



**COLORADO'S**  
Decision Support Systems  
CWCB / DWR

# Arkansas River Decision Support System (ArkDSS) Update

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Colors of Water PM: John Rogers, P.E., DWR  
Critical Staff: DWR Division 2 Staff, OIT App Dev

ARCA Annual Meeting / Engineering Committee – December 7, 2022



# ArkDSS Progress

- Phase I:
  - GIS ✓
  - Admin Tools ✓
  - Modeling
    - Evapotranspiration Dataset ✓
    - Surface Water Model **IN PROGRESS**
      - [Wilson Water Group](#)
- Phase II:
  - Colors of Water and Forecasting Tool **IN PROGRESS**
  - Groundwater **PLANNING**

# ArkDSS – Where to find Materials



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- Admin Tools: [div2waterops.com](http://div2waterops.com)
  - Colors of Water Training Video:  
[drive.google.com/file/d/17SEJWtmoA2x5GgjQEKqpamjHuZA0siBH/view](https://drive.google.com/file/d/17SEJWtmoA2x5GgjQEKqpamjHuZA0siBH/view)
- GIS and Aerial Photos: [cdss.colorado.gov/gis-data/division-2-arkansas](http://cdss.colorado.gov/gis-data/division-2-arkansas)
- Modeling Documentation/Memos and ET dataset:  
[cdss.colorado.gov/arkansas-river-dss](http://cdss.colorado.gov/arkansas-river-dss)

# ArkDSS Surface Water Model



- Developing using standard Colorado DSS approach
- StateMOD platform; publicly available (i.e. for free) on CDSS website
  - StateMOD models have been developed for all other major Colorado basins
  - Allocates water based on water rights (prior appropriation), agricultural and M&I demands, capacities, and operations
  - Uses crop irrigation requirements (CIR) to determine depletions and return flows
  - Estimates natural flows (baseflow) by removing effects of man
- Data collection and processing complete
- Most code development completed, some refinements ongoing
- Currently in 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

# New Model Operations



- Winter Water Storage Program
  - Track WWSP supplies stored in numerous reservoirs, releases by a variety of users, and carry-over supplies
- Fryingpan-Arkansas Project Operations
  - New Features to allocate/track use in three reservoirs plus allow upper reservoir releases for VFMP or for draw-down to meet intermediate demand and captures in Pueblo Reservoir
- John Martin Reservoir Storage
  - Baseflow portion of gaged flow at Las Animas and all of Purgatoire River stored in Conservation Storage account
  - Enhanced Baseflow portion of Las Animas gaged flow stored in Other account
- Trinidad Project Operations
  - Store over the winter and distribute stored water to accounts
  - During summer, check Project Account storage to determine if Project Administration or “Empty”
    - **Project Administration**- Account for water available under all Project Ditch water rights, Meet Hoehne Ditch demand, limited to 5,028 af, Divide up remaining water to each Project Ditch based on acreage and divert water to meet irrigation demand
    - **Project “Empty”**- Divert water under each Project Ditch’s water rights to meet their own demand
  - Release water from Project Accounts to meet remaining demand
  - Book any remaining water from Project Ditch’s Accounts back to the Project Account on Oct. 15th



# ArkDSS Surface Water Model Expected Timeline Before 2023 ARCA Mtg

- Next 6-9 months
  - Wrap up code refinements
  - Wrap up calibration of historical model
  - Develop Baseline Dataset
- In 9-12 months
  - Begin work on Trinidad Project Scenario
  - Coordinate and receive input on initial Scenario Modeling Methodologies developed by Consultant

# ArkDSS - Phase II Colors of Water



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## **GOALS:**

### **1. Transparency to water users and public – Viewer**

- Show colors of all water in river in front of nodes (ie headgates etc)

### **2. Tools to aid river administration – Scenario Planner**

- Potential reservoir releases - Evaluate transit loss and design release or diversions patterns
- Exchanges – Evaluate exchange conditions through exchange reaches

### **3. Enterprise solution**

- Sustainable system for Division 2 and usable in other Colorado basins

# ArkDSS - Phase II Colors of Water



## 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 - Phase II Colors of Water



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- **ArkDSS + Bureau of Reclamation SmartWater Grant**
  - Initiated 2022, expected completion by end of 2023
  - Brown & Caldwell
    - assisting with calibration, forecasting, evaluation, documentation
  - DWR – development of model engine code
    - Initial code for viewer output complete
    - Reservoir release scenario planning code under development
  - Colorado OIT App Dev – development of web tools
    - Initial Web Viewer Built and under testing/evaluation

# Colors of Water – Viewer



Colors of Water Viewer Export Help

**Display** Hide

Upstream-Downstream

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**Structures**

Location  
Division 2: Arkansas

Water Source  
Arkansas River [00078956]

Upstream  
BESSEMER DITCH (1400533) mile 214.63

Downstream  
ARKANSAS RIVER NEAR COOLIDGE, KS (6709510) mile 0

76 of 76 Structures Selected

Structure	Water Source	Stream Mile
<input checked="" type="checkbox"/>	BESSEMER DITCH	Arkansas River [00078956] 214.63
<input checked="" type="checkbox"/>	PUEBLO RESERVOIR	Arkansas River [00078956] 214.58
<input checked="" type="checkbox"/>	HAMP-BELL DITCH	Arkansas River [00078956] 214.25
<input checked="" type="checkbox"/>	ARKANSAS RIVER ABOVE PUEBLO	Arkansas River [00078956] 214.13
<input checked="" type="checkbox"/>	PUEBLO FISH HATCHERY OUTFLOW	Arkansas River [00078956] 213.48
<input checked="" type="checkbox"/>	COMANCHE PUMP STATION	Arkansas River [00078956] 212.92
<input checked="" type="checkbox"/>	PBWW NORTHSIDE INTAKE	Arkansas River [00078956] 210.21
<input checked="" type="checkbox"/>	RIVERSIDE DAIRY DITCH	Arkansas River [00078956] 209.36

Search

Map **ON** Table **ON**

**BESSEMER DITCH (1400533) Arkansas River at mile 214.63** 8/3/2021

Table Graph

Reset table layout

Structure Name	Stream Mile	Total Flow	Native Flow	Release Total	Exchange Total	Diversion Total
BESSEMER DITCH	214.63	1294.38	1231.71	63.33	22.51	172
PUEBLO RESERVOIR	214.58	733.38	701.38	32	11.25	384.78
HAMP-BELL DITCH	214.25	1122	1059.33	63.33	22.59	0.38
ARKANSAS RIVER ABOVE PUEBLO	214.13	1122	1059.33	63.33	22.52	0
PUEBLO FISH HATCHERY OUTFLOW	213.48	1166.65	1104.22	63.16	22.97	0
COMANCHE PUMP STATION	212.92	1191.15	1128.94	63.14	23.29	17.57
PBWW NORTHSIDE INTAKE	210.21	1244.25	1184.06	62.39	24.91	1.62

1 - 76 of 76 items

**Releases**

1403526.217 S:2 F: U:Q T:7 G: To:1700557 Released 8/3/2021	10
1403526.241 S:2 F: U:Q T:7 G: To:1700542 Released 8/3/2021	22
1403526.241 S:2 F: U:Q T:7 G: To:1700542 Released 8/3/2021	22

**Exchanges**

1403526.006 S:2 F:1703525.154 U:0 T:1 G: To: Released 8/3/2021	5.09
1403526.237 S:8 F:1400662 U:0 T:1 G: To: Released 8/3/2021	0.96
FORMALLY ACCOUNT 231	0.15
1403526.176 S:1 F:1700800 U:0 T:1	1.05

**Diversions**

1400533 S:1 F: U:1 T: G: To: Released 8/3/2021	140.37
1400533 S:1 F:1100936 U:2 T:4 G: To:1400648 Released 8/3/2021	2.6
1400533 S:2 F:1403526.030 U:1 T: G: To: Released 8/3/2021	25.99

# Colors of Water – Spatial View



Colors of Water Viewer
Export Help

**Display** Hide

Upstream-Downstream

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**Structures**

Location  
Division 2: Arkansas

Water Source  
Arkansas River [00078956]

Upstream  
BESSEMER DITCH (1400533) mile 214.63

Downstream  
ARKANSAS RIVER NEAR COOLIDGE, KS (6709510) mile 0

76 of 76 Structures Selected

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<input checked="" type="checkbox"/> BESSEMER DITCH	Arkansas River [00078956]	214.63
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<input checked="" type="checkbox"/> RIVERSIDE DAIRY DITCH	Arkansas River [00078956]	209.36

Search

Map  Table

+

Home

-

Leaflet | © OpenStreetMap contributors

**ROCKY FORD D-WASTEWAY (1700668) Arkansas River at mile 141.97**

7/15/2020

Y Min: 0.00 Y Max: 2,500.00 Log Scale: OFF Legend: OFF

Table

Graph

**Upstream**

Total in River	167.13
Native Flow	113.29
+ Release Total	54.07
+ Exchange Total	0.48

**Diversions**

1700668 S:1 F:1700558 U:C T:7 G:1700807 To:1720001	29.4
--	------

**Downstream**

Total in River	196.54
Native Flow	142.71
+ Release Total	53.83
+ Exchange Total	0.48

# Colors of Water – Time Series View



**Display** Hide

Time Series ▼

Last 2 Weeks ▼

From: 7/26/2021 📅 To: 8/9/2021 📅

**Structures**

Location ▼

Division 2: Arkansas ▼

Water Source ▼

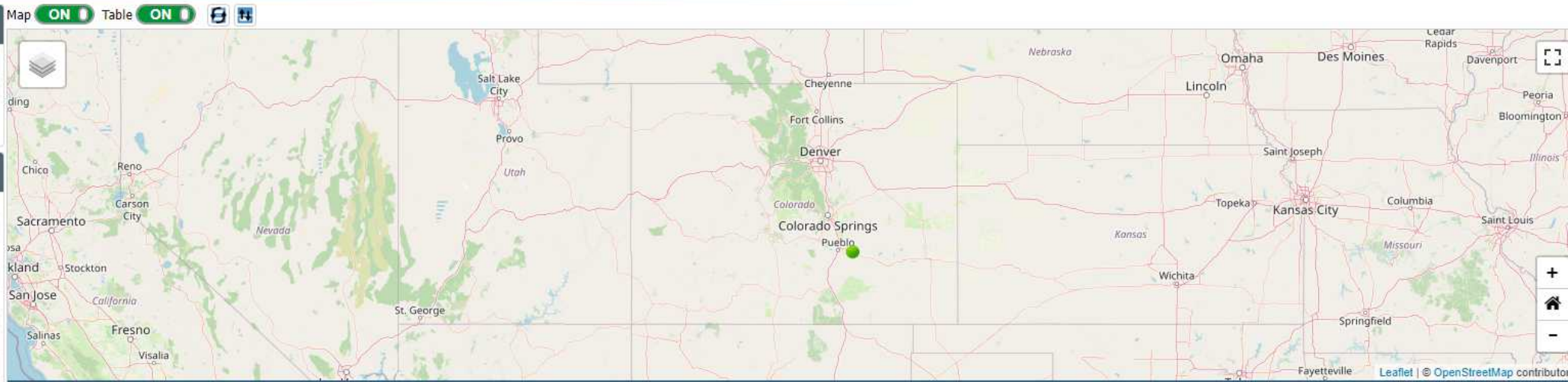
Arkansas River [00078956] ▼

Upstream ▼

BESSEMER DITCH (1400533) mile 214.63 ▼

Downstream ▼

ARKANSAS RIVER NEAR COOLIDGE, KS (6709510) mile 0 ▼



1 of 76 Structures Selected

Structure	Water Source	Stream Mile
<input type="checkbox"/> EXCELSIOR DITCH	[00078956]	177.57
<input type="checkbox"/> EXCELSIOR AUG STATION	Arkansas River [00078956]	194.31
<input type="checkbox"/> AVONDALE AUG STATION	Arkansas River [00078956]	190.59
<input type="checkbox"/> ARKANSAS RIVER NEAR AVONDALE	Arkansas River [00078956]	190.27
<input type="checkbox"/> COLLIER DITCH	Arkansas River [00078956]	186.91
<input checked="" type="checkbox"/> COLORADO CANAL	Arkansas River [00078956]	184.12
<input type="checkbox"/> ROCKY FORD HIGHLINE	Arkansas River [00078956]	178.78
<input type="checkbox"/> OXFORD CANAL	Arkansas River [00078956]	171.95



**Upstream**

—	Total in River	1637.95
—	Native Flow	1279.85
+	Release Total	358.11
+	Exchange Total	0.63

**Diversions**

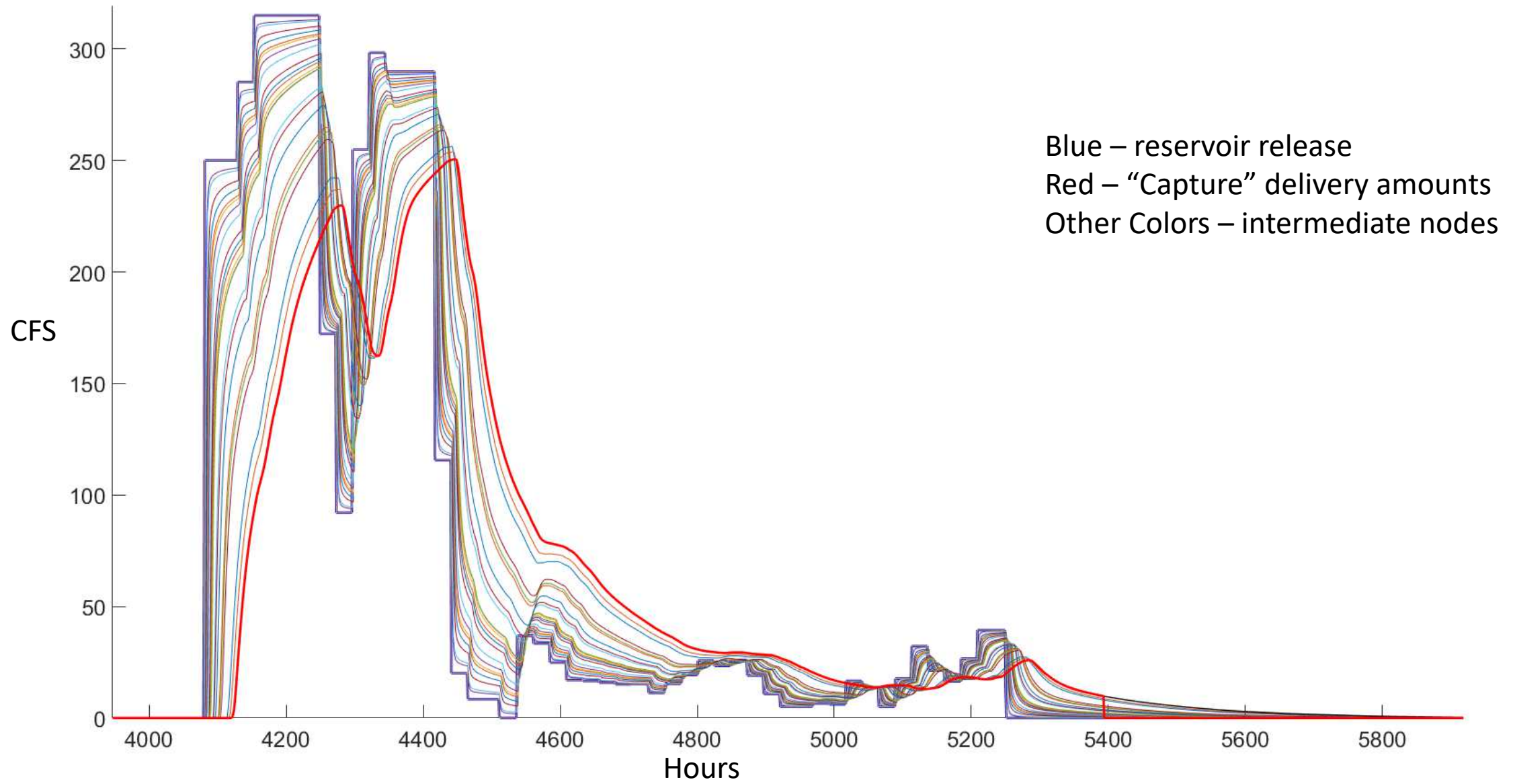
1700540 S:2 F:1403526.075 U:1 T: G: To:	7.88
1700540 S:2 F:1403526.078 U:1 T: G: To:	17.6
1700540 S:2 F:1703525.042 U:1 T:1 G: To:	115.8

**Downstream**

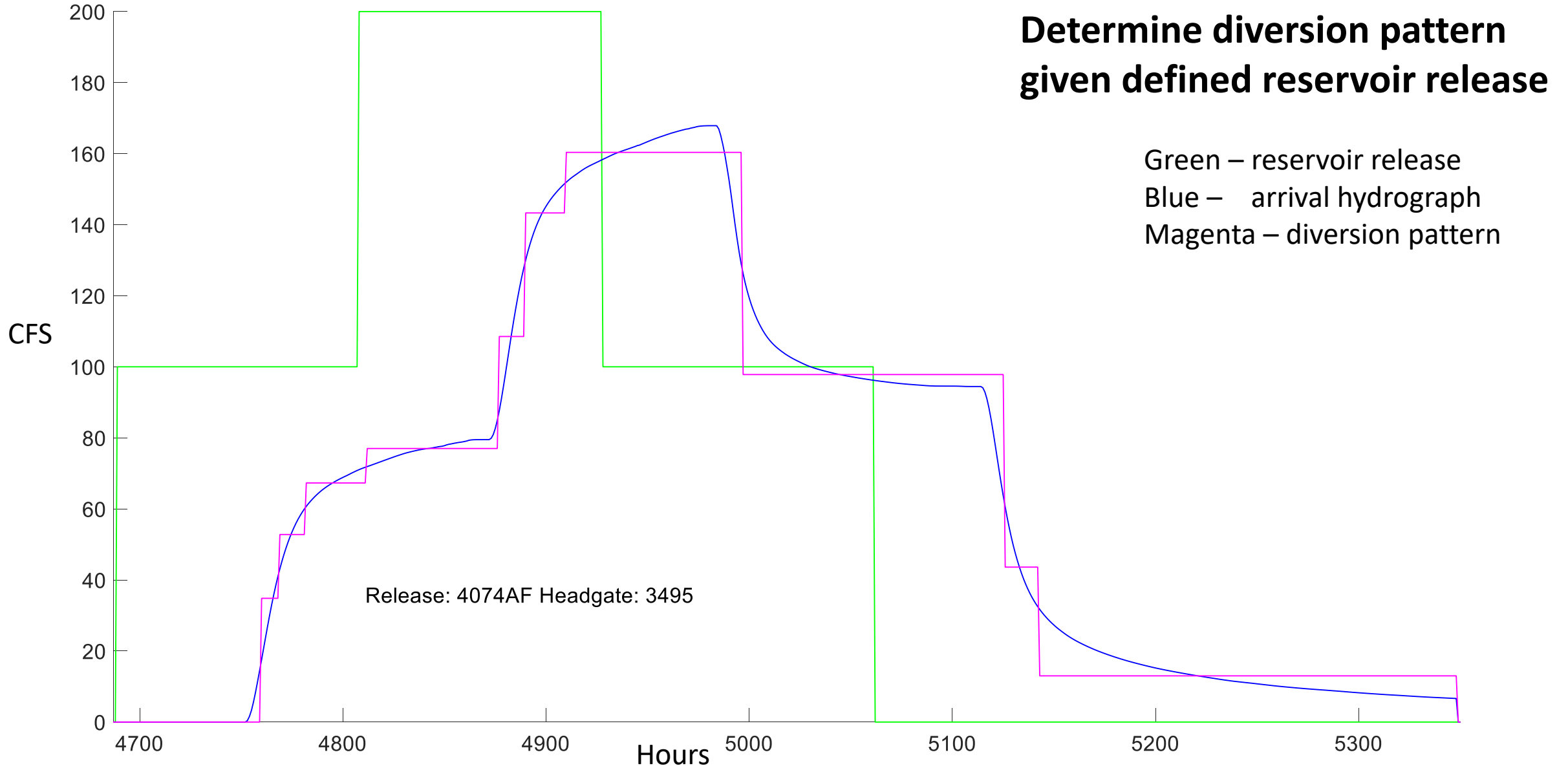
—	Total in River	1497
—	Native Flow	1163.37
+	Release Total	333.63
+	Exchange Total	116.43

# Colors of Water – Transit Losses

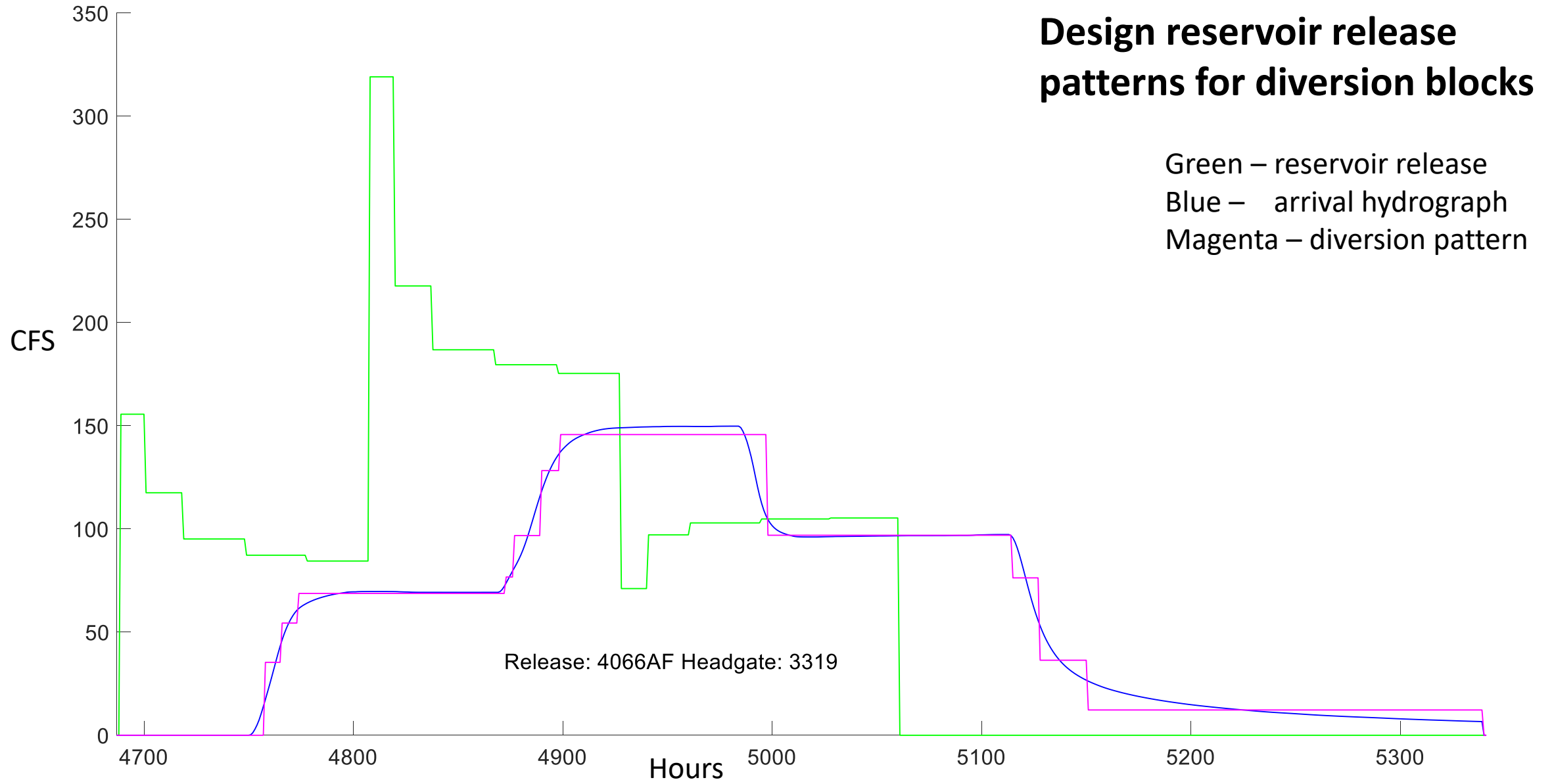
W149313 6703512.035 S:2 F: U:Q T:7 G: To:6799999



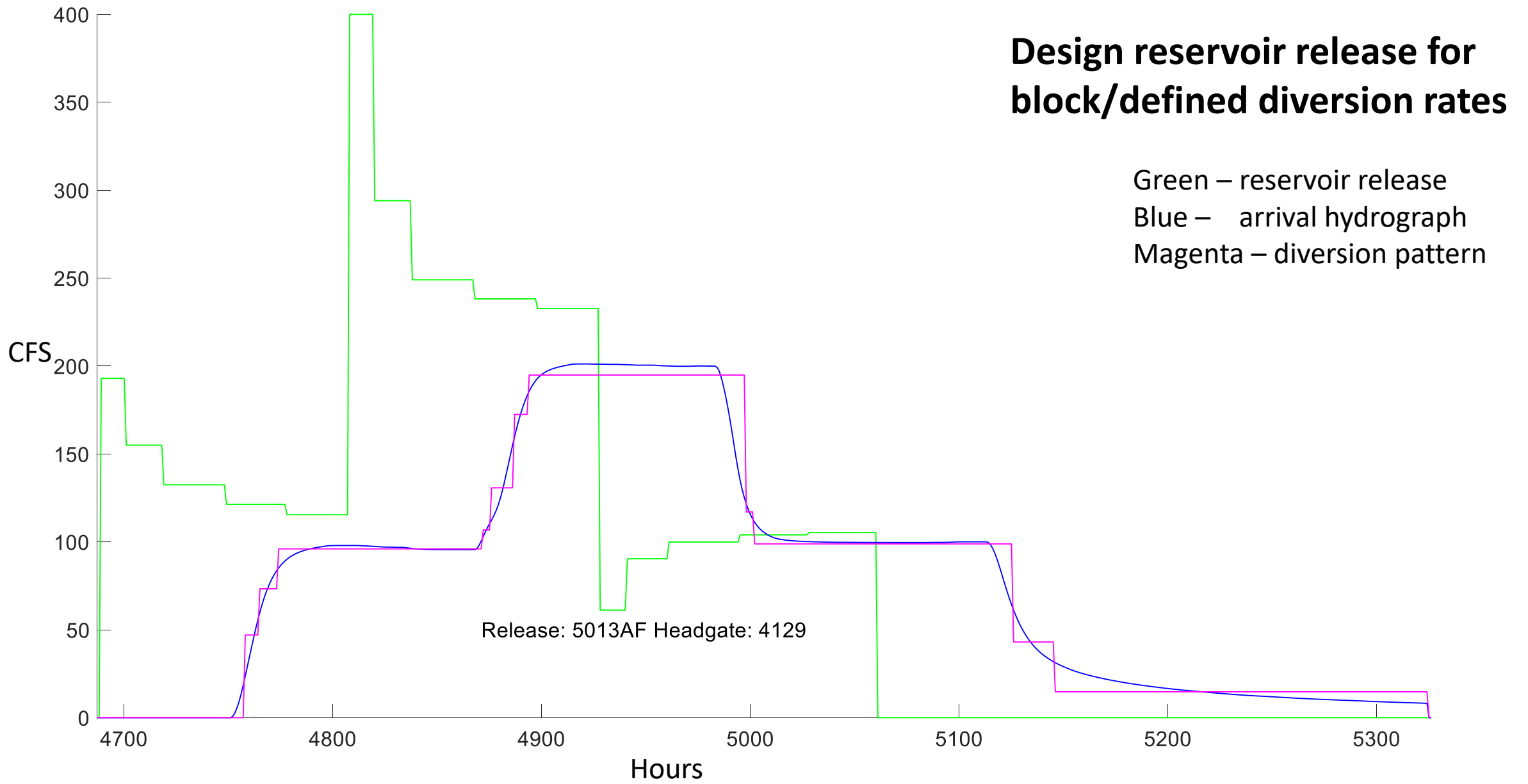
# Colors of Water – Scenario Planner



# Colors of Water – Scenario Planner



# Colors of Water – Scenario Planner





# ArkDSS –Groundwater Component



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- **Additional funding available July 2023**
- **Scope / RFP 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.