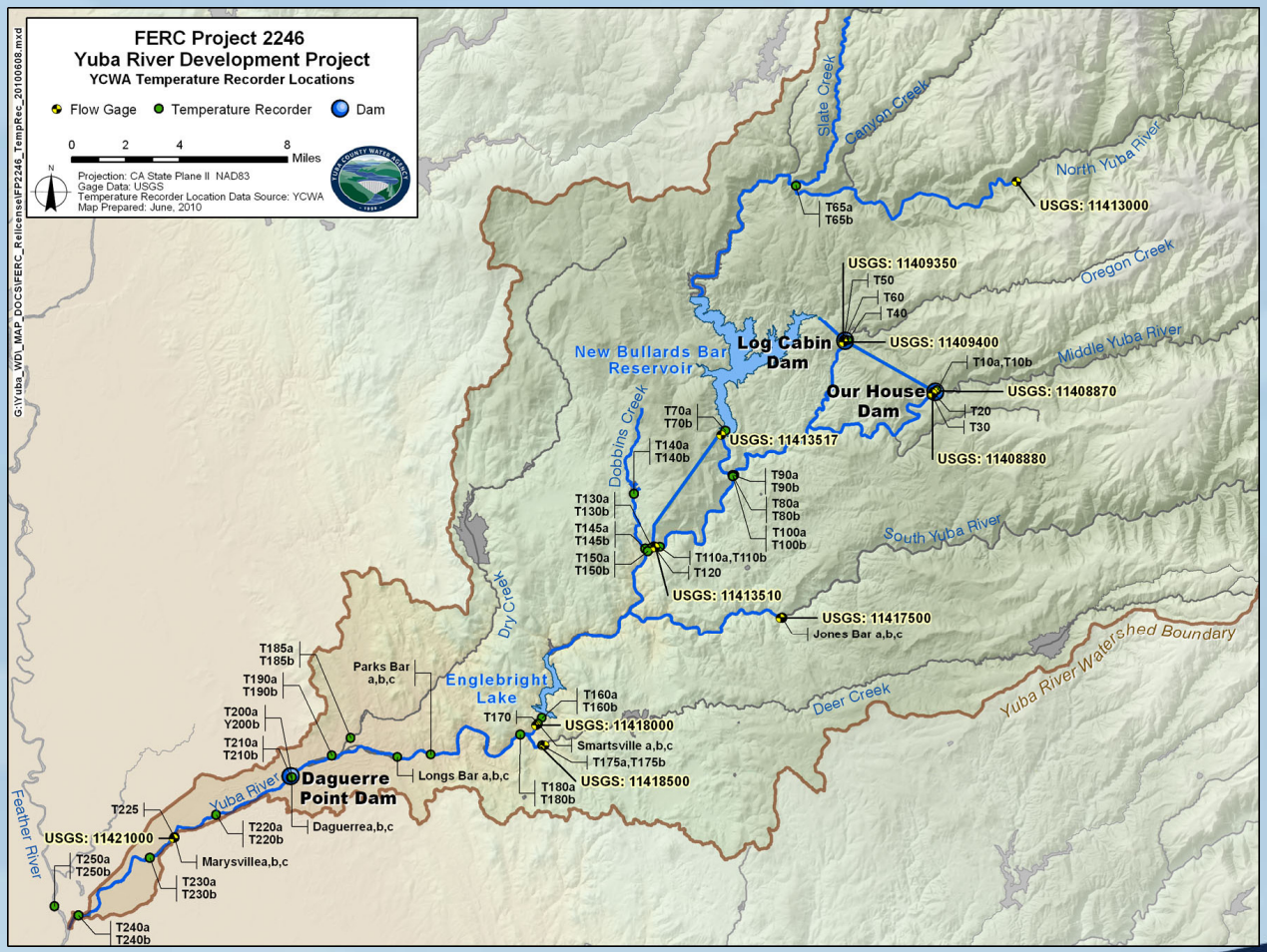
Intended Use

- Simulate reservoir and stream temperatures affected by Project operations
- Provide reservoir and stream temperatures at key locations throughout the Project for use in preparing other studies
- Provide reservoir and stream temperatures resulting from a representative range of historical hydrological and meteorological conditions

Water Temperature Model

Available Inputs

- Water temperature monitoring data from Study 2.5
- Historical YCWA monitoring data
- Available regional meteorological data
  - CIMIS
  - CDEC
  - NCDC



Water Temperature Model

Simulation Inputs

- Will attempt to simulate hydrologic period of record (1970-2008) on a 6-hour timestep
- Since not all meteorological and inflow water temperature data is available for the full period of record, some data will have to be synthesized
  - Statistical regressions using available information
    - Air temperature
    - Precipitation
    - Etc.
  - Repeat input data sets from similar years
- Since models are to be used in a comparative manner, exact duplication of historical data is not required.
  - Goal is to create a representative data set for study modeling
  - Validation will use historical data

Water Temperature Model

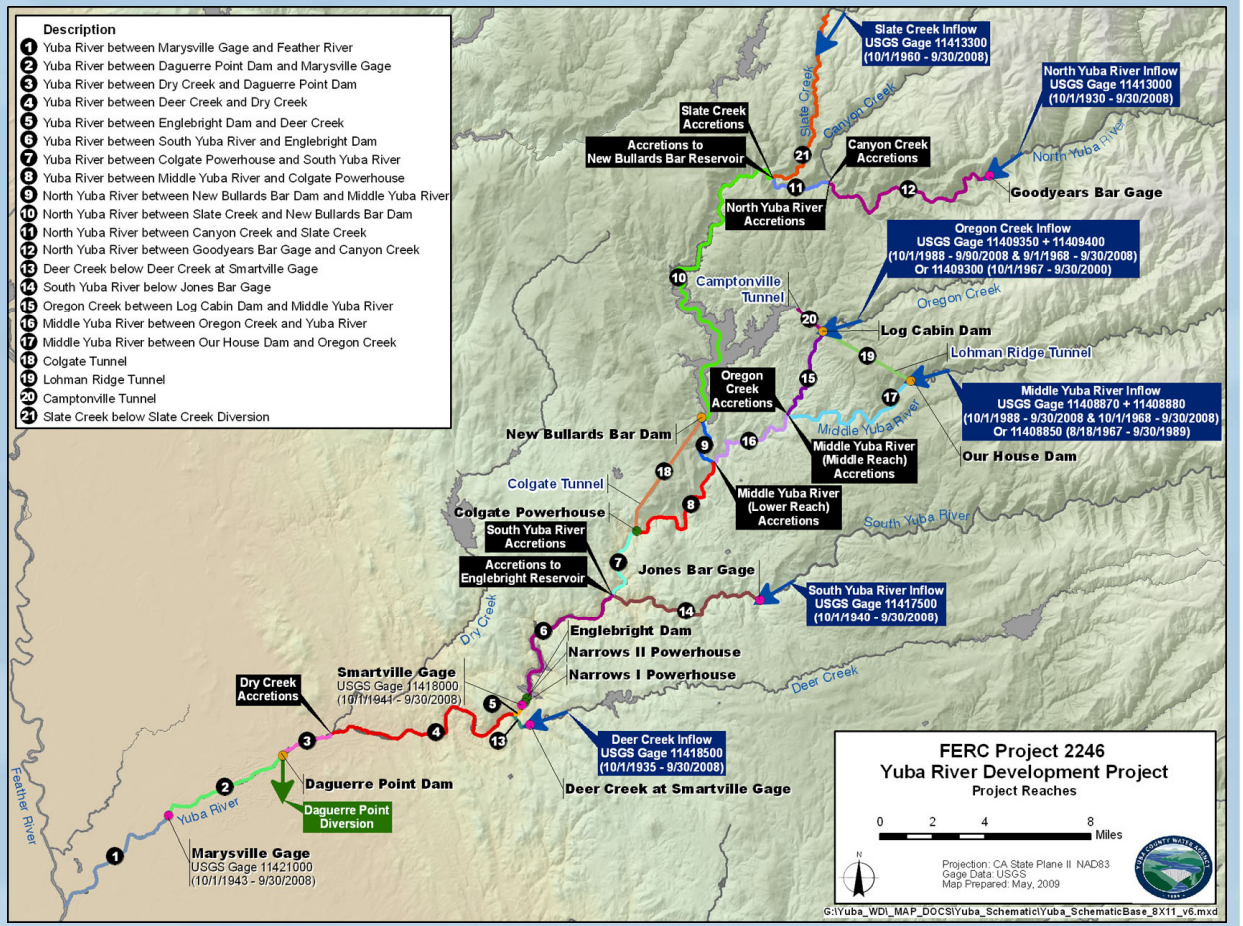
Platform Selection

- Water temperature modeling platform selection driven by needs of other studies
- Potential platforms
  - HEC-5Q ←Tentatively suggested platform
  - WQRRS
  - CE-QUAL-R1
  - CE-QUAL-W2
  - RMA-11
  - Linear regression-based tool
  - Combination of above

Water Temperature Model

Suggested Model Output

- 6-Hour Timestep
- 10/1/1969-9/30/2008
- On half-mile intervals throughout Project area
- Profiles at Colgate and Narrows 2 powerhouse intakes
- Other locations identified through collaboration
- Calibrated for:
  - Powerhouse intake profiles
  - Middle Yuba at confluence with North Yuba
  - Smartville
  - Marysville



Water Temperature Model

Requested Study Plan Changes

From 6/9/2010 Relicensing Participants' meeting

- Expanded discussion of previous Lower Yuba River water temperature modeling efforts
- Identified additional collaboration opportunities
- Identified method to incorporate systematic changes in input water temperatures due to changes in upstream project operations
- Identified specific ability to simulate ability to make releases from upper and lower New Bullards Bar Dam outlets