COLORADO'S
Decision Support Systems
CWCB / DWR

Arkansas River Decision Support System (ArkDSS) Update

Project Manager: Brian Macpherson, P.E., CWCB

Technical Lead: Kelley Thompson, P.E., DWR

Colors of Water PM: John Rogers, P.E., DWR

Critical Staff: DWR Division 2 Staff, OIT App Dev

ARCA Annual Meeting / Engineering Committee – December 6, 2023

ArkDSS Progress

COLORADO'S Decision Support Systems
CWCB / DWR

- Phase I:
  - GIS ✓ cdss.colorado.gov/gis-data/division-2-arkansas
  - Admin Tools ✓ div2waterops.com
  - Modeling cdss.colorado.gov/arkansas-river-dss
    - Evapotranspiration Dataset ✓
    - Surface Water Model **95% Complete (final cal+documentation)**
    - Trinidad Project Scenario **Year 2024**
- Phase II:
  - Colors of Water Viewer and Scenario Planner **95% Complete**
  - Groundwater **PLANNING**

ArkDSS Surface Water Model (STATEMOD) 2023 Efforts:

COLORADO'S Decision Support Systems
CWCB / DWR

- Refining data inputs
  - Ensuring that all appropriate irrigation pumping records in Hydrobase are associated with a well that is attached in the irrigated acres
  - Ensuring that ArkDSS pumping nearly matches H-I Model pumping
  - Ensuring that H-I model acreage and crop information appropriately used for years without GIS irrigated acreage snapshots
  - Associating wells with augmentation plans
- Natural flow estimation given refined data inputs
  - Estimates natural flows (baseflow) by removing effects of man (diversions, RFs, reservoirs, etc)
  - Additional methods developed to address losing tributary reaches
- Currently in final calibration of historical model
  - Compare simulated results from the model to measured data at streamflow gages, diversions, and reservoir contents
  - Adjust primarily return flows and operations to improve calibration
- Baseline dataset will be developed to use for “What-If” scenarios
- Final / Complete documentation of model
  - Baseline model and documentation completed before Trinidad Project Scenario

ArkDSS –Groundwater Component

COLORADO'S Decision Support Systems
CWCB / DWR

- **Scope / RFP still under development**
  - Phase I
    - Compile Existing Data for Physical Parameters
      - Develop GIS based grids based on compiled data
      - Map drain locations and conditions, etc.
    - Evaluate Futile Call Areas and Hydraulic Disconnects
    - Link Administrative Documents Spatially
  - Phase II
    - Fill Identified Data Gaps and Redevelop Aquifer Extents and Grids
      - Install monitoring wells, run aquifer tests, etc.
  - Awaiting CWCB staffing changes

ArkDSS Colors of Water Tool

COLORADO'S Decision Support Systems
CWCB / DWR

Transit Loss / Timing Model Engine

- Routing – Muskingum type
- Transit Loss - bank storage, evaporation, capture rules
- Network – nodes and reaches
- Livingston framework and routing/aquifer parameters
  - parameters recalibrated using calibration tool

Hydrobase

- release, diversion, telemetry records
- model output
- Network locations
- web interactions

Web Tool

- Data Viewer
- Scenario Planner
- Conductor / Manager

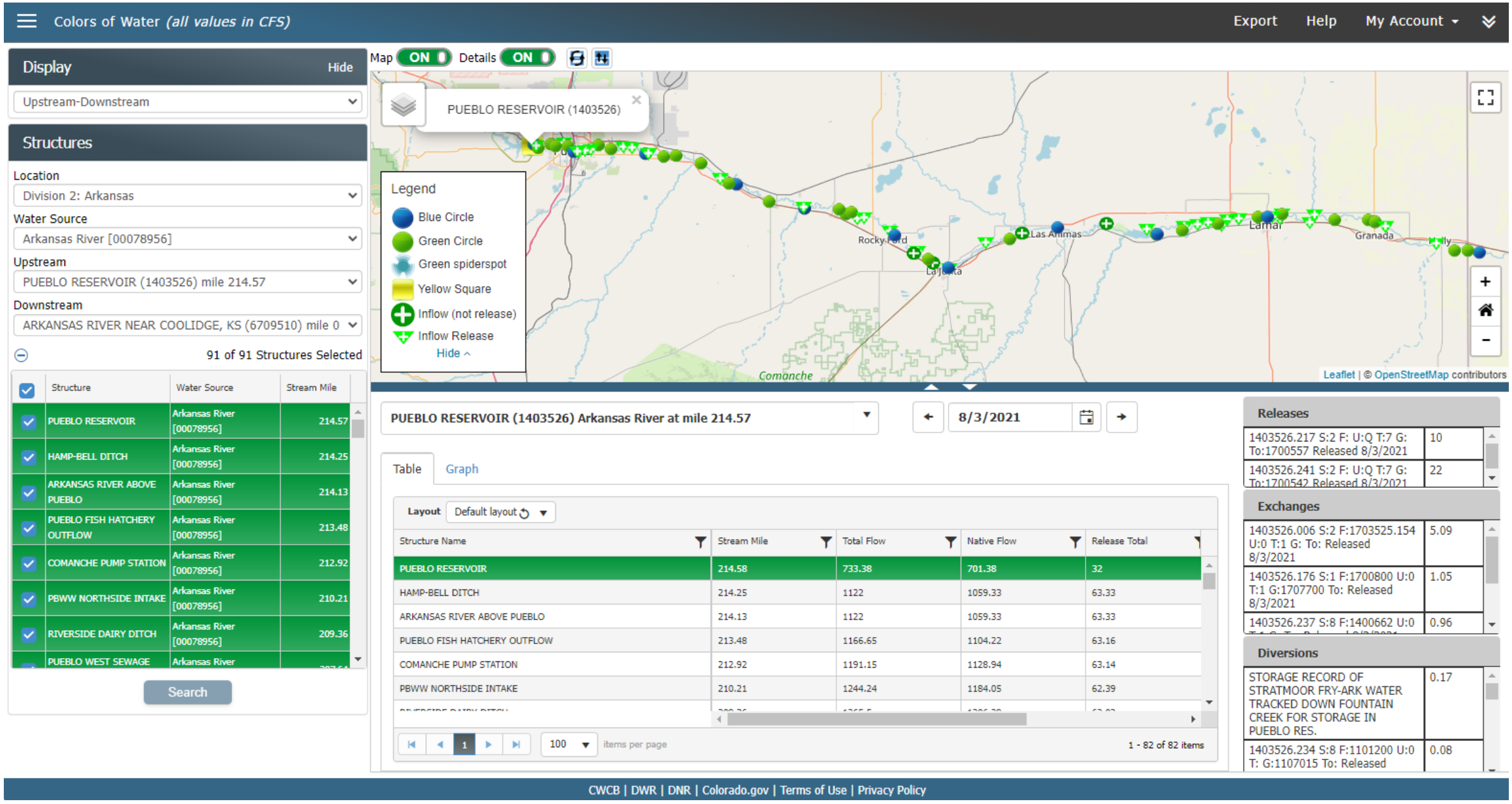
ArkDSS Colors of Water Progress

COLORADO'S Decision Support Systems
CWCB / DWR

- **Data Viewer Webtool Deployed**
  - Show colors of all water in river in front of nodes (ie headgates etc)
  - Missing current/real-time release records
- **Scenario Planner Developed and Deployed**
  - Reservoir releases - Evaluate transit loss and design diversions patterns
  - Currently in final testing and documentation
  - Anticipated for use for 2024 Water Year
    - Replace use of TLAP for releases to ditches above JMR (and to JMR)
    - New use for deliveries to ditches below John Martin Reservoir
    - Hoping to use for Kansas stateline deliveries
  - Exchanges – this “extra” (non-Grant) capability build but not yet for use
- **Bureau of Reclamation SmartWater Grant wrapping up**

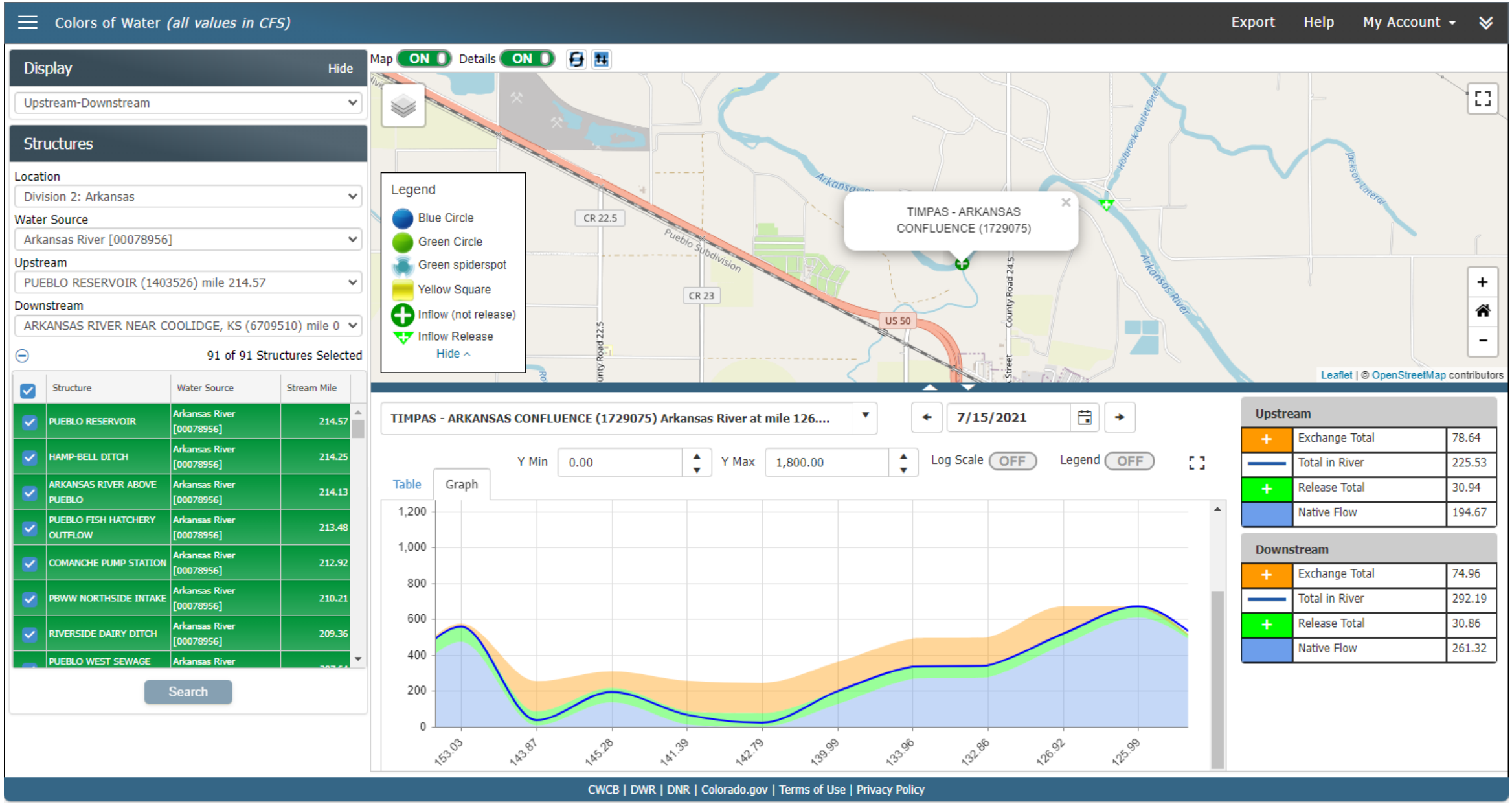
Colors of Water – Viewer

COLORADO'S Decision Support Systems
CWCB / DWR



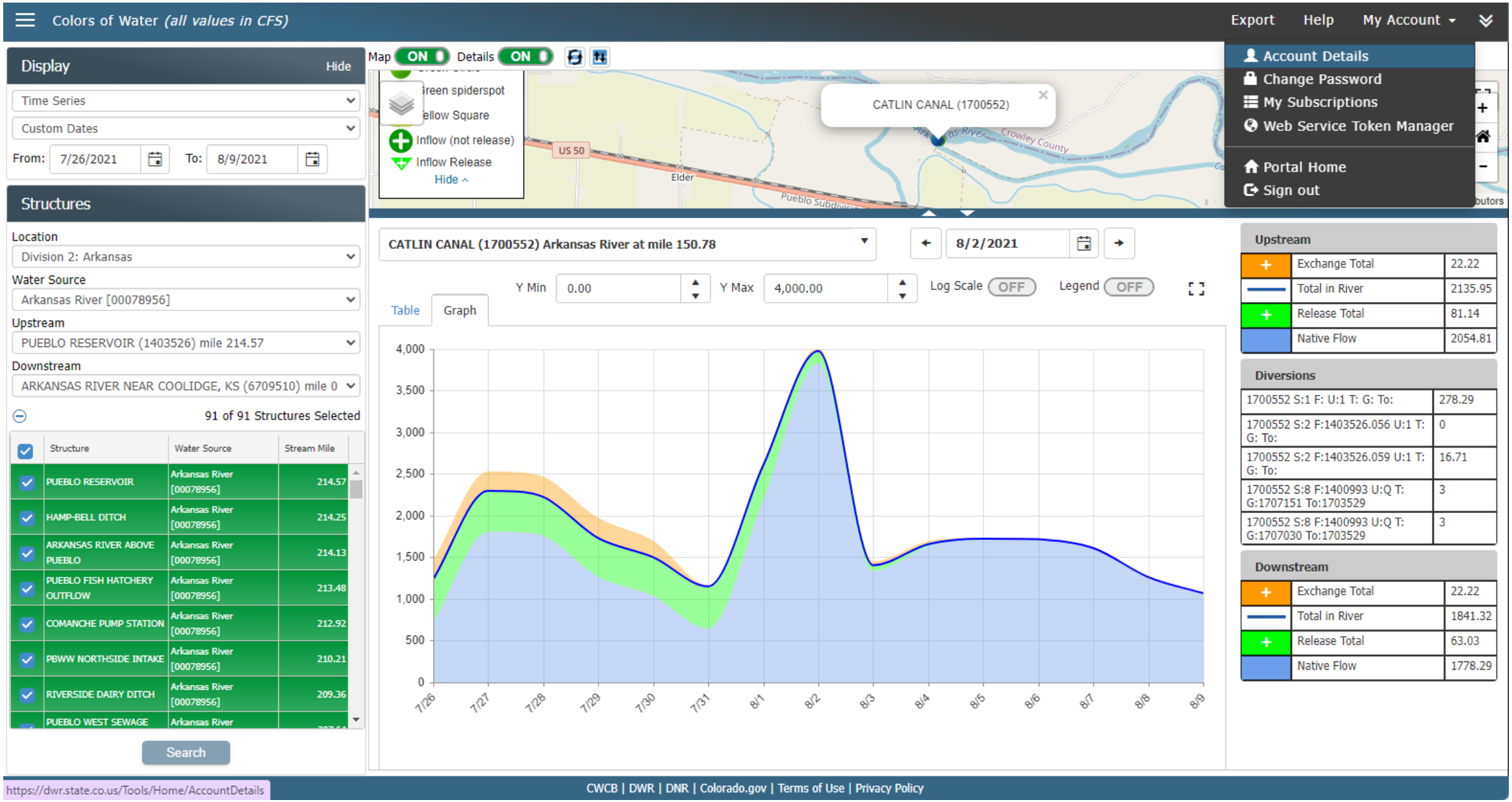
Colors of Water – Spatial View

COLORADO'S
Decision Support Systems
CWCB / DWR



Colors of Water – Time Series View

COLORADO'S Decision Support Systems
CWCB / DWR



COW Scenario Planner – Example WD17 Run

Scenario Name: WD17_2023_ColoCanal_0724

Setup

Scenario Name:*	WD17_2023_ColoCanal_0724	Scenario Type:	Release
Water Source:	Arkansas River	River Flow Basis:	Actual River
Upstream Structure:	PUEBLO RESERVOIR (1403526) at mile 214.57	Date Basis:	Upstream Release Dates
Downstream Structure:	COLORADO CANAL (1700540) at mile 179.45	Rate Basis:	Upstream Release Blocks
Owner:	COLORADO SPRINGS		
Water Class:	1403526.342 S:2 F: U:Q T:7 G: To:1700540		

Headgate Pattern: YES

Planned Major Delivery Steps

Block	Date	Time	Rate (CFS)	
1	07/24/2023	06:00 PM	100	⊗
2				⊗
3				⊗
4				⊗
5				⊗
End	07/25/2023	10:00 PM		
			Total (AF): 231.41	

Optional Headgate Pattern and Transit Loss Settings

	Option		Value
☐	Flatten delivery blocks by varying release		
☐	Maximum release (CFS) when flattening		##.##
☐	Maximum headgate step (CFS)		##.##
☐	Minimum headgate step (CFS)		##.##
☐	Limit hours of turnout and changes	Start:	8:00 AM
		End:	5:00 PM
☐	Transit loss percentage, override default	Percent per mile	##.##
☑	Gage / Baseflow Evaluation of past release		
☐	Is past event but is hypothetical (not in gage)		

SAVE | SAVE AS | UNDO | RUN

COW Scenario Planner – Graph Output

Scenario Name: WD17_2023_ColoCanal_0724

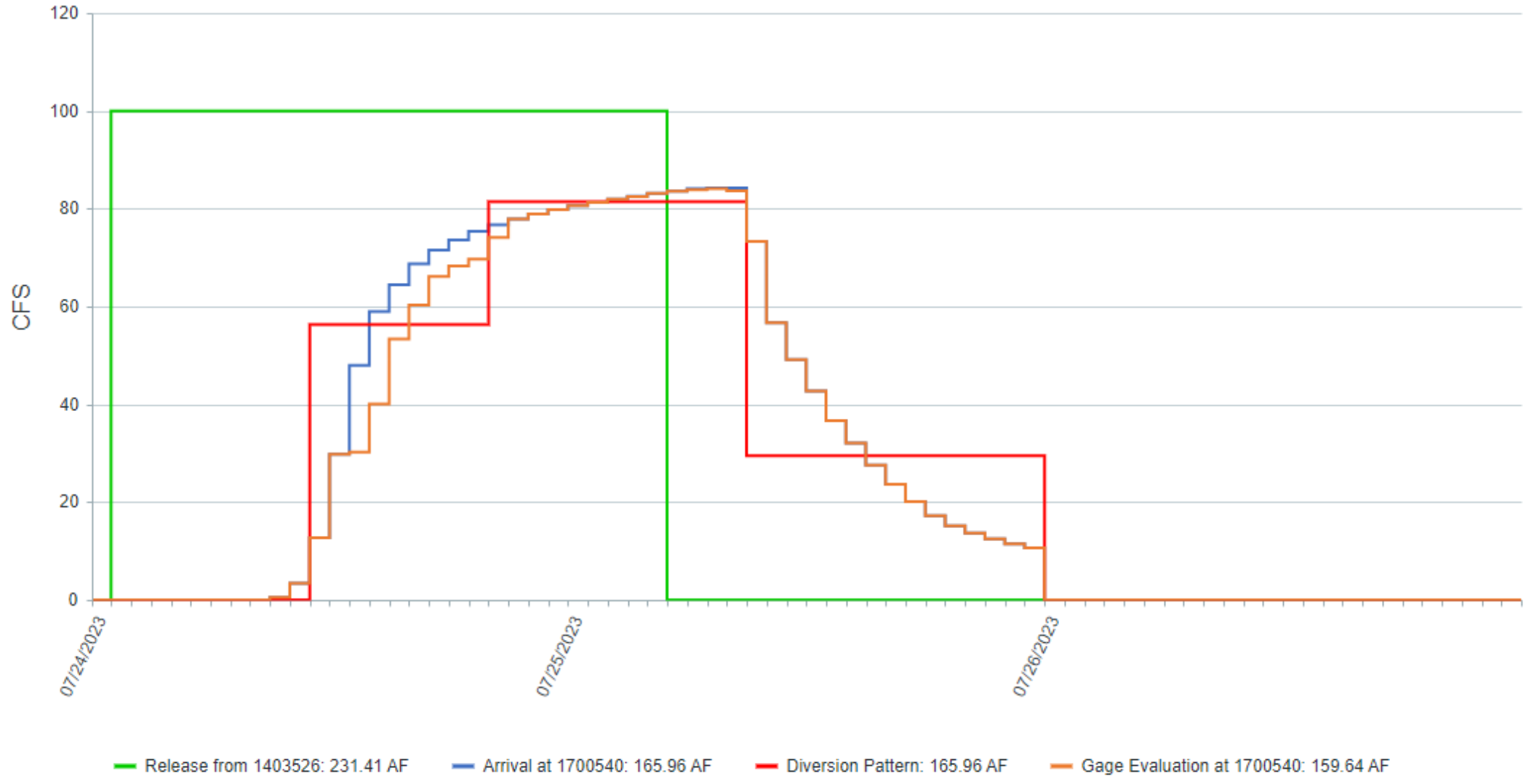
Table | Graph

	Release	Delivery	Headgate	Evaporation	Unconsumed TL	Gage Eval
Totals (AF)	231.41	165.96	165.96	2.33	63.12	159.64

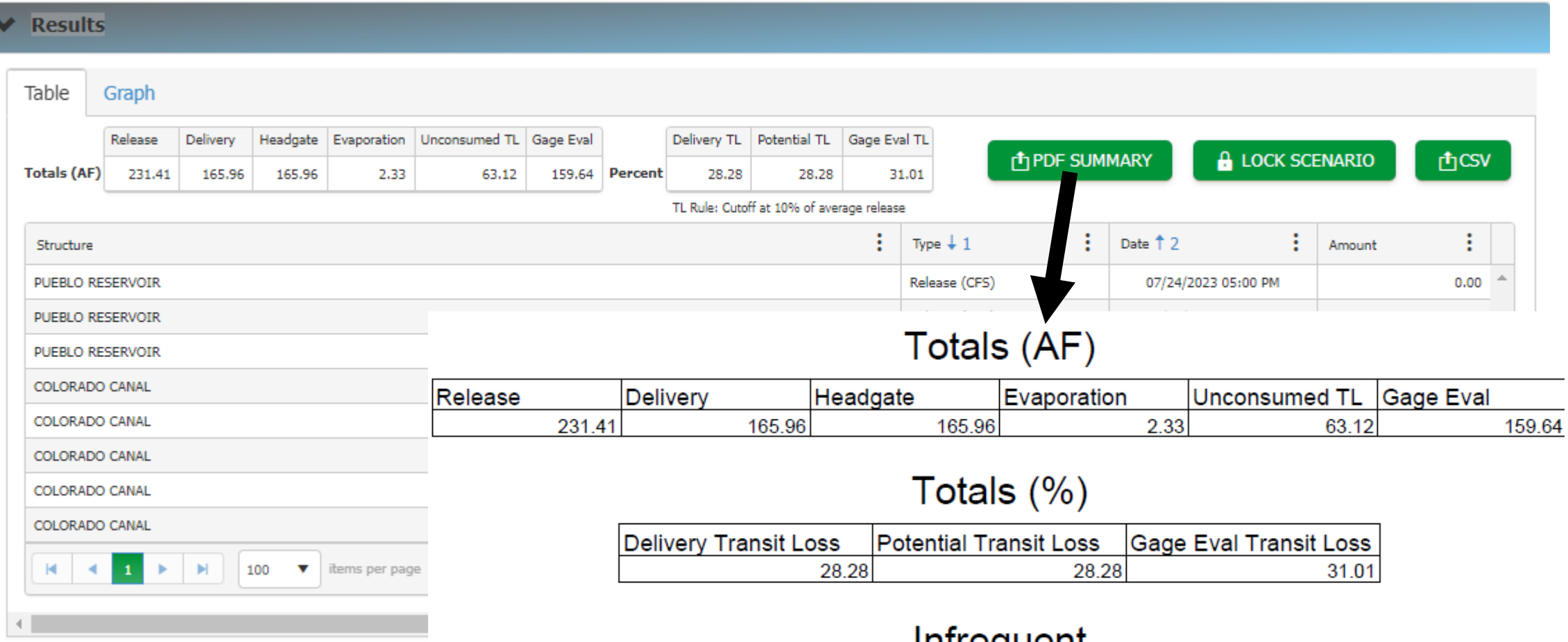
	Delivery TL	Potential TL	Gage Eval TL
Percent	28.28	28.28	31.01

TL Rule: Cutoff at 10% of average release

SEND EMAIL | PDF



COW Scenario Planner – Tabular Output



Totals (AF)

Release	Delivery	Headgate	Evaporation	Unconsumed TL	Gage Eval
231.41	165.96	165.96	2.33	63.12	159.64

Totals (%)

Delivery Transit Loss	Potential Transit Loss	Gage Eval Transit Loss
28.28	28.28	31.01

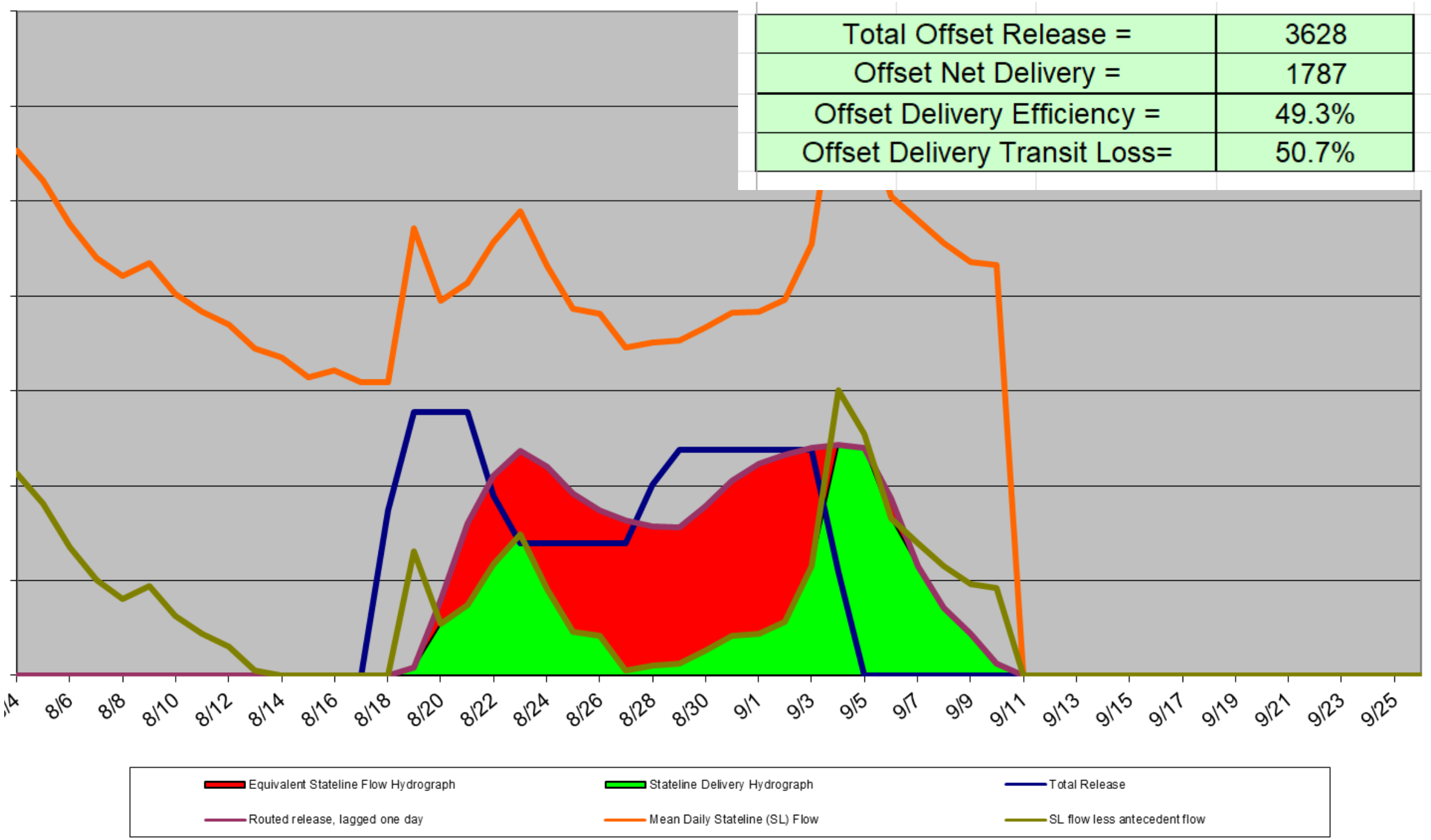
Infrequent

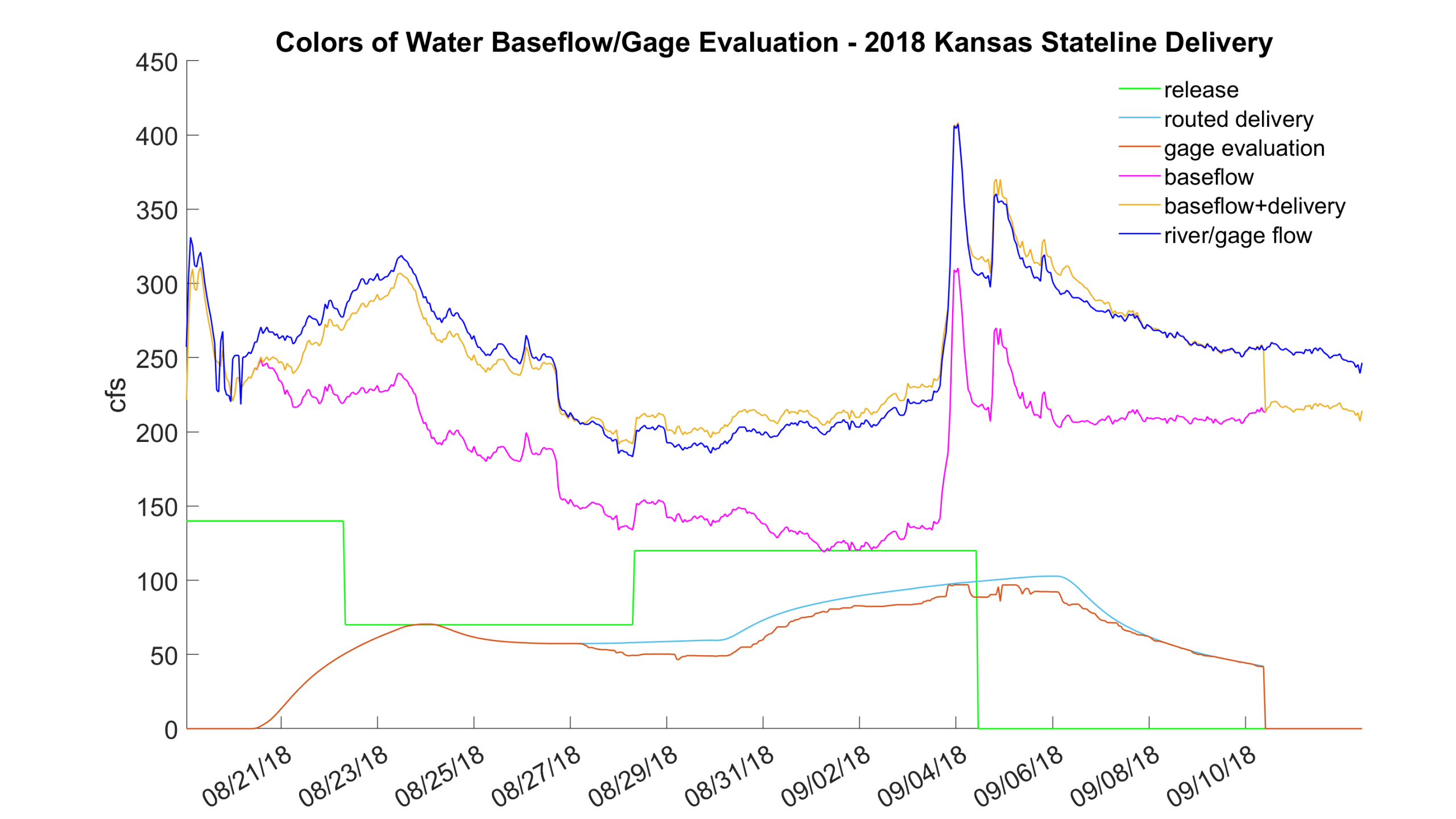
Structure	Type	Date	Amount (CFS)
PUEBLO RESERVOIR (1403526)	Release (CFS)	07/24/2023 05:00 PM	0.00
PUEBLO RESERVOIR (1403526)	Release (CFS)	07/24/2023 06:00 PM	100.00
PUEBLO RESERVOIR (1403526)	Release (CFS)	07/25/2023 09:00 PM	0.00
COLORADO CANAL (1700540)	Headgate Intake(CFS)	07/25/2023 03:00 AM	0.00
COLORADO CANAL (1700540)	Headgate Intake(CFS)	07/25/2023 04:00 AM	56.32
COLORADO CANAL (1700540)	Headgate Intake(CFS)	07/25/2023 01:00 PM	81.46
COLORADO CANAL (1700540)	Headgate Intake(CFS)	07/26/2023 02:00 AM	29.48
COLORADO CANAL (1700540)	Headgate Intake(CFS)	07/26/2023 05:00 PM	0.00

+ Daily and Hourly Data

2018 Kansas Delivery Calculation

Total Offset Release =	3628
Offset Net Delivery =	1787
Offset Delivery Efficiency =	49.3%
Offset Delivery Transit Loss=	50.7%




Colors of Water Baseflow/Gage Evaluation - 2018 Kansas Stateline Delivery
cfs
450
400
350
300
250
200
150
100
50
0
08/21/18
08/23/18
08/25/18
08/27/18
08/29/18
08/31/18
09/02/18
09/04/18
09/06/18
09/08/18
09/10/18
release
routed delivery
gage evaluation
baseflow
baseflow+delivery
river/gage flow

COW Scenario Planner –WD67 Stateline Run

Scenario Name: WD67_2018_KS_0818

Setup

Scenario Name:*	WD67_2018_KS_0818	Scenario Type:	Release
Water Source:	Arkansas River	River Flow Basis:	Actual River
Upstream Structure:	JOHN MARTIN RESERVOIR (6703512) at mile ...	Date Basis:	Upstream Release Dates
Downstream Structure:	ARKANSAS RIVER COMPACT(COLORADO-KAN...	Rate Basis:	Upstream Release Blocks
Owner:	KANSAS		
Water Class:	6703512.035 S:2 F: U:Q T:7 G: To:6799999		

Headgate Pattern: NO

Planned Major Delivery Steps

Block	Date	Time	Rate (CFS)	
1	08/18/2018	09:00 AM	140	⊗
2	08/22/2018	09:00 AM	70	⊗
3	08/28/2018	09:00 AM	120	⊗
4				⊗
5				⊗
End	09/04/2018	11:00 AM		
			Total (AF): 3629.8	

Optional Headgate Pattern and Transit Loss Settings

	Option		Value
☐	Flatten delivery blocks by varying release		
☐	Maximum release (CFS) when flattening		##.##
☐	Maximum headgate step (CFS)		##.##
☐	Minimum headgate step (CFS)		##.##
☐	Limit hours of turnout and changes	Start:	8:00 AM
		End:	5:00 PM
☐	Transit loss percentage, override default	Percent per mile	##.##
☑	Gage / Baseflow Evaluation of past release		
☐	Is past event but is hypothetical (not in gage)		

SAVE UNDO | RUN

COW Scenario Planner – Graph Output

Scenario Name: WD67_2018_KS_0818

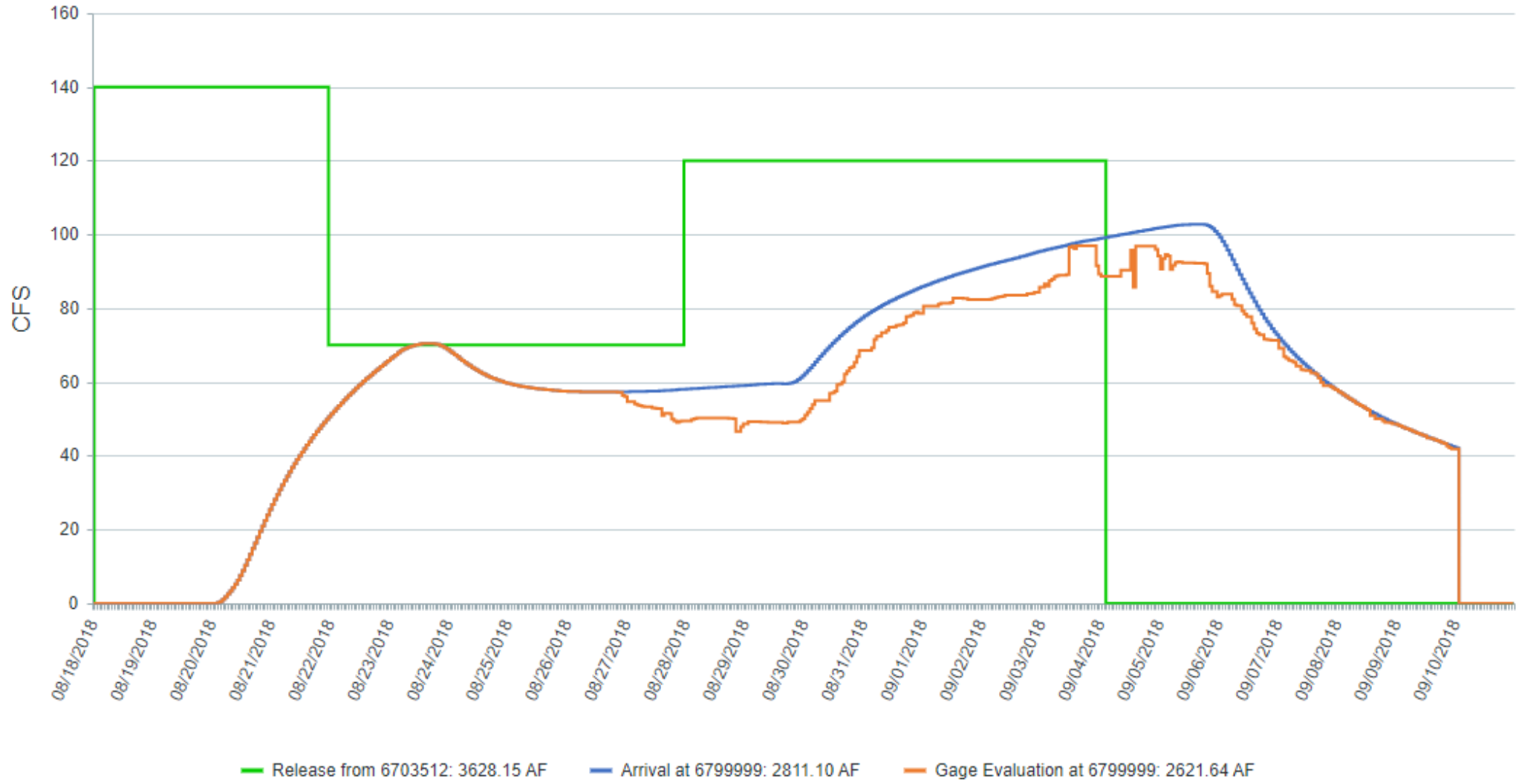
Table | Graph

	Release	Delivery	Headgate	Evaporation	Unconsumed TL	Gage Eval
Totals (AF)	3628.15	2811.1	N/A	94.35	722.7	2621.64

	Delivery TL	Potential TL	Gage Eval TL
Percent	22.52	22.52	27.74

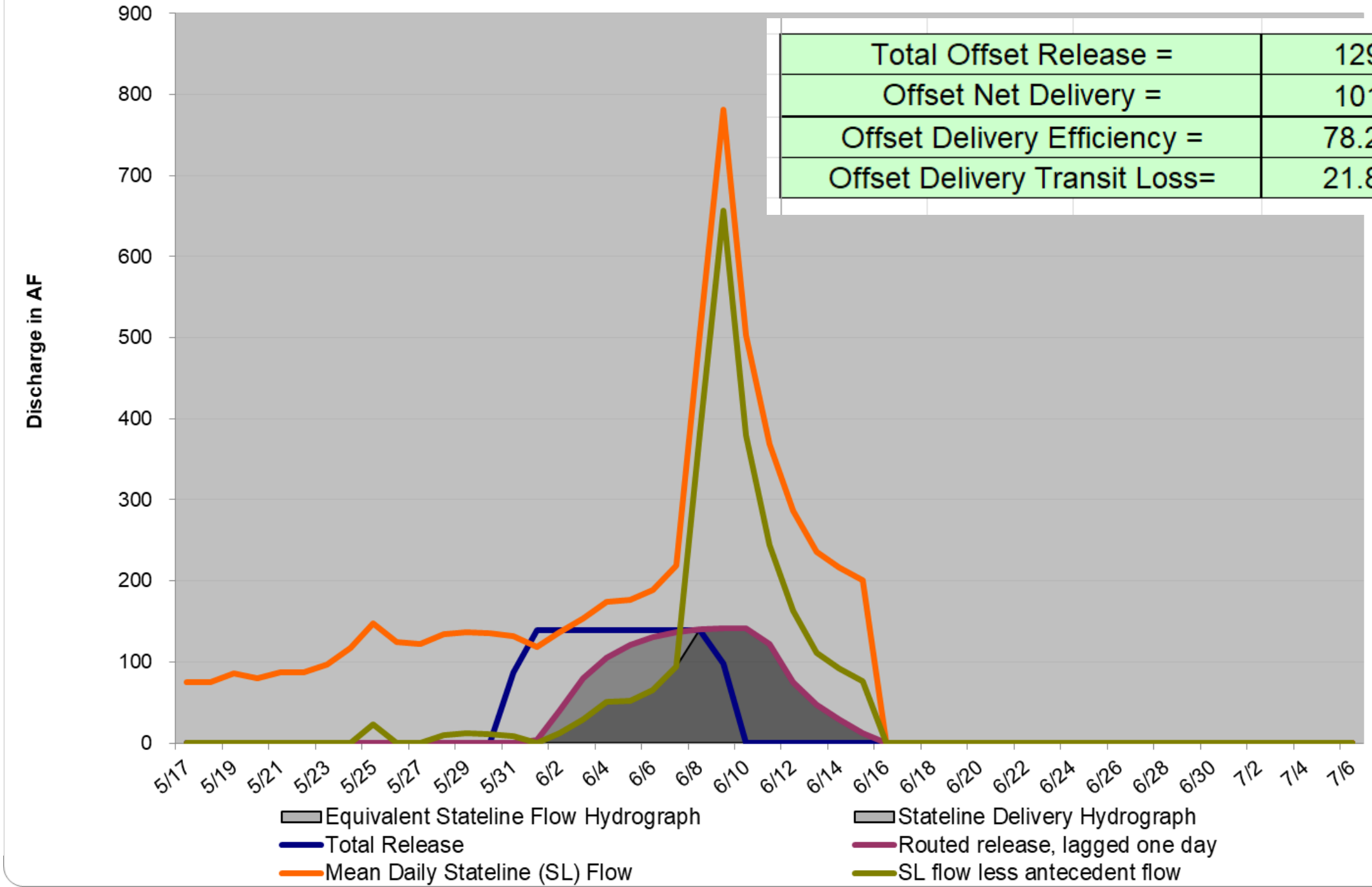
TL Rule: Cutoff 6-days after release end

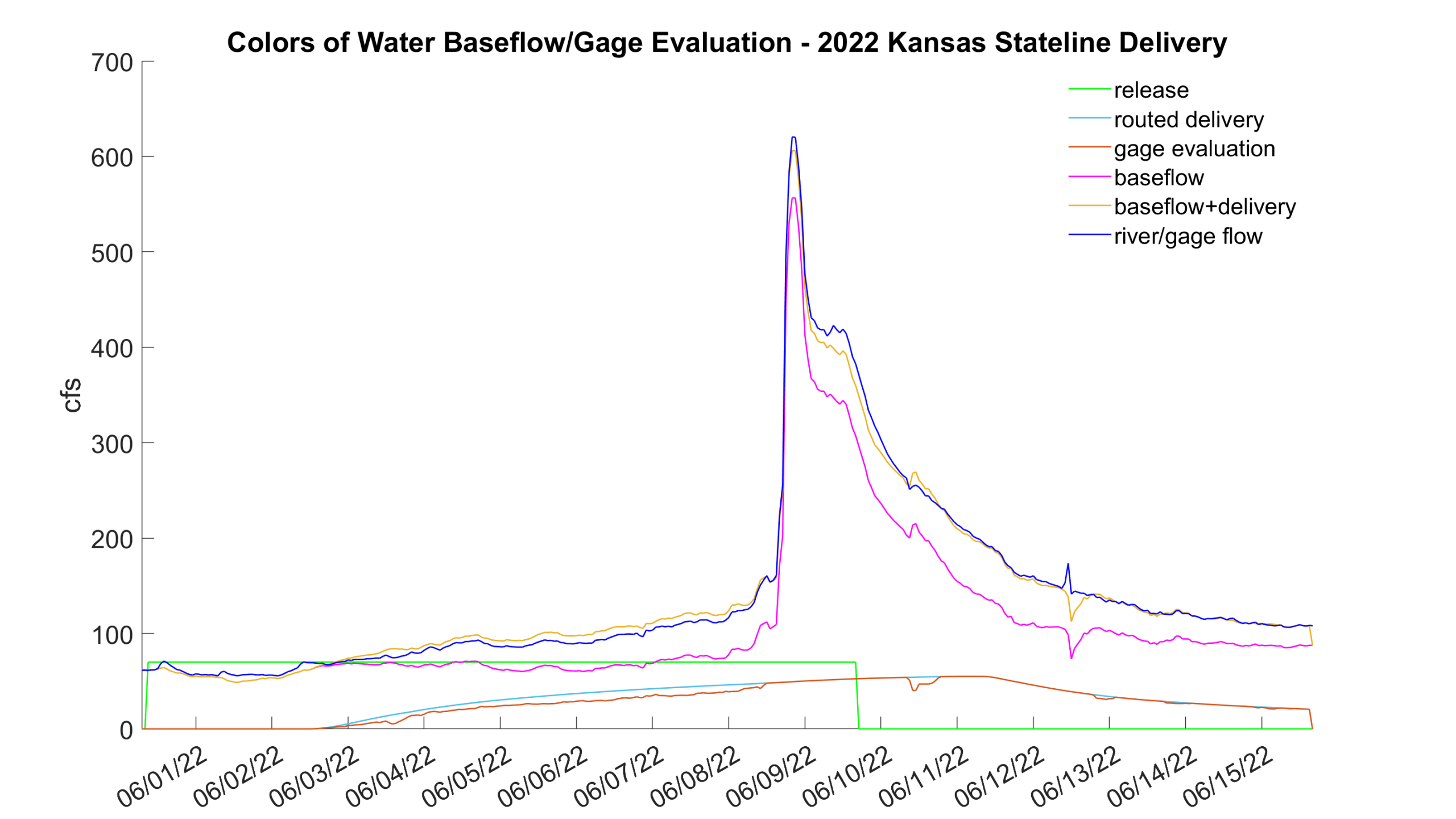
SEND EMAIL | PDF



2022 Kansas Delivery Calculation

Total Offset Release =	1296
Offset Net Delivery =	1014
Offset Delivery Efficiency =	78.2%
Offset Delivery Transit Loss=	21.8%




Colors of Water Baseflow/Gage Evaluation - 2022 Kansas Stateline Delivery
cfs
700
600
500
400
300
200
100
0
release
routed delivery
gage evaluation
baseflow
baseflow+delivery
river/gage flow
06/01/22
06/02/22
06/03/22
06/04/22
06/05/22
06/06/22
06/07/22
06/08/22
06/09/22
06/10/22
06/11/22
06/12/22
06/13/22
06/14/22
06/15/22

COW Scenario Planner –WD67 Stateline Run

Scenario Name: WD67_2022_KS_0531

Setup

Scenario Name:*	WD67_2022_KS_0531	Scenario Type:	Release
Water Source:	Arkansas River	River Flow Basis:	Actual River
Upstream Structure:	JOHN MARTIN RESERVOIR (6703512) at mile ...	Date Basis:	Upstream Release Dates
Downstream Structure:	ARKANSAS RIVER COMPACT(COLORADO-KAN...	Rate Basis:	Upstream Release Blocks
Owner:	KANSAS		
Water Class:	6703512.035 S:2 F: U:Q T:7 G: To:6799999		

Headgate Pattern: NO

Planned Major Delivery Steps

Block	Date	Time	Rate (CFS)	
1	05/31/2022	09:00 AM	70	⊗
2				⊗
3				⊗
4				⊗
5				⊗
End	06/09/2022	08:00 AM		
			Total (AF): 1243.82	

Optional Headgate Pattern and Transit Loss Settings

	Option		Value
☐	Flatten delivery blocks by varying release		
☐	Maximum release (CFS) when flattening		##.##
☐	Maximum headgate step (CFS)		##.##
☐	Minimum headgate step (CFS)		##.##
☐	Limit hours of turnout and changes	Start:	8:00 AM
		End:	5:00 PM
☐	Transit loss percentage, override default	Percent per mile	##.##
☑	Gage / Baseflow Evaluation of past release		
☐	Is past event but is hypothetical (not in gage)		

SAVE | UNDO | RUN

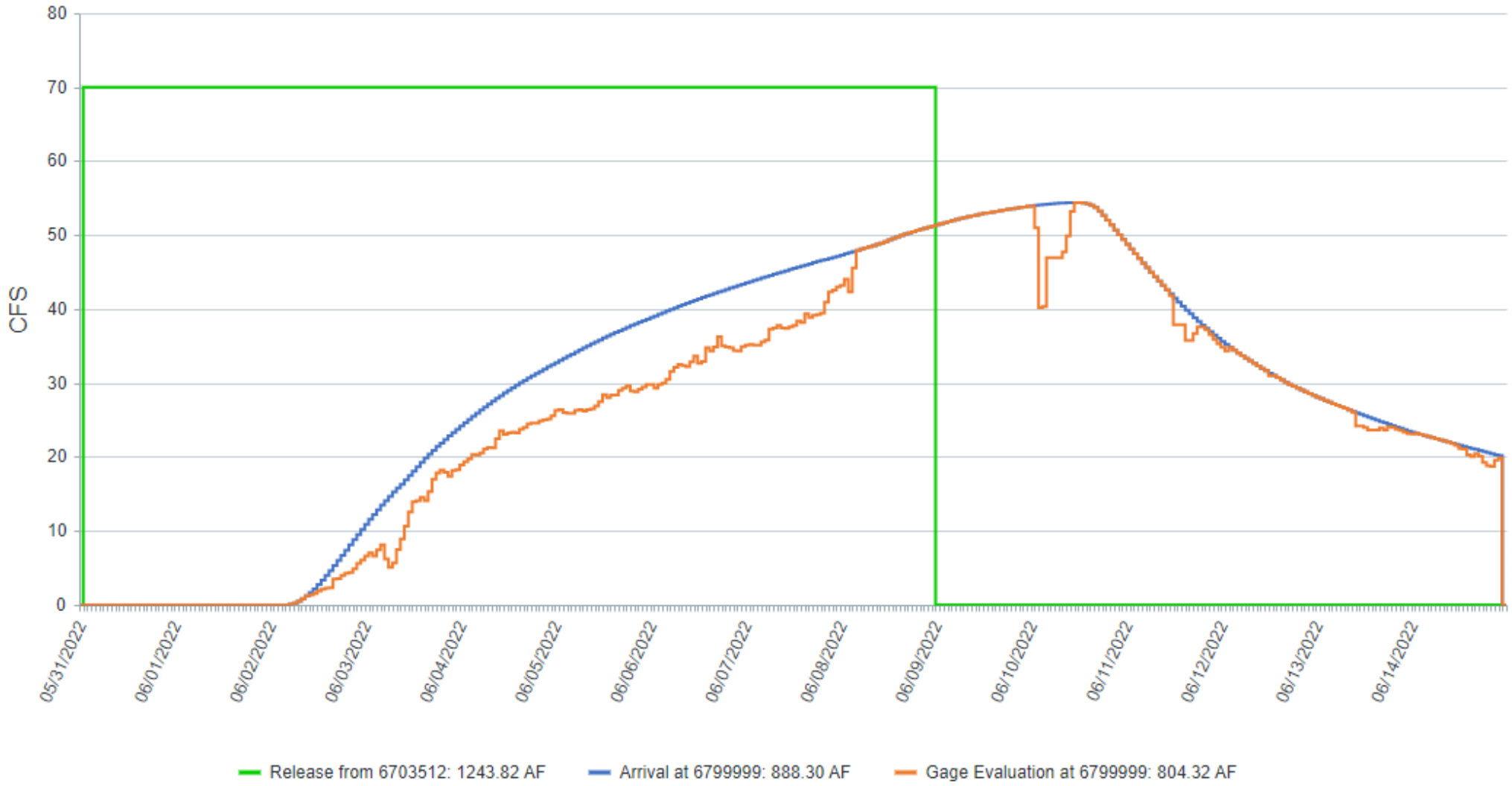
COW Scenario Planner – Graph Output

Scenario Name: WD67_2022_KS_0531

Table | Graph

	Release	Delivery	Headgate	Evaporation	Unconsumed TL	Gage Eval
Totals (AF)	1243.82	888.3	N/A	52.01	303.5	804.32

Percent	Delivery TL	Potential TL	Gage Eval TL
	28.58	30.64	35.33

TL Rule: Cutoff 6-days after release end

SEND EMAIL | PDF