Jacobs Challenging today. Reinventing tomorrow.

Cartography meets Modeling: Implementing a Complex Offstream Reservoir in CalSim 3

Reed Thayer, PE

Jacobs

DISCLAIMER

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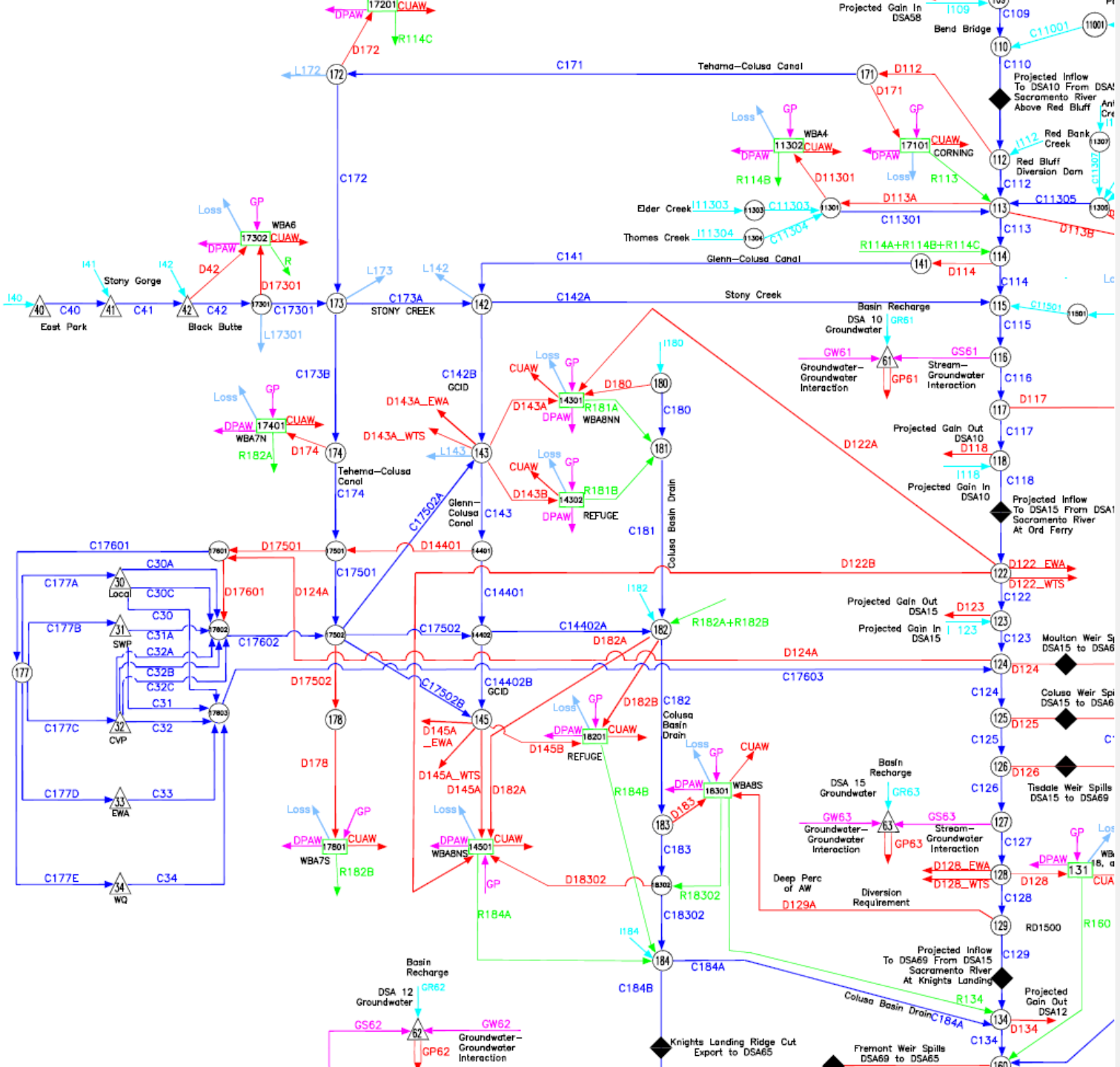
CARTOGRAPHIC
Atlas Miller 1519
DOCUMENT
Atlas Miller 1519


Tehama–Colusa Canal
Glenn–Colusa Canal
Stony Creek
Colusa Basin Drain
Stony Gorge
East Park
Black Butte
STONY CREEK
Tehama–Colusa Canal
Glenn–Colusa Canal
REFUGE
Local
SWP
CVP
EWA
WQ
CORNING
Red Bluff Diversion Dam
Bend Bridge
Elder Creek
Thomes Creek
Red Bank Creek
Projected Inflow To DSA10 From DSA5 Sacramento River Above Red Bluff
Projected Gain In DSA58
Projected Gain Out DSA10
Projected Gain In DSA10
Projected Inflow To DSA15 From DSA1 Sacramento River At Ord Ferry
Projected Gain Out DSA15
Projected Gain In DSA15
Projected Inflow To DSA69 From DSA15 Sacramento River At Knights Landing
Projected Gain Out DSA12
Basin Recharge DSA 10 Groundwater
Basin Recharge DSA 15 Groundwater
Basin Recharge DSA 12 Groundwater
Groundwater–Groundwater Interaction
Stream–Groundwater Interaction
Moulton Weir Spill DSA15 to DSA69
Colusa Weir Spill DSA15 to DSA69
Tisdale Weir Spills DSA15 to DSA69
Fremont Weir Spills DSA69 to DSA65
Knights Landing Ridge Cut Export to DSA65
Deep Perc of AW
Diversion Requirement
RD1500
Colusa Basin Drain

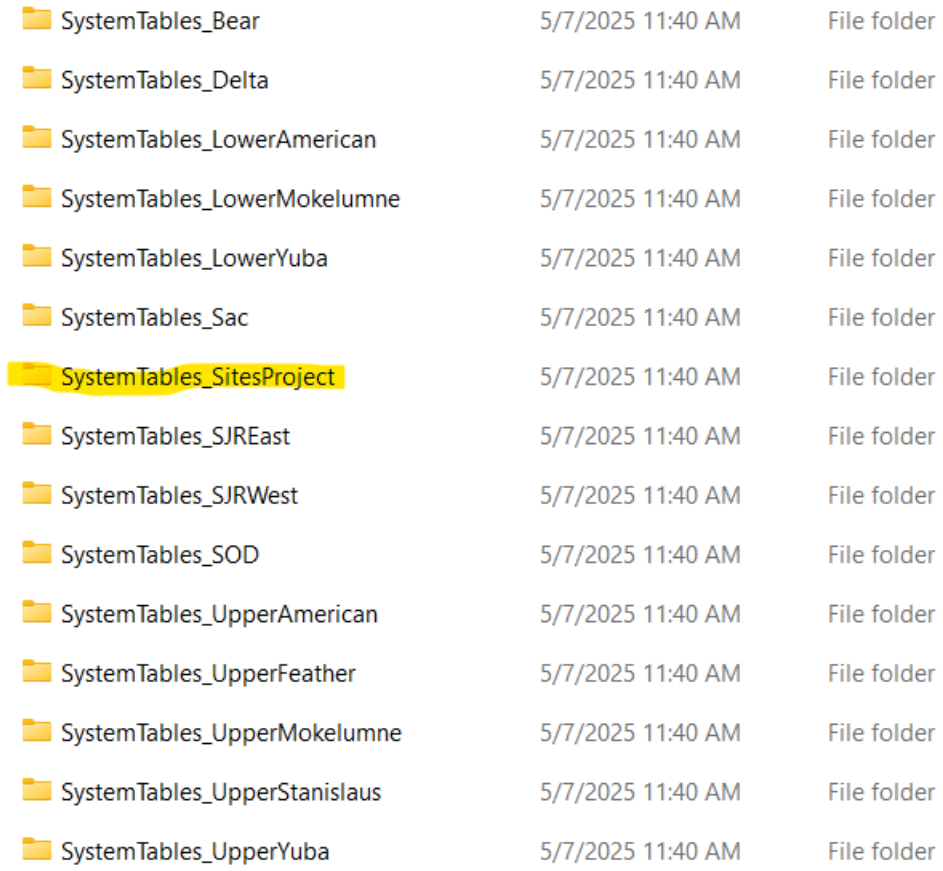
Baseline

- 2021 BiOp – established in 2024 (based on CalSim 3 model provided by Reclamation) with:
  - No Healthy Rivers & Landscapes
  - Daily flow estimates in the Upper Sacramento River to more accurately determine weir spills into the Sutter Bypass and Yolo Bypass
- Existing facilities
- Currently using 2022 Median hydrology but 2040 Median in progress

Guiding Principles

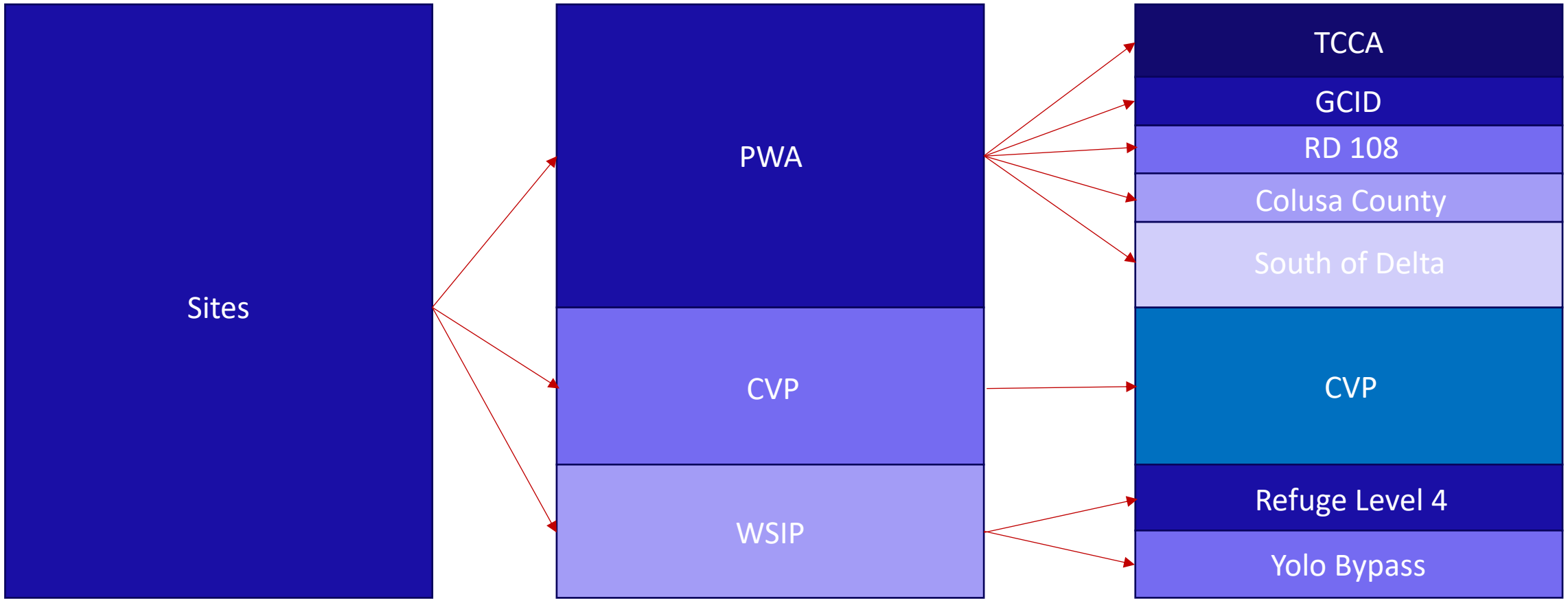
- Represent current project
- Make turning on and off as simple as possible
- Model like a watershed

The Sites “Watershed”

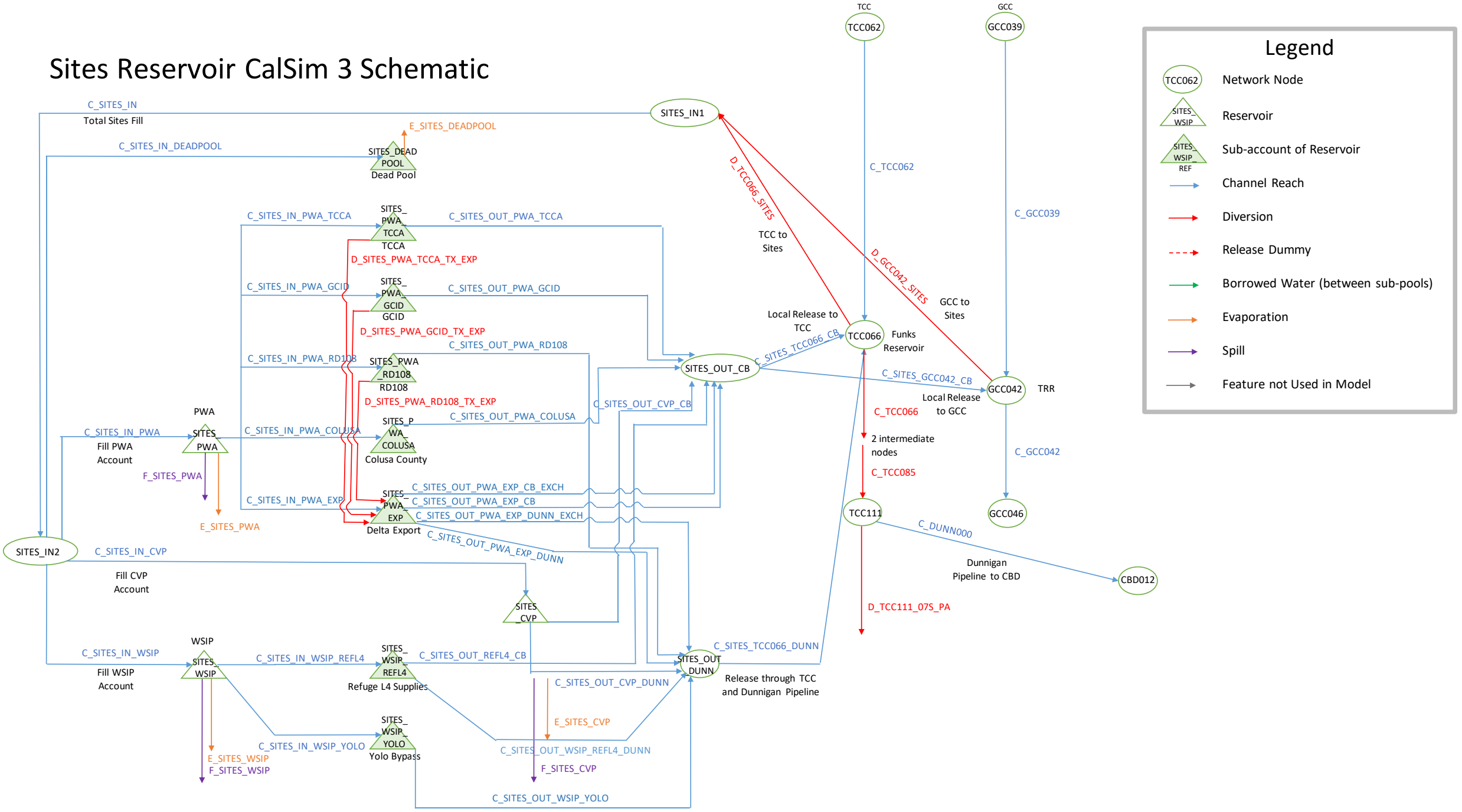


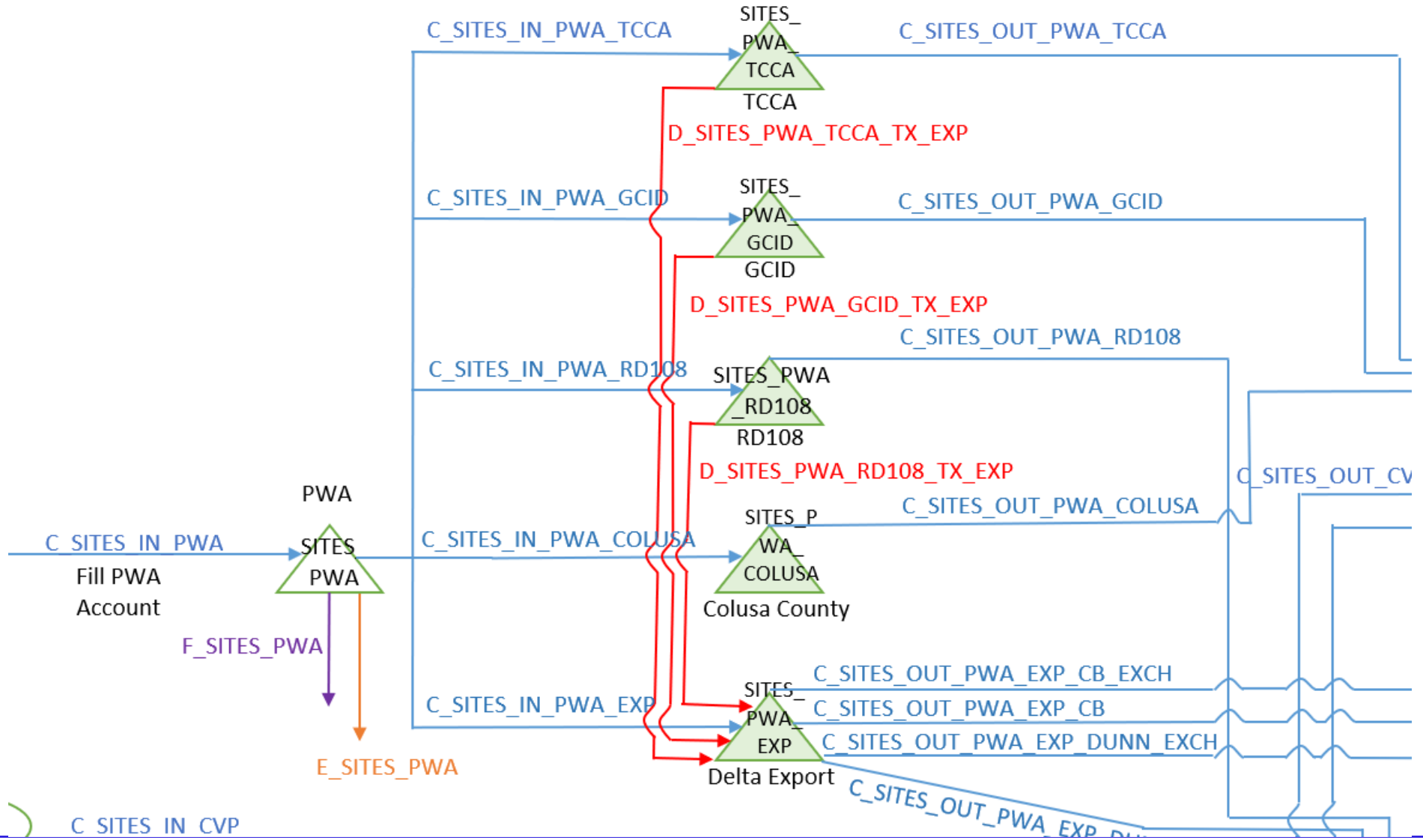
Storage

Many reservoirs in one



Sites Reservoir CalSim 3 Schematic




C_SITES_IN_PWA_TCCA
SITES_PWA_TCCA
TCCA
C_SITES_OUT_PWA_TCCA
D_SITES_PWA_TCCA_TX_EXP
C_SITES_IN_PWA_GCID
SITES_PWA_GCID
GCID
C_SITES_OUT_PWA_GCID
D_SITES_PWA_GCID_TX_EXP
C_SITES_OUT_PWA_RD108
C_SITES_IN_PWA_RD108
SITES_PWA_RD108
RD108
D_SITES_PWA_RD108_TX_EXP
C_SITES_OUT_CV
PWA
C_SITES_IN_PWA
SITES PWA
Fill PWA Account
C_SITES_IN_PWA_COLUSA
SITES_PWA_COLUSA
Colusa County
C_SITES_OUT_PWA_COLUSA
F_SITES_PWA
C_SITES_OUT_PWA_EXP_CB_EXCH
C_SITES_IN_PWA_EXP
SITES_PWA_EXP
C_SITES_OUT_PWA_EXP_CB
C_SITES_OUT_PWA_EXP_DUNN_EXCH
E_SITES_PWA
Delta Export
C_SITES_OUT_PWA_EXP
C_SITES_IN_CVP

Standardized Nomenclature

- C_SITES_[IN/OUT]_[ACCOUNT]_[SUB-ACCOUNT]
  - C_SITES_IN_WSIP_REFL4
- S_SITES_[ACCOUNT]_[SUB-ACCOUNT]
  - S_SITES_WSIP_REFL4

Fills

Sites Modeling Diversion Criteria		Daily vs Monthly Implementation
Sites Storage Capacity	1.5 MAF	Daily
Red Bluff diversion capacity	2,100 cfs	Daily
Red Bluff Bypass	3,250 cfs	Daily
Hamilton City diversion capacity	1,800 cfs & variable winter capacities	Daily
Hamilton City Bypass	4,000 cfs	Daily
GCID Main Canal maintenance	Last week in Jan, first week in Feb	Daily
Wilkins Slough Bypass	10,930 cfs	Daily
Balanced Conditions	No diversions when Delta is in Balanced conditions	Monthly
Fully Appropriated Streamflow	No diversion from Jun 15 to Aug 31	Daily
Flow Dependent Diversions	Diversions limited by flow at Bend Bridge and Hamilton City (per Section 9.14 of the Sites Ops ITP)	Daily
Near Excess conditions	Limit diversions to not use first 3,000 cfs of Surplus Delta Outflow	Monthly
Shasta Spring Pulse	Limit diversions in months with Shasta releases for Spring Pulse objectives	Monthly

Sites Fill <

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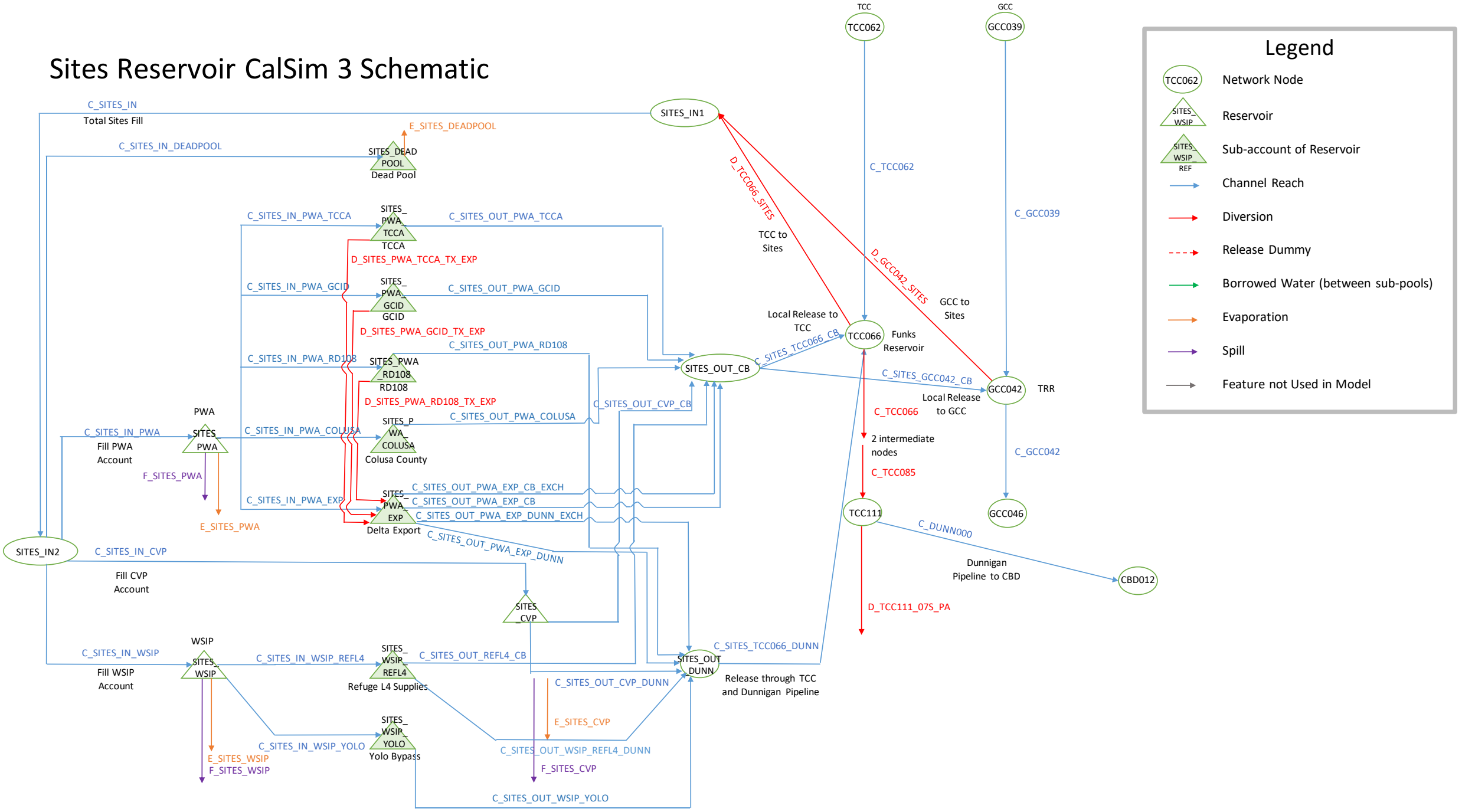
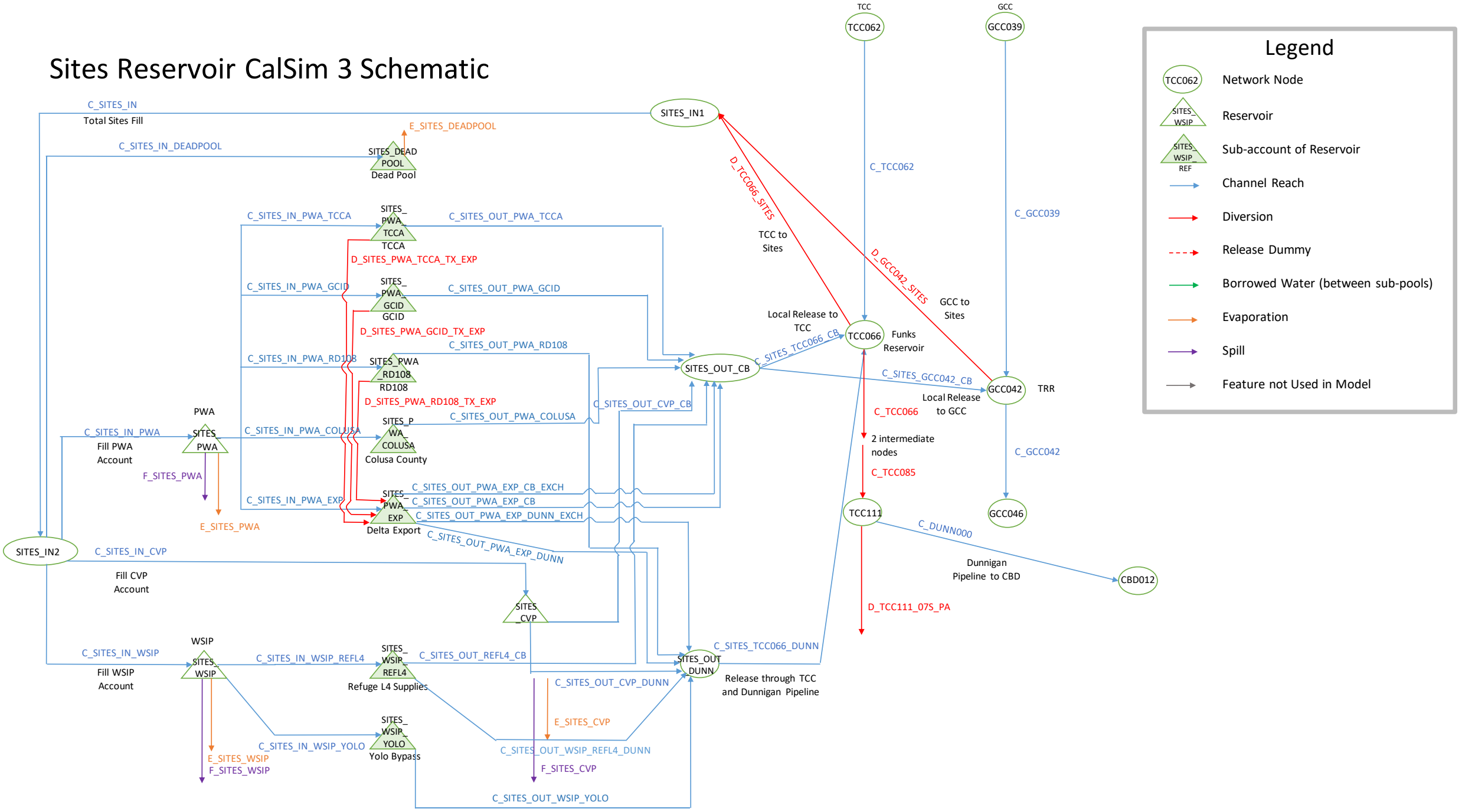
Sites Reservoir CalSim 3 Schematic



Releases

Sites Reservoir CalSim 3 Schematic



Operations

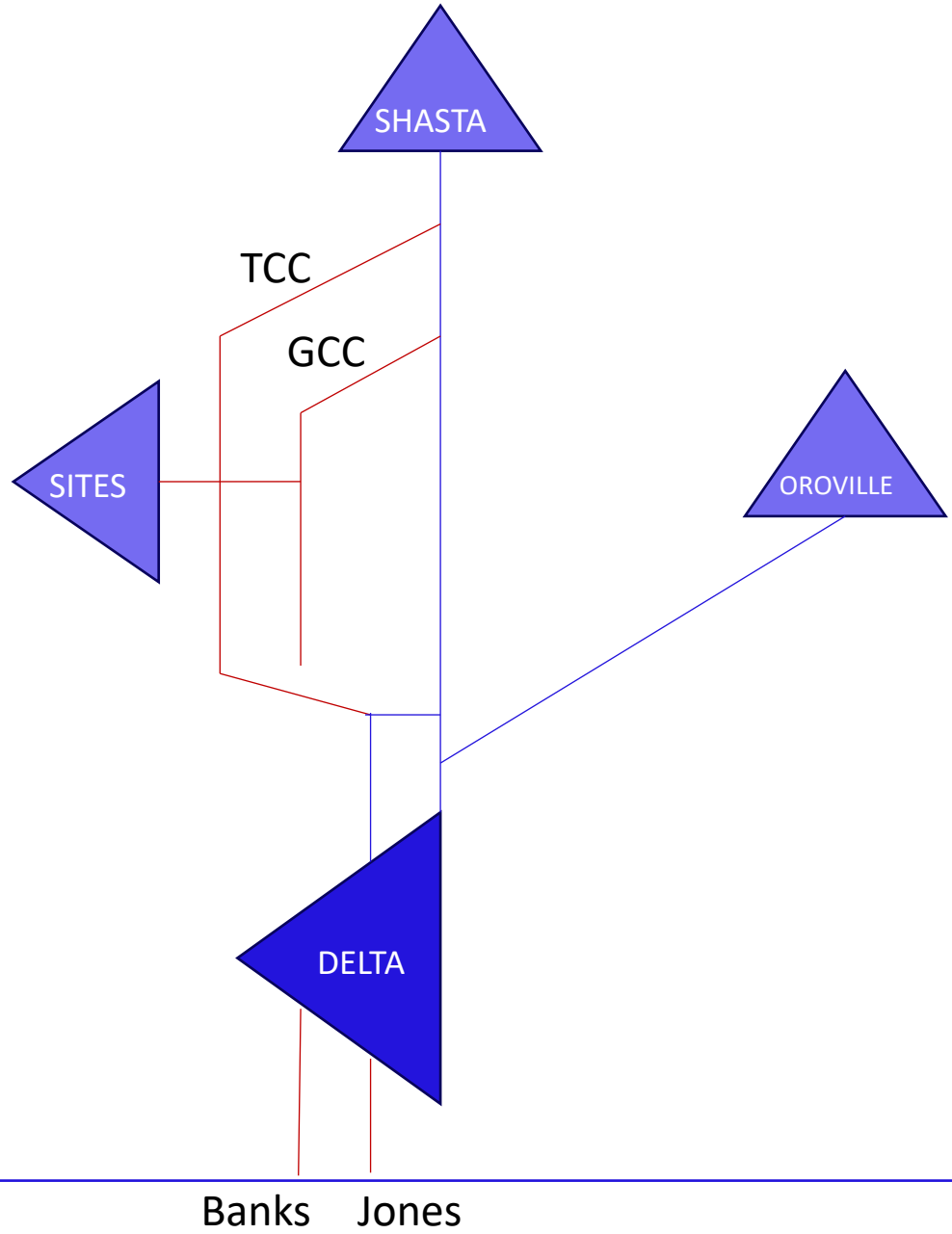
- Public Water Agencies (PWA)
  - North of Delta
    - Ag Service Contractors
    - Settlement Contractors
  - South of Delta
- CVP Operational Flexibility
- Public Benefits (WSIP)
  - Yolo Bypass Augmentation Flows
  - CVPIA Level 4 Refuge Deliveries

Release Rules

- There must be storage!!!
- Can release to North of Delta when Sites is not filling
  - Ag Service Contractors – release to meet target allocation
  - Settlement Contractors – Shasta Critical Years
  - Colusa County – Set GW replenishment release
- Can only release to South of Delta between July and November
  - Limited by conveyance capacity and Delta constraints
- CVP water belongs to the CVP

Release Mechanisms

- Direct releases to Colusa Basin
- Dunnigan Pipeline
- In-river exchange at Hamilton City
- Oroville reoperation
- Shasta exchange



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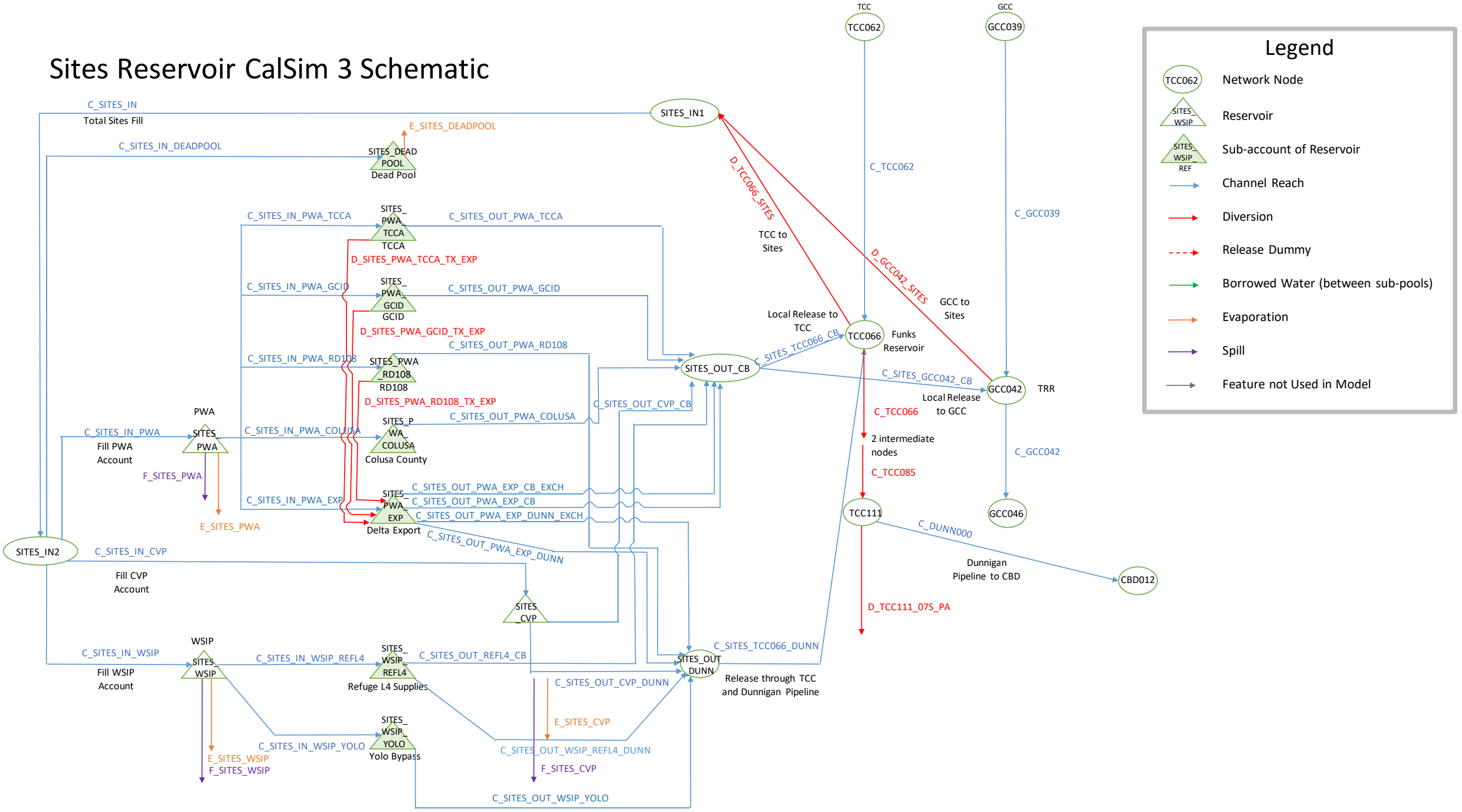


Grand Continuity Equation

Sites PWA SOD Release + Oroville Sites Release + Shasta Sites Release + Exchange Spill

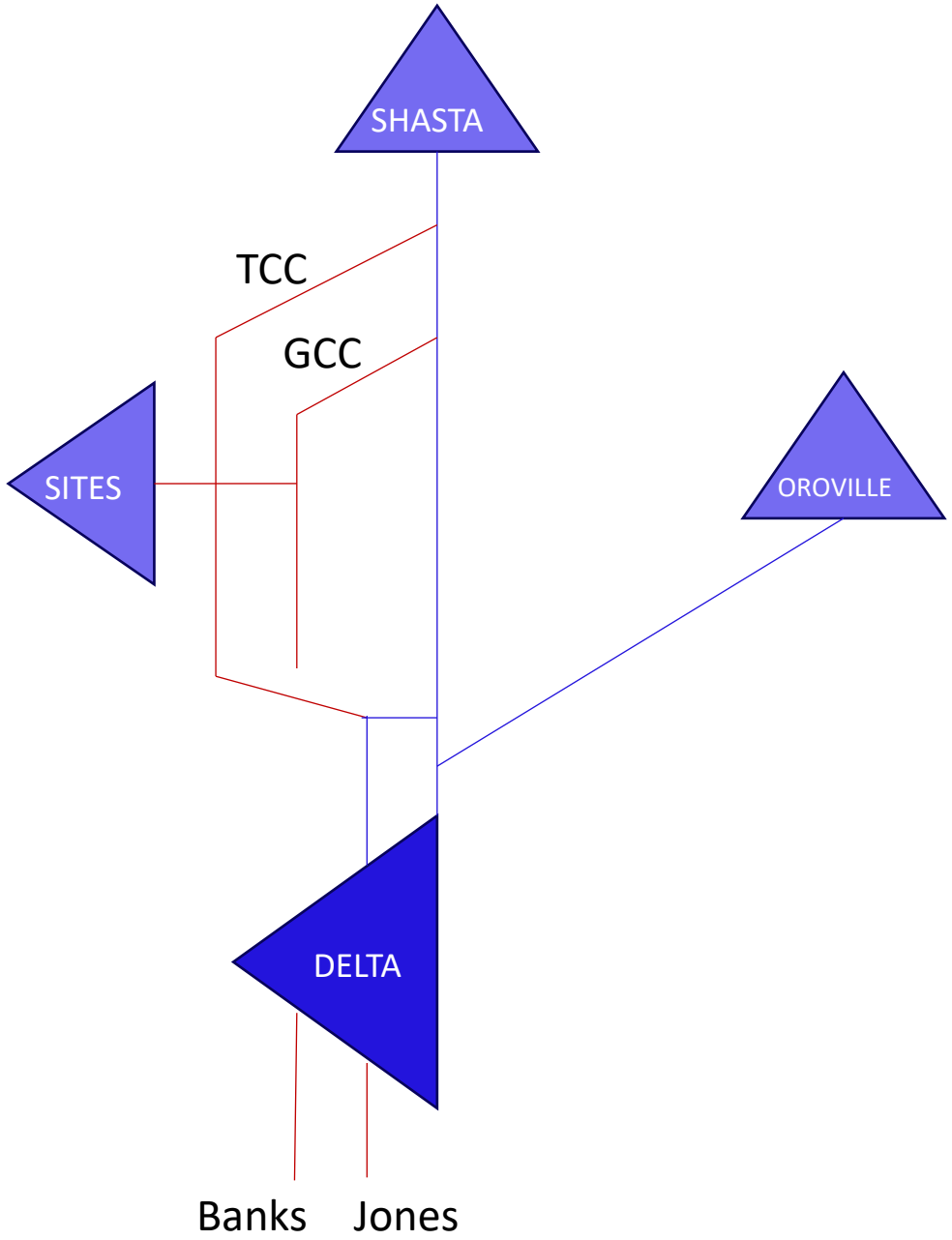
=

Exchange with Oroville + Exchange with Shasta + Sites PWA EXP Exports + Sites PWA EXP Delta Outflow

What's being released?

=

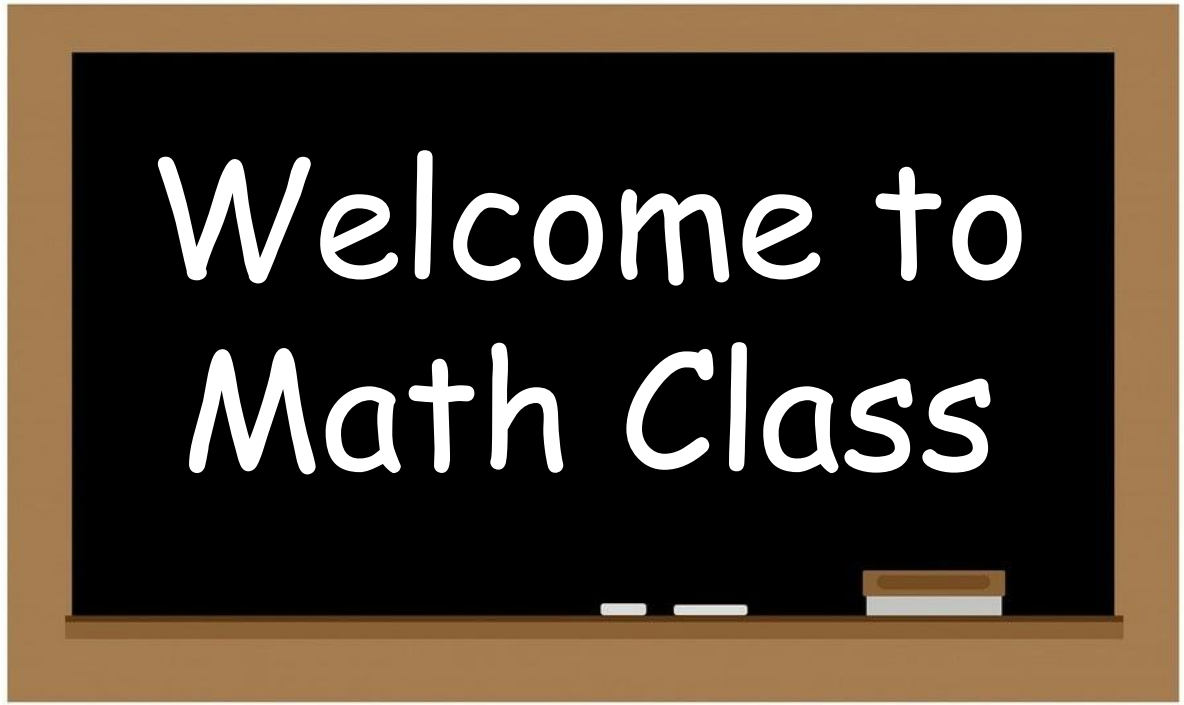
Where's it going?



Deliveries

How do releases become deliveries?

- North of Delta
  - Release = Delivery
- South of Delta
  - Release - Carriage water = Deliveries
- CVP
  - To be taught in grad school



South of Delta

- South of Delta deliveries are calculated at Banks PP
- Deliveries are assigned to storage partners based on participation level

Los Angeles Times

CVP Operational Flexibility

- Left to CVP logic
- Add storage to COA equations
- Some goes to storage, some goes direct to contractor deliveries

Big Lesson Learned

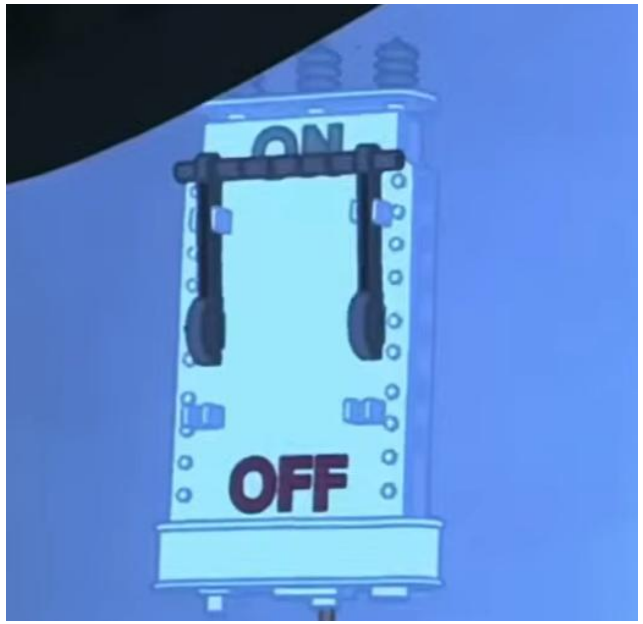
- Keep Sites deliveries outside of delivery equations

```
!=========================================================================
! 8N_PR1
!=========================================================================
! gross surface water diversions
goal setDG_08N_PR1  {DG_08N_PR1 = D_GCC027_08N_PR1/* + D_GCC027_08N_PR1_SITES*/}
! net surface delivery = surface diversion - conveyance losses
goal setDN_08N_PR1  {DN_08N_PR1 = DG_08N_PR1 - DL_08N_PR1}
! Total Applied Water = net surface delivery + groundwater pumping
goal meetAW_08N_PR1 {AW_08N_PR1 + RP_08N_PR1 = DN_08N_PR1 + GP_08N_PR1 + RU_08N_PR1 + SHRTG_08N_PR1 } ! shortage activated
```

Development

Centralize controls

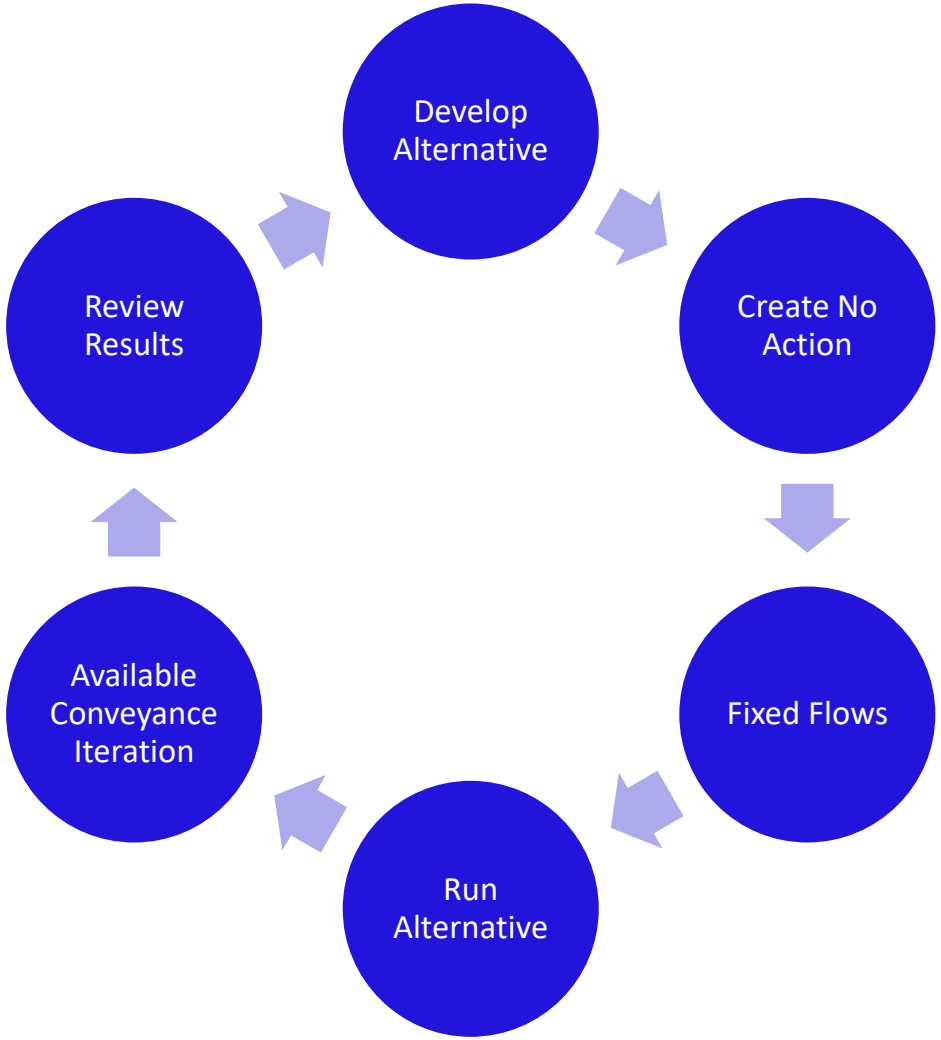
- Sites_JobControl.table
- If it can be adjusted, put it in Job Control!
- Goal: the only two things that need to be turned on and off are a master Sites switch and zeroing out initial storages



Fortunately, we had a CalSim II model to start with

- Fix all releases to CalSim II output timeseries
- Replace each one with a dynamic operation

Iterative Process



Cycle Implementation

CYCLE #	CYCLE NAME	SITES PROJECT ELEMENTS
19-22	SJR	Sites is inactive, but need parameters defined
23-27	GW	
28	PRESETUP	Sites is active, but no diversions to Sites storage
29	SETUP	Rough Sites diversions
30	MONTHLYWEIGHTED	All NOD actions are activated (NOD PWA, NOD REFL4, Yolo, CVP OpFlex - inc Jones PP exports)
31	UPSTREAM	
32	DELTASRPLS	
33	DELTA	
34	TRANSFERS_STAGE1	
35	WHEELCVC	
36	WHEELJPOD	
37	STOREXCH	Storage exchange operations
38	SITES_EXPORT	All Sites operations
39	ITP	Sites operations fixed to SITES_EXPORT

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