Tailrace egress and hydraulic conditions during tests of a top spillway weir (TSW) at John Day Dam.

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Objective

Map large-scale hydraulic trends in the tailrace of John Day Dam

- **Describe:**
  - ✓ Movement patterns and egress times of drift buoys (drogues)
  - ✓ Influence of TSWs on tailrace conditions
  - ✓ Influence of test spill conditions
    - 30% and 40% spill

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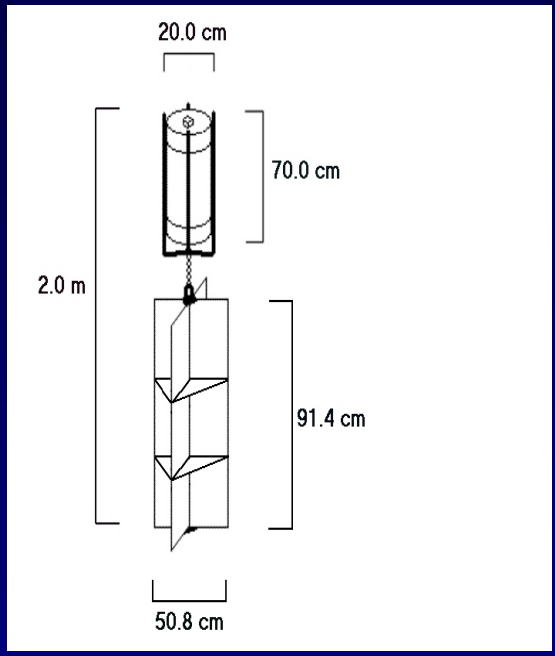
Drogue Methods



- **Design**
  - ✓ Drifters that follow bulk flow
  - ✓ Limited surface exposure
  - ✓ 2 m overall length
- **Materials**
  - ✓ PVC float with a GPS unit
    - Configured to collect position every second
    - Collect spatial information as they drift
  - ✓ Aluminum drag element
- **History**
  - ✓ Used at JDA
  - ✓ Paths and travel times correlate well with fish data

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Drogue Methods

- Release Sites:
  - ✓ TSW bays 15 and 16
  - ✓ Unmodified bays: 2, 8, 14, 17
    - Bays 14 and 17 adjacent to TSWs
  - ✓ JBS outfall
  - ✓ Turbine units 5 & 16
- Sites selected to represent whole tailrace
- Drogues retrieved at BRZ line (0.8 km)
  - ✓ Subset retrieved at dredge island (1.5 km)

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Study Design

- Monitor both spring and summer periods
- Capture variety of flow conditions
  - ✓ Early, Middle, and Late parts of each run
- Release at all sites in a short window
  - ✓ Keep river conditions similar

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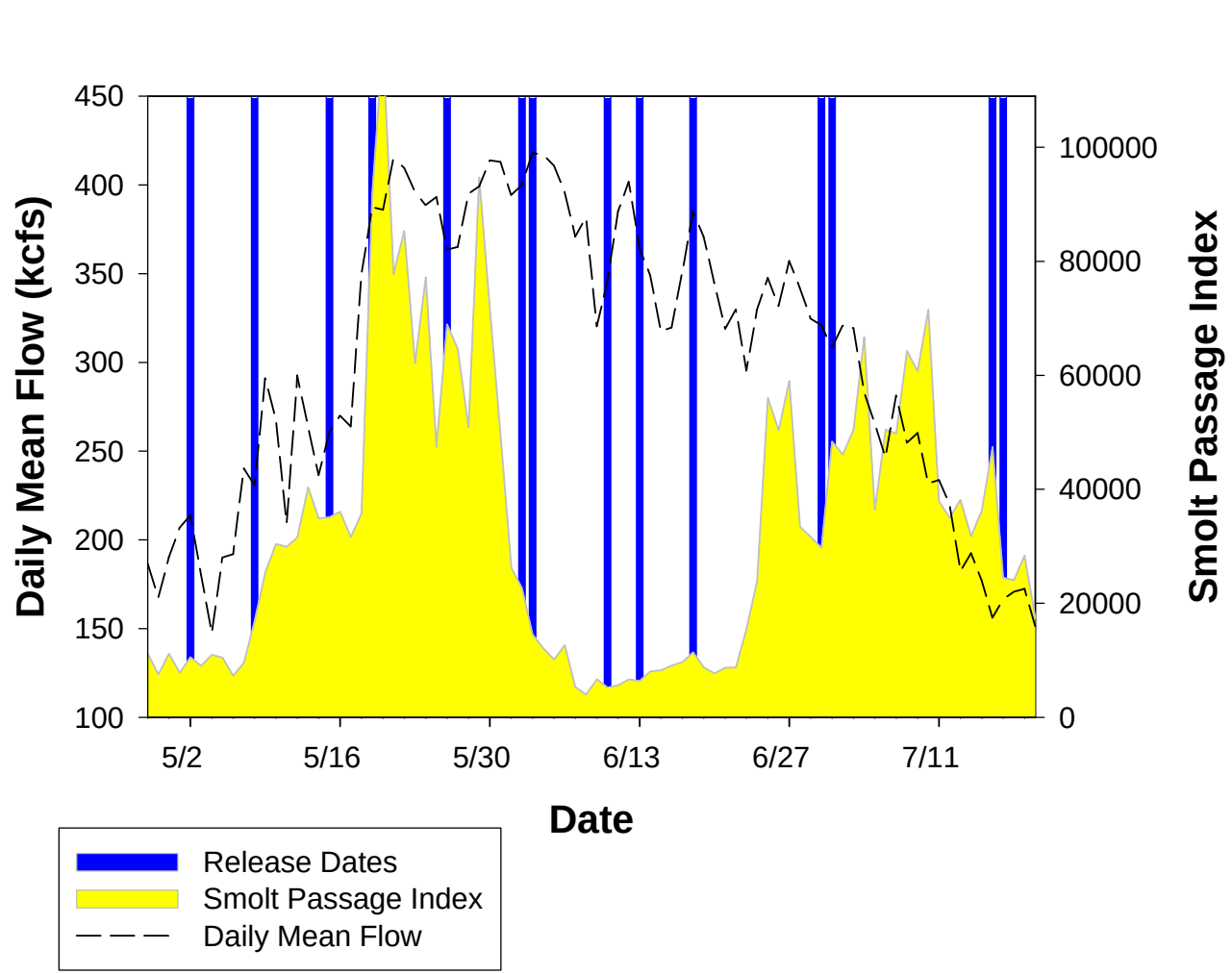
Releases

- 14 release dates (2 May – 17 July)
  - ✓170 drogues



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Project Operations

Season	Dates	Proposed Spill (%)	Actual Spill (%)	Actual Spill (kcfs)	Total Discharge (kcfs)	Tailrace Elevation (ft)
Early	2 May – 15 May	30	30	82	270	162.7
		40	40	99	246	161.0
Middle	19 May – 1 July	30	**30**	115	370	165.2
		40	**34**	131	397	165.7
Late	16 July- 17 July	30	30	58	191	159.4
		40	40	73	181	160.1

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Results: Outline

- Travel Time
  - ✓ Early Season
  - ✓ Middle Season
  - ✓ Late Season
- Travel Paths
  - ✓ GIS views
- Extended Duration Drifts
  - ✓ Travel times
  - ✓ Travel paths

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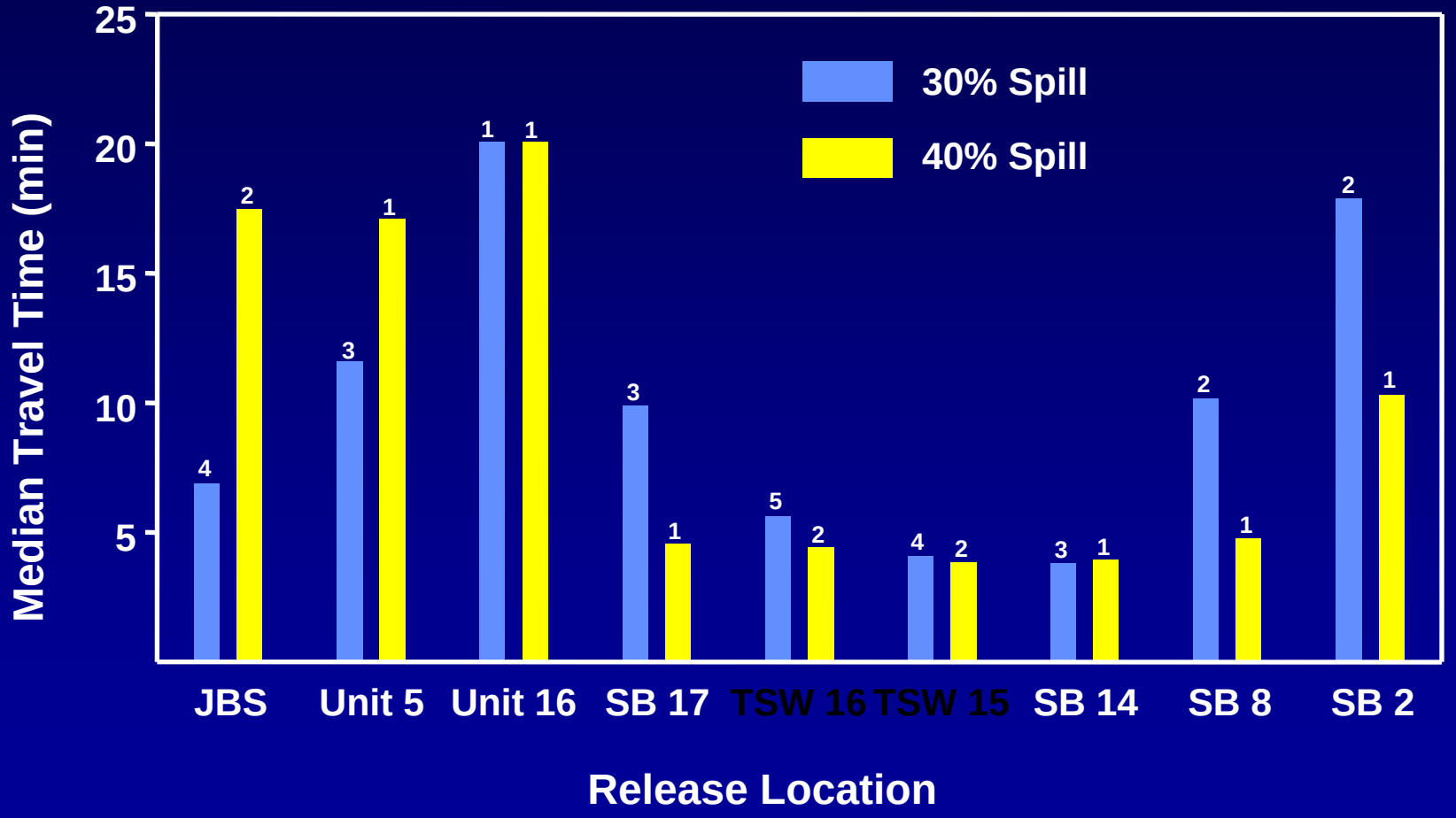
Travel Time: Early Season



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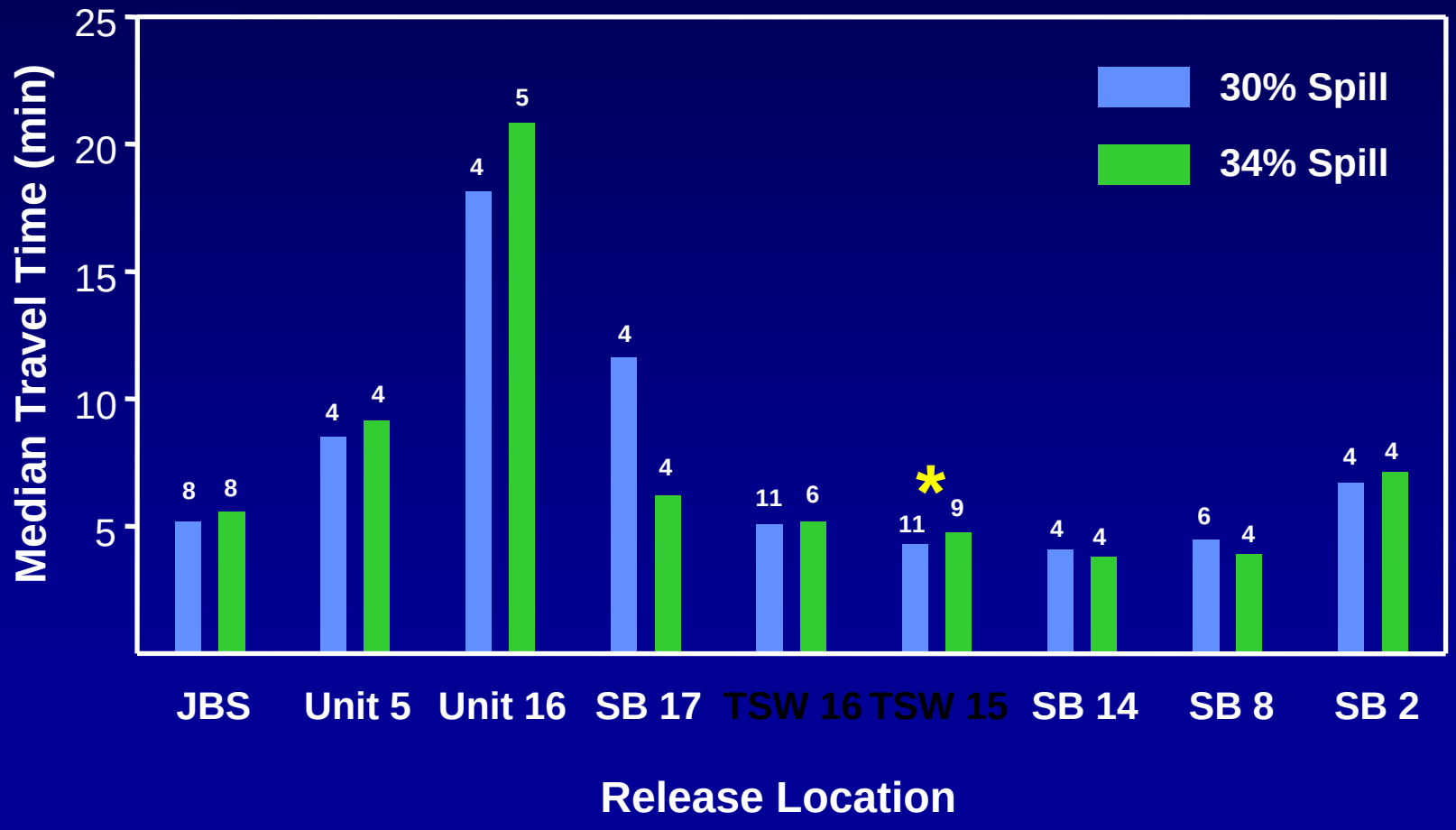
Travel Time: Middle Season



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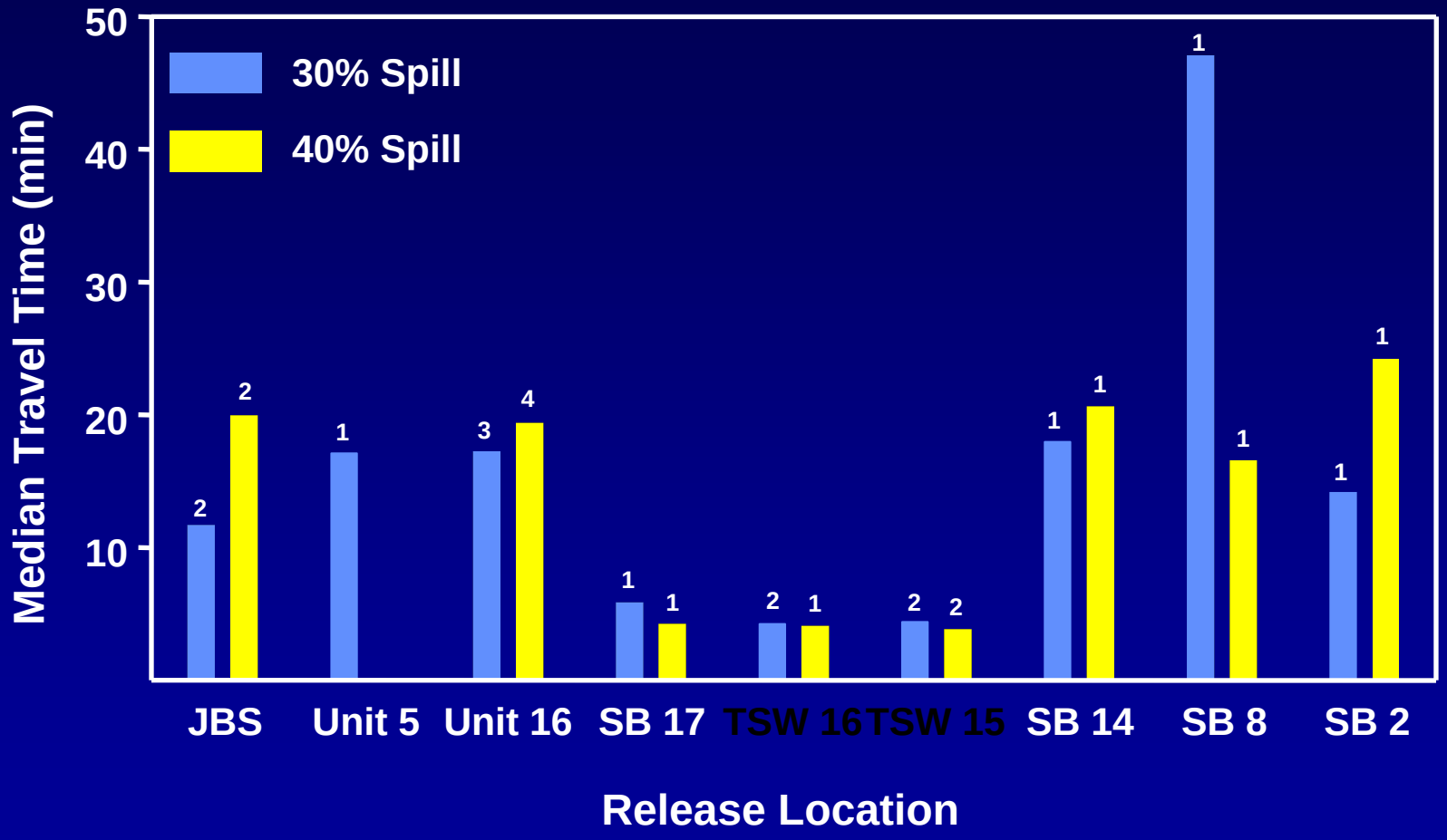
Travel Time: Late Season



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Travel Time Benchmark

- 2000 & 2003 Drogue Studies at JDA

  - ✓ 2000: Spillway releases at bays 2, 10, 18
    - Spring & Summer
    - 30% and 60% spill
    - Overall travel times < 10 min

  - ✓ 2003: JBS releases
    - Spring & Summer
    - 30 – 58 % spill
    - Low spill (30 - 44%) travel times < 10 min
    - High spill (56 - 58%) travel times > 20 min

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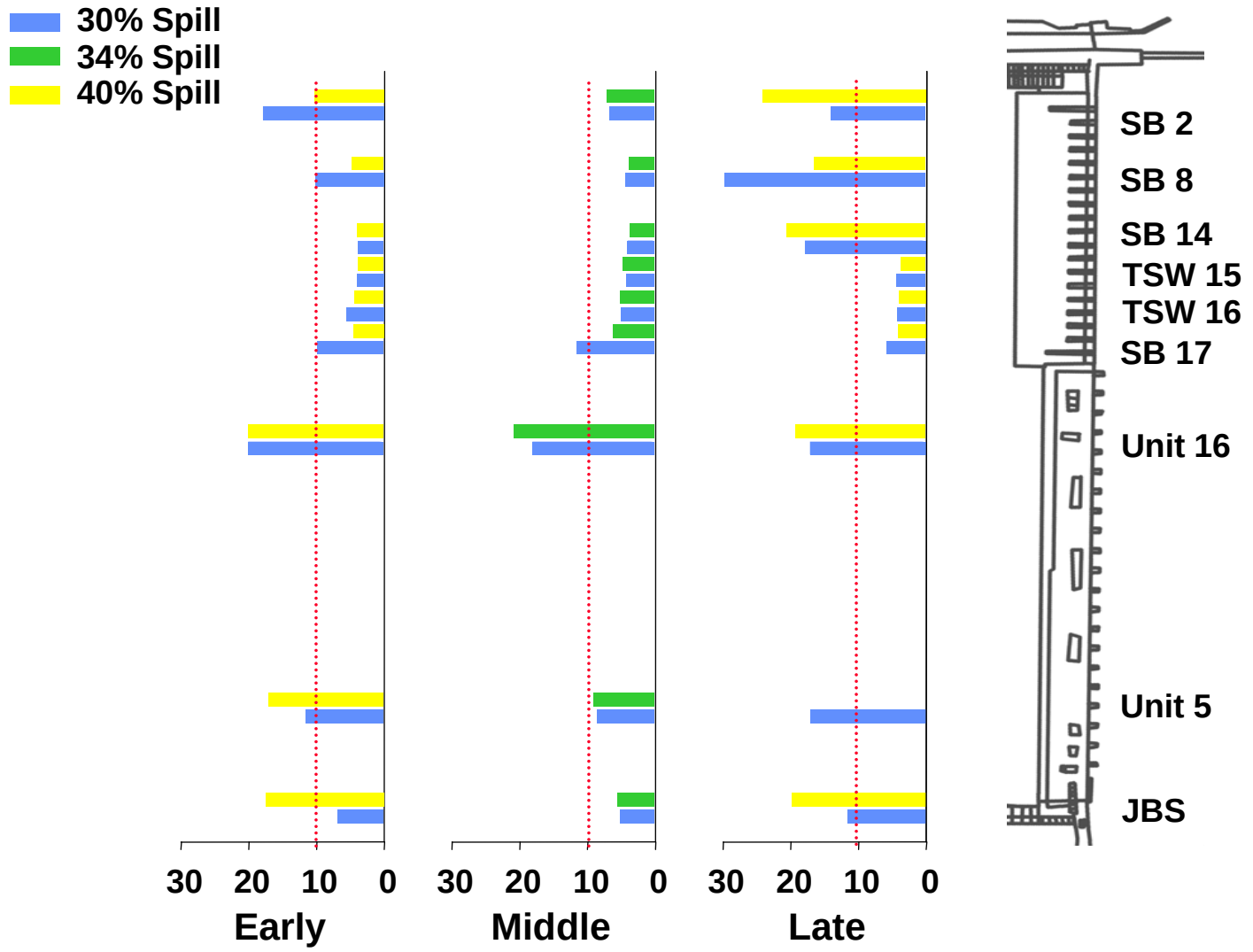
Travel Time: Overall Summary



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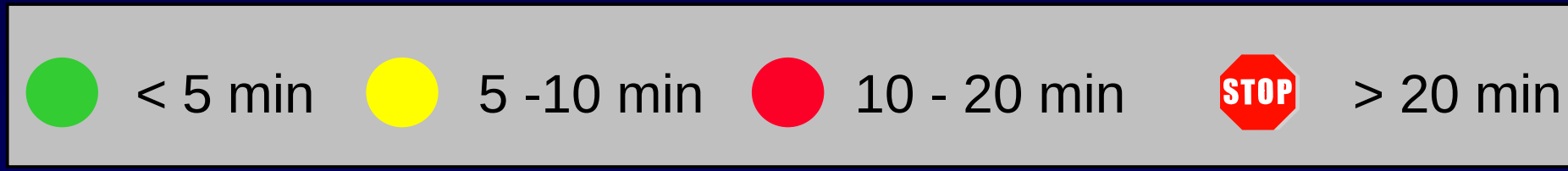
Traffic Report for Egress



Late				STOP	STOP	
Mid						
Early						
	17	16 TSW	15 TSW	14	8	2

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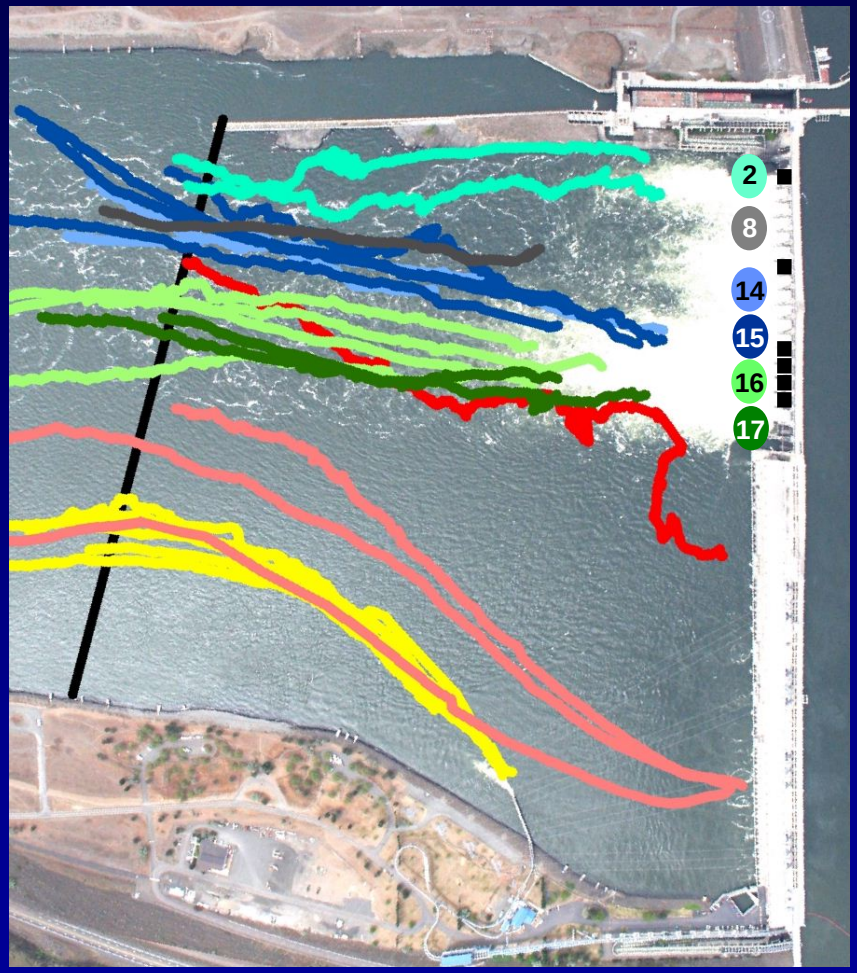
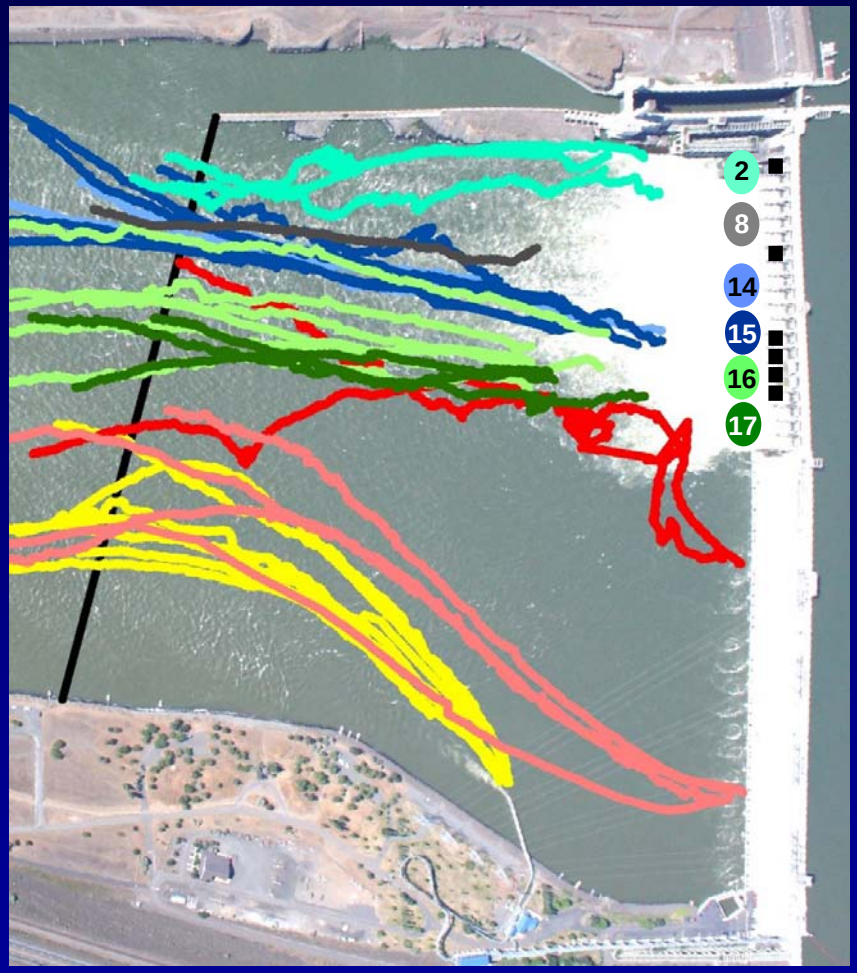
Travel Paths: Early Season



30% Spill



40% Spill

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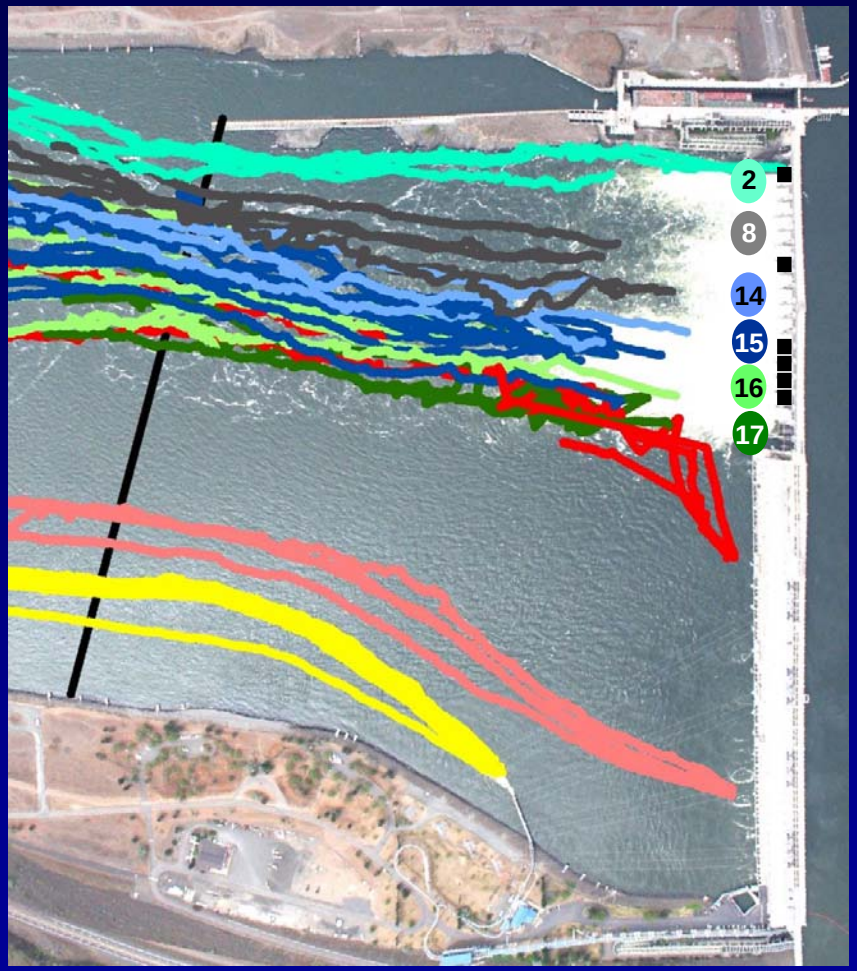
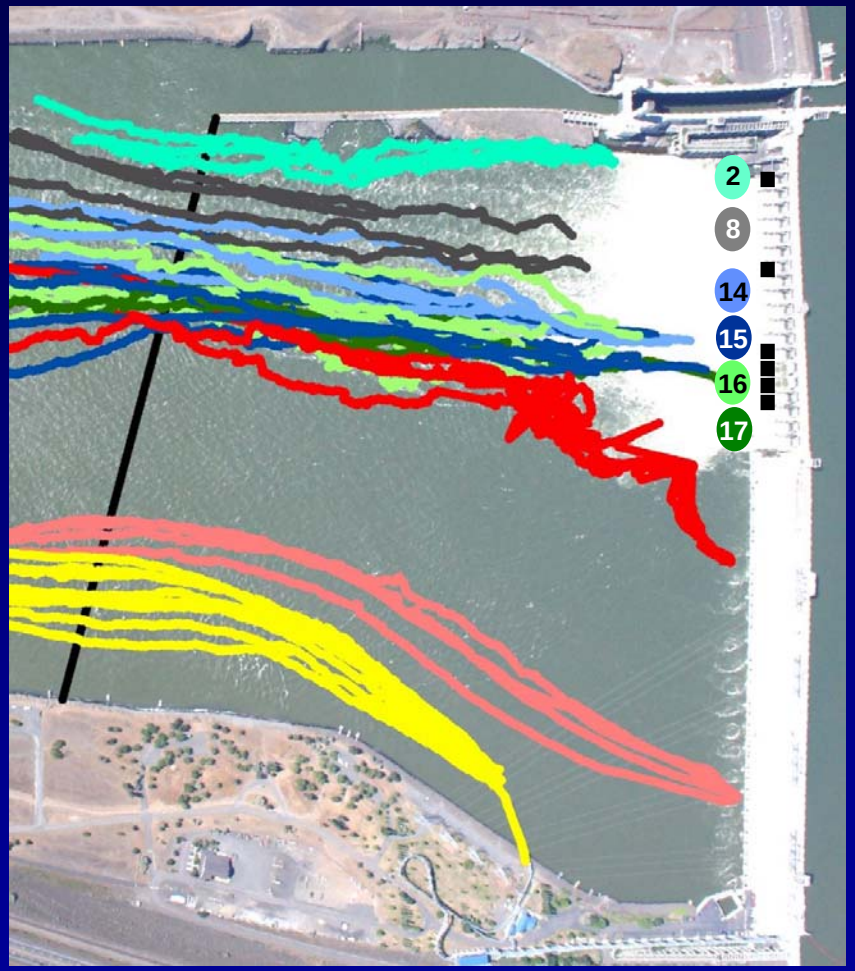
Travel Paths: Middle Season



30% Spill



34% Spill

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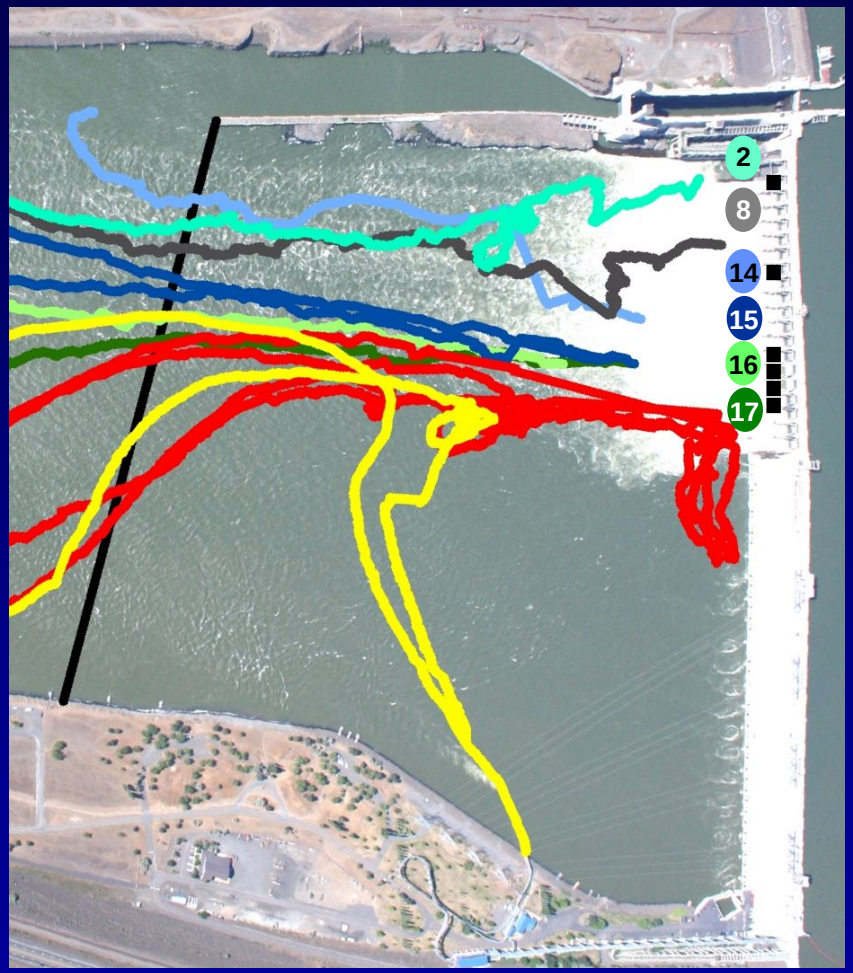
Travel Paths: Late Season

30% Spill



40% Spill

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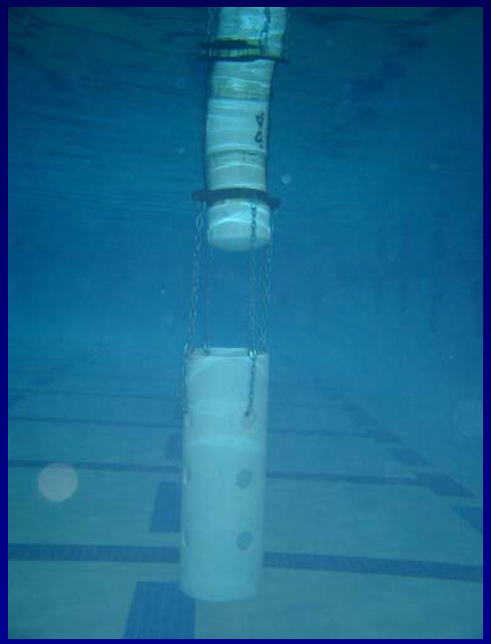
Extended Duration Drifts

- 50 drogues drifted 1.5 km to dredge island
  - ✓ 6 early season
  - ✓ 20 middle season
  - ✓ 24 late season



- Emphasis on TSW bays
- TSW travel times ranged from 9.9 to 16.2 min
  - ✓ No significant differences between spill levels

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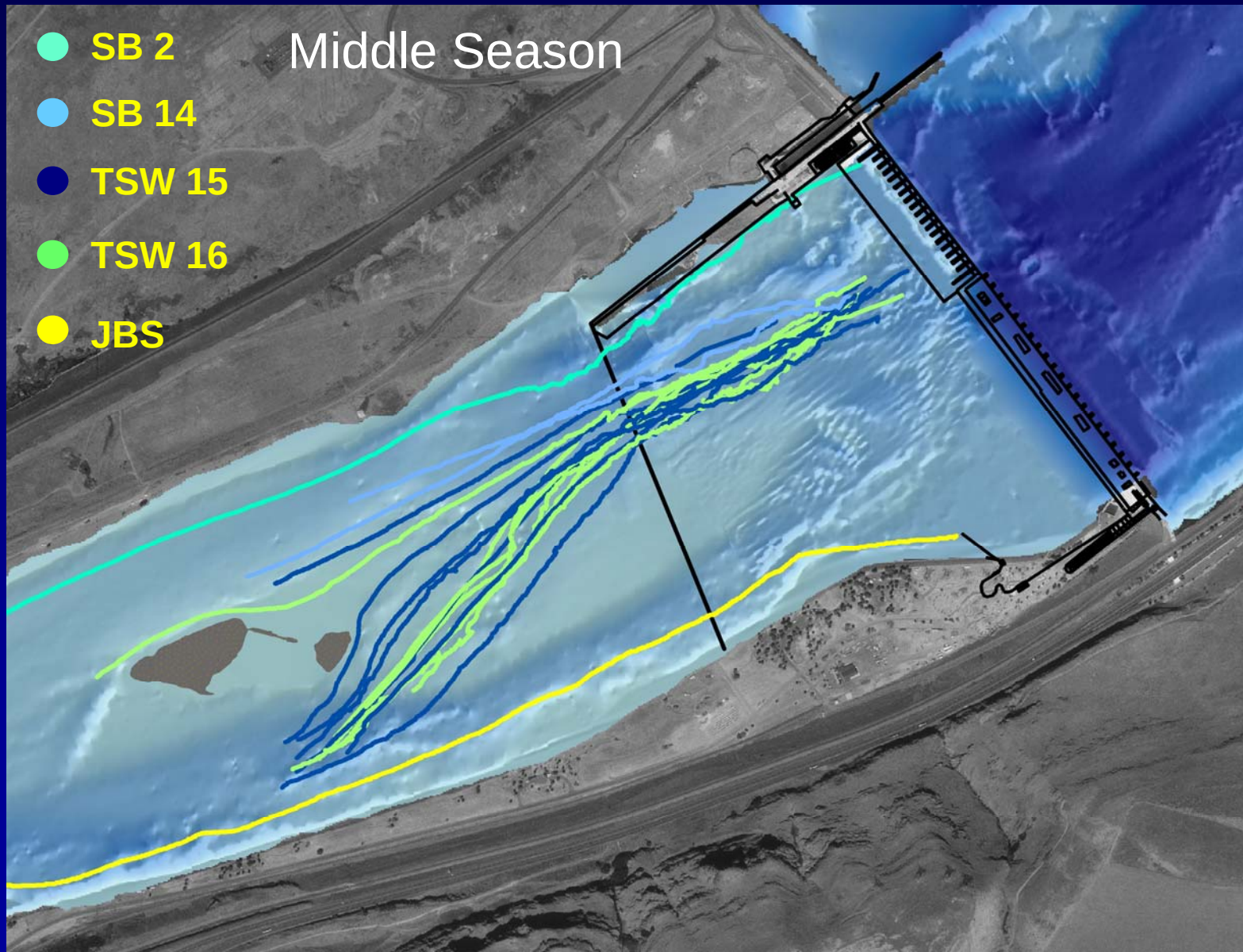
Extended Duration Drifts



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Conclusions

- Limited effect of spill level
  - ✓ JBS early and late season (neither sig at 0.05)
  - ✓ Paths into stilling basin at low flow
- TSW bays had good egress conditions
  - ✓ Times ~ 5 min and direct travel paths
  - ✓ Consistent across spill level and seasons
- Unit 16 extended times and indirect paths

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Conclusions Con't

- Spillway egress better than JBS or PH
  - ✓ JBS times similar to TSW times in middle season (within ~ 1 min)
- TSW 15 vs. TSW 16
  - ✓ No differences in times or routes
- Adjacent Bays (SB 14, SB 17)
  - ✓ Slightly higher travel times than TSW bays
  - ✓ More variable
- Bays 2 and 8
  - ✓ Most variable within the spillway

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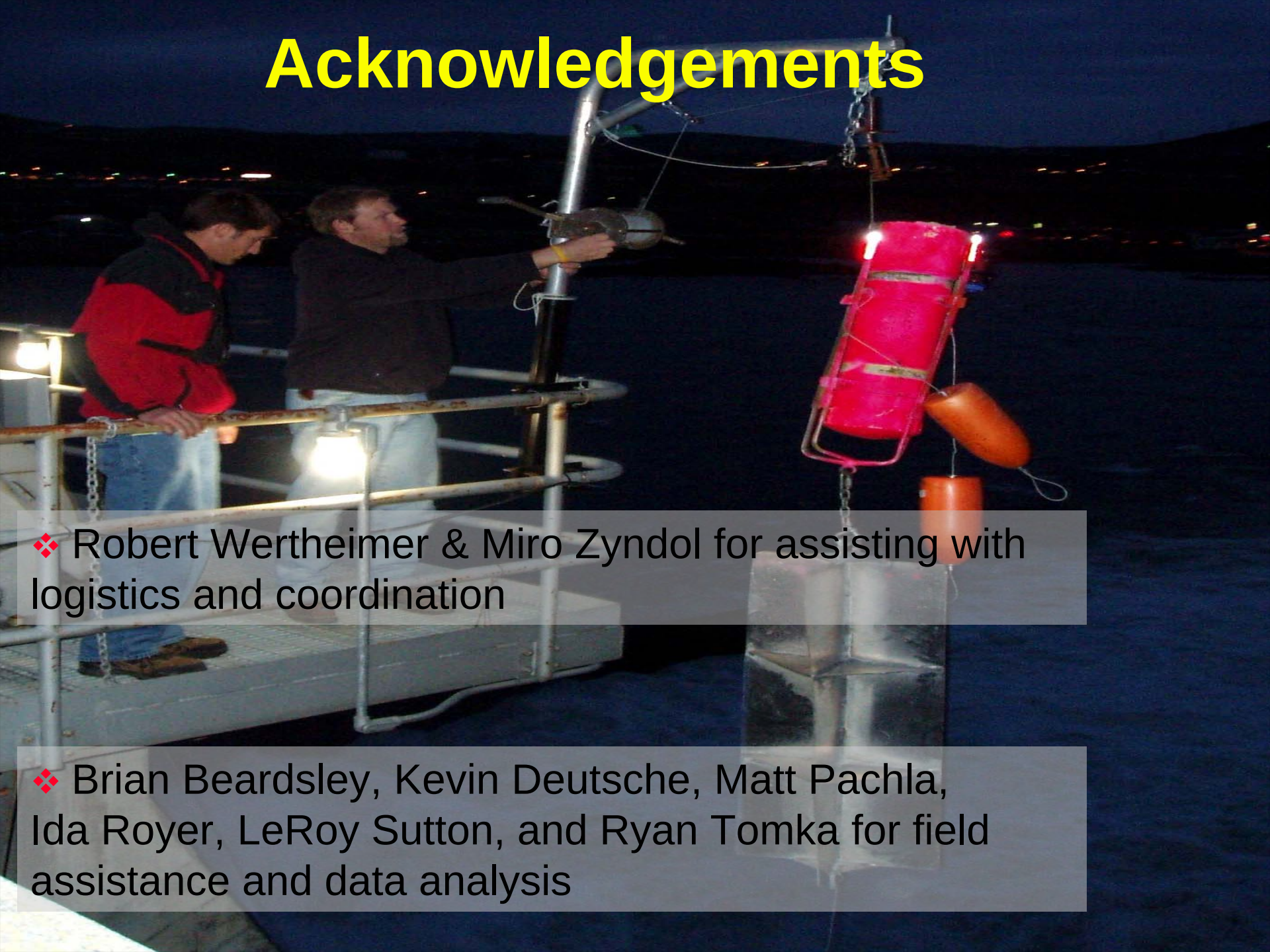
Acknowledgements



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Release Sites

- **TSW Bays 15 and 16**
  - Upriver, center of bay release, 1 m above forebay elevation
  - 57 total releases
- **Unmodified Spill Bays (2, 8, 14, 17)**
  - Downriver, center of bay release, 1 m above ogee
  - 56 total releases
- **Turbine Units 5 and 16**
  - Boat release on boil, downstream direction of travel, ~20 m from dam
  - 31 total releases
- **JBS**
  - Released into cement flume channel, ~85 m from outfall
  - 26 total releases

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Travel Time Summary

	Early	Middle	Late
Discharge (Kcfs)	245 – 285	350 – 410	185
Slowest TT	Unit 16 (20 min) JBS 40% (18 min)	Unit 16 (20 min)	JBS and PH 12 -30 min Slower @ 40%
Fastest TT	SB 14, TSW 15 (4 min)	SB 8, SB 14, TSW 15 (3.8 -4.5 min)	TSW 15, TSW 16 3.8 – 4.4 min Faster @ 40%
Spill Effects	JBS 3x slower (P=0.06) @ 40%	TSW 15 4.3 vs. 4.8 min	None (low N)
TSW Median TT (min)	**4.1**	**4.8**	**4.0***
Unmodified bays Median TT (min)	**7.3**	**4.9**	**17.2***
Adjacent bays Median TT (min)	**4.5**	**4.5**	**11.9***

SB 8 47 min travel time

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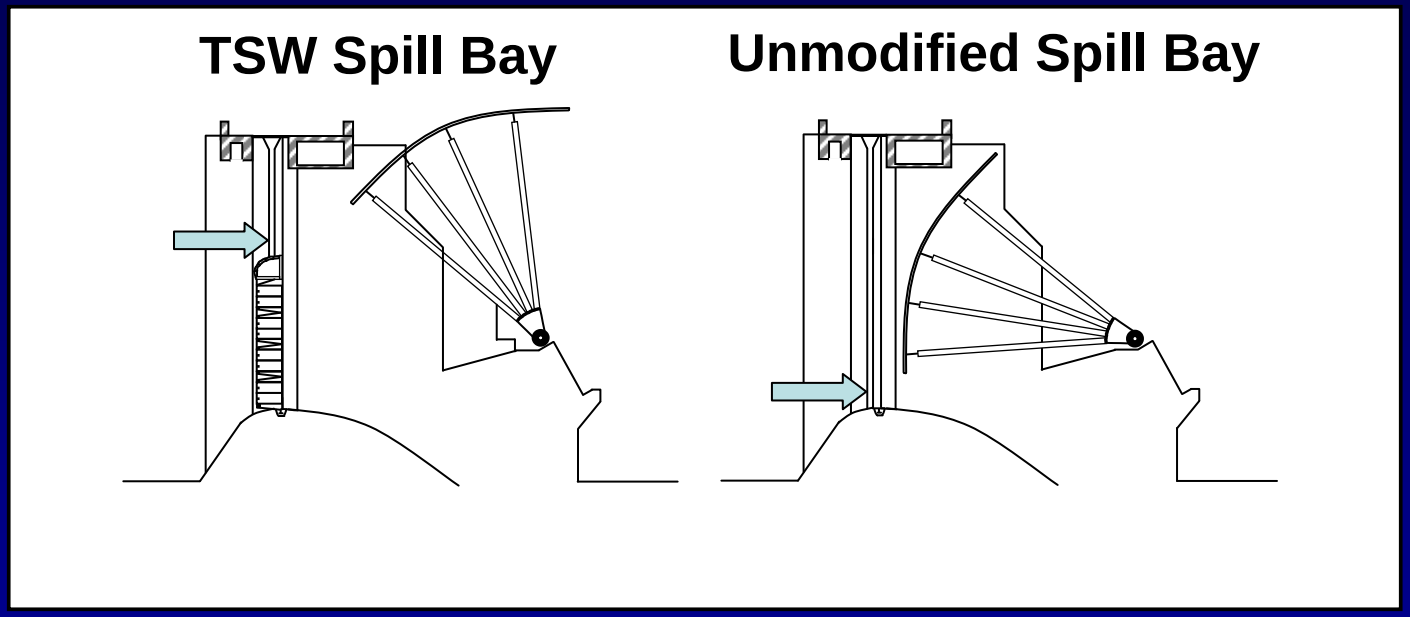

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