

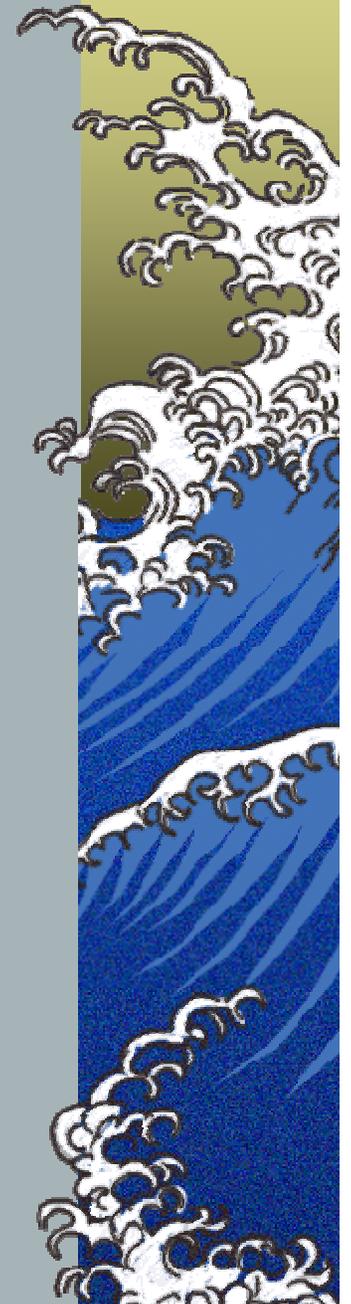
DSM2-PTM Results: Assessment of Entrainment Effects from SDIP

Russ T. Brown, J&S

Aaron Miller & Felix Ko, DWR

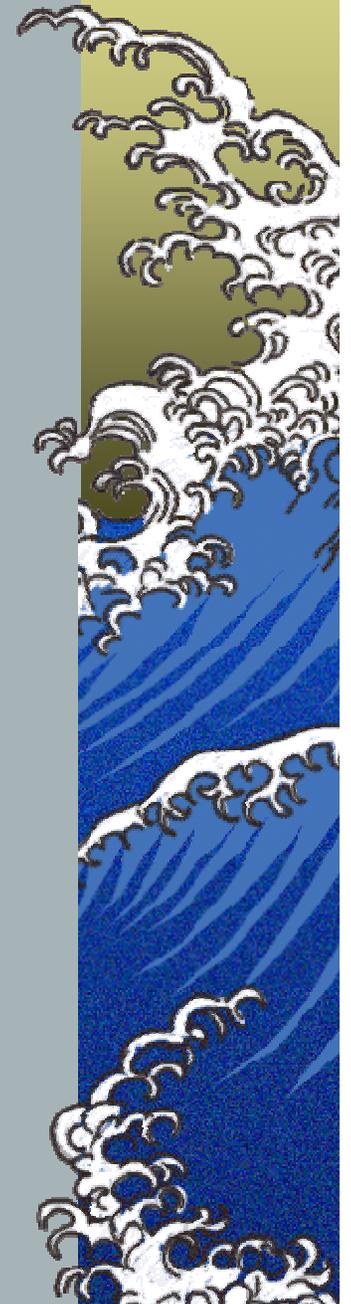
DSM2 Users Group

October 25, 2005

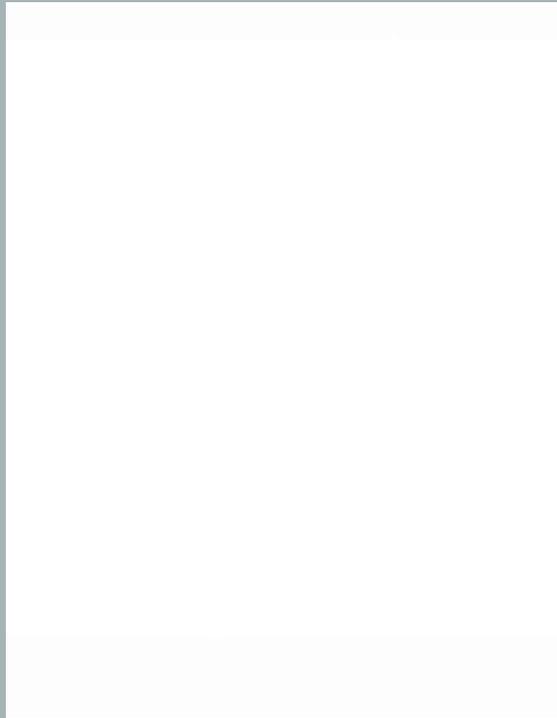


DSM2-PTM with “Behavior”

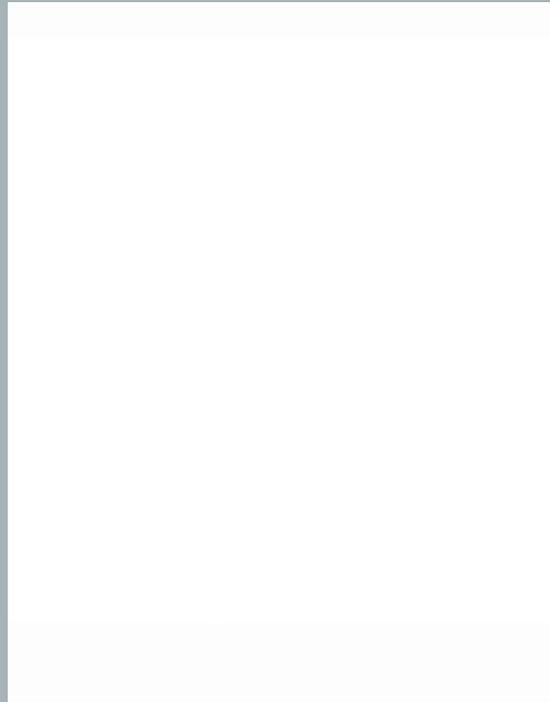
- ▶ *Mimic active fish movement towards bay during ebb (i.e., falling) tides: “Tidal Surfing”*
- ▶ *Determine movement and entrainment patterns for various starting locations*
- ▶ *Track 1000 particles released evenly on day 0 for 30 days*
- ▶ *Report the daily cumulative entrainment % in CVP, SWP, CCWD, NB and agricultural diversions*
- ▶ *Report the daily % remaining in Delta regions*
- ▶ *Report the daily cumulative movement past Chipps Island and Martinez*



Particle Behavior: Vertical Positioning



Passive Drift



Tidal Trigger



Control Screen for PTM Stage Behavior

Behavior Center for stage1

Physical | Time | Flow | **stage**

Horizontal Position

	Lower Limit	Upper Limit
Rising Stage	<input type="text"/>	<input type="text"/>
Falling Stage	<input type="text"/>	<input type="text"/>

Vertical Position

	Lower Limit	Upper Limit
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Falling Stage	<input type="text" value="90"/>	<input type="text" value="100"/>

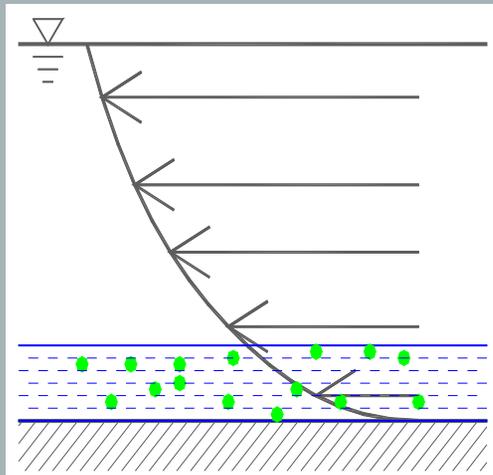
Additional Velocity

	Velocity	Units
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Falling Stage	<input type="text"/>	<input type="text" value="ft/s"/>

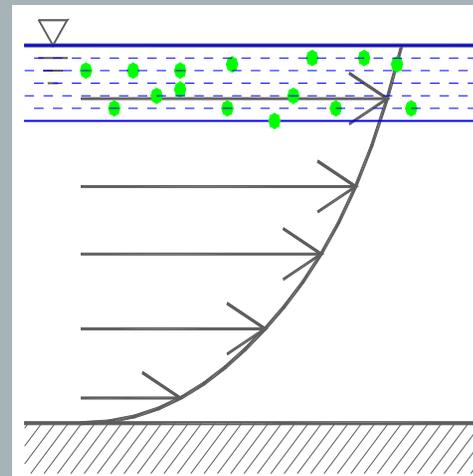
DONE CANCEL



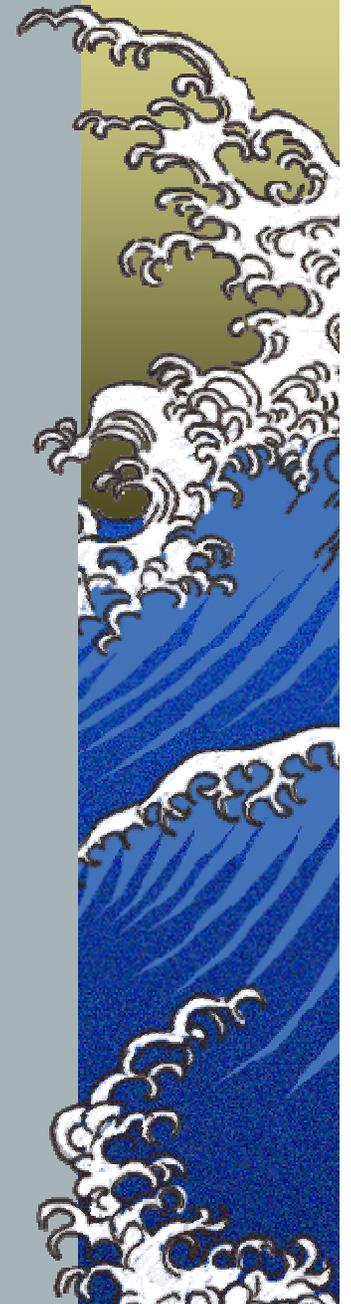
Stage Positioning



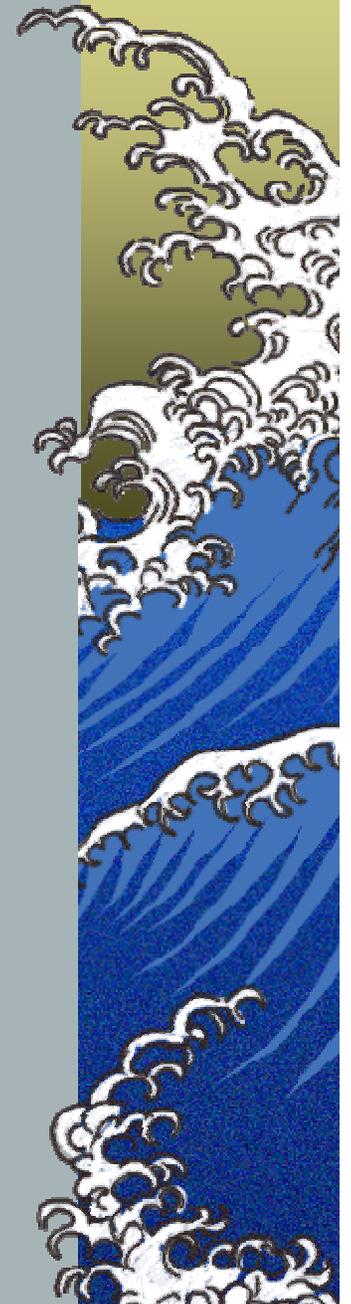
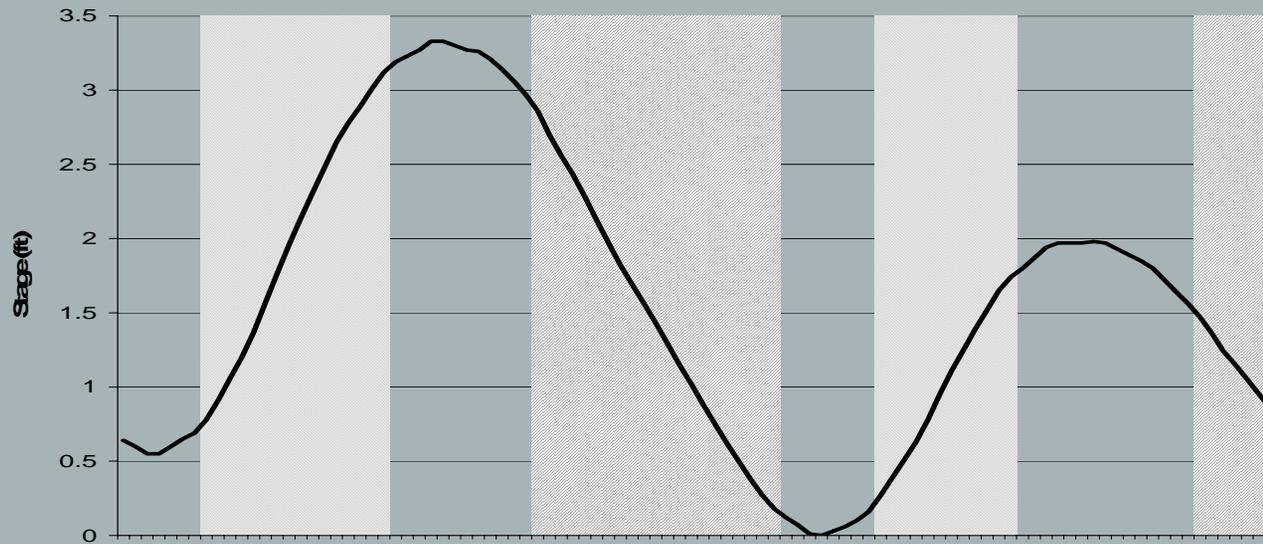
Rising Stage:
45% of average
velocity

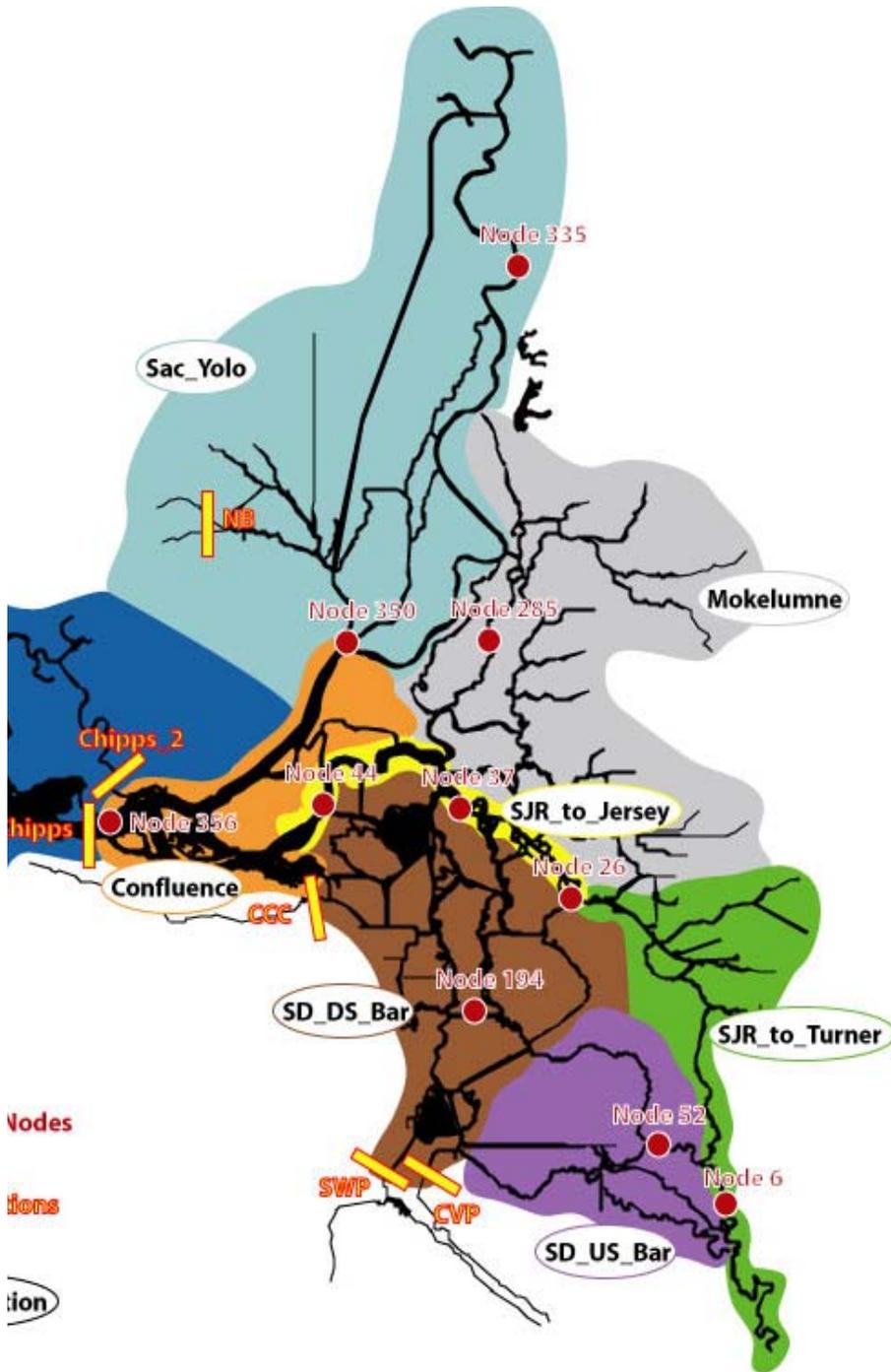


Falling Stage:
125% of average
velocity



Falling tide of >0.09 feet (1 inch) per 15-minutes





Each injection
of 1,000
particles
tracked to:

Ag Diversions

CVP Exports

SWP Exports

CCWD Intakes

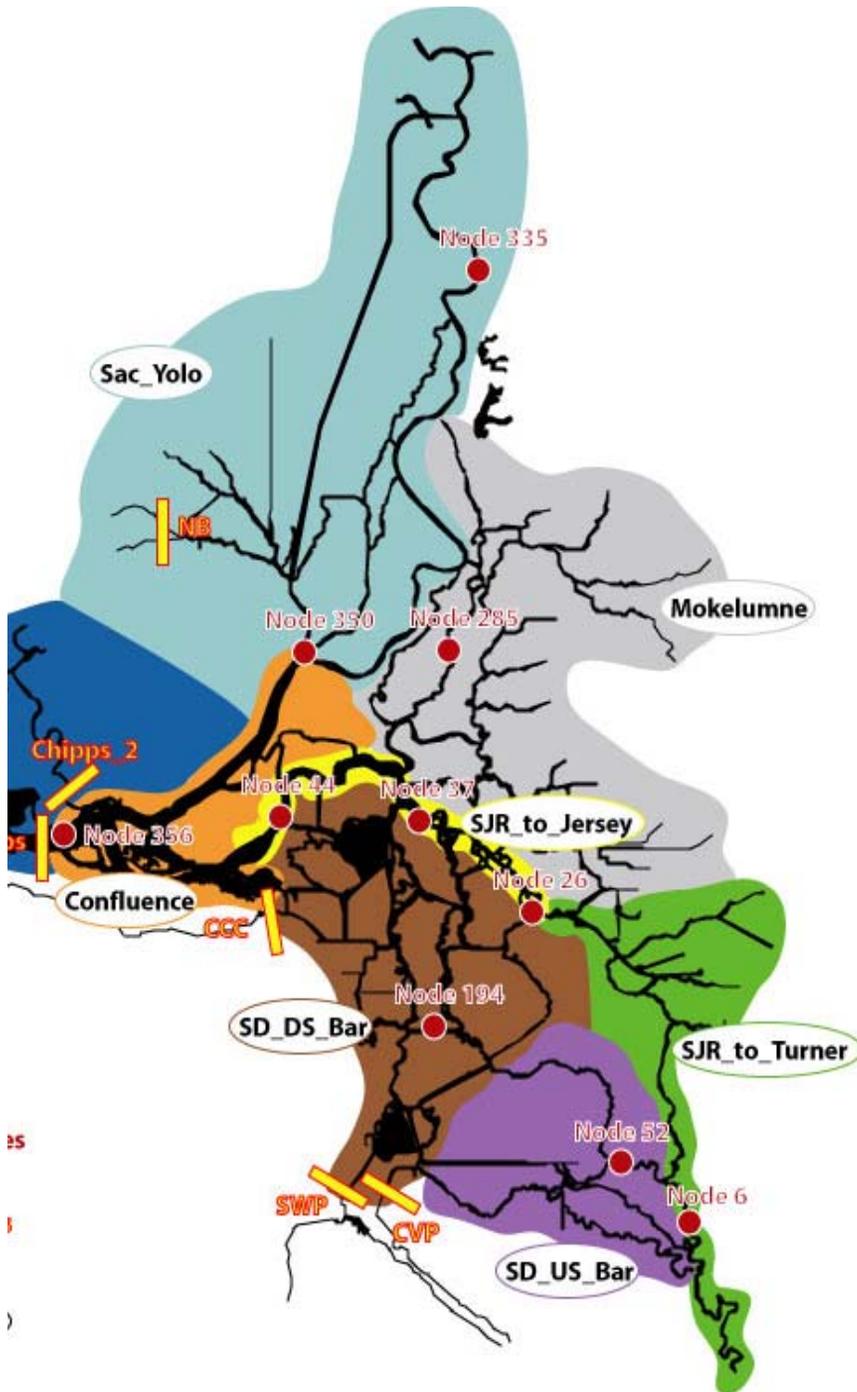
North Bay
Intake

Past Chipps

Past Martinez

Still in Delta:
8 Regions





6 Exports:

Ag Diversions

4,600 cfs CVP

+3,340 cfs SWP

+6,680 cfs SWP

+8,500 cfs SWP

+10,300 cfs SWP

At 3 Outflows:

5,000 cfs

7,000 cfs

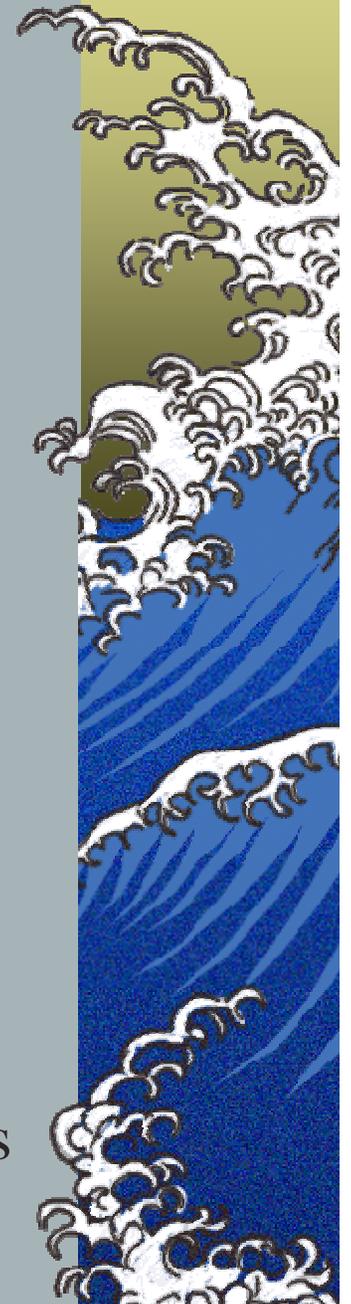
12,000 cfs

With Passive and

Surfing Behavior

At 10 release sites

= 360 cases



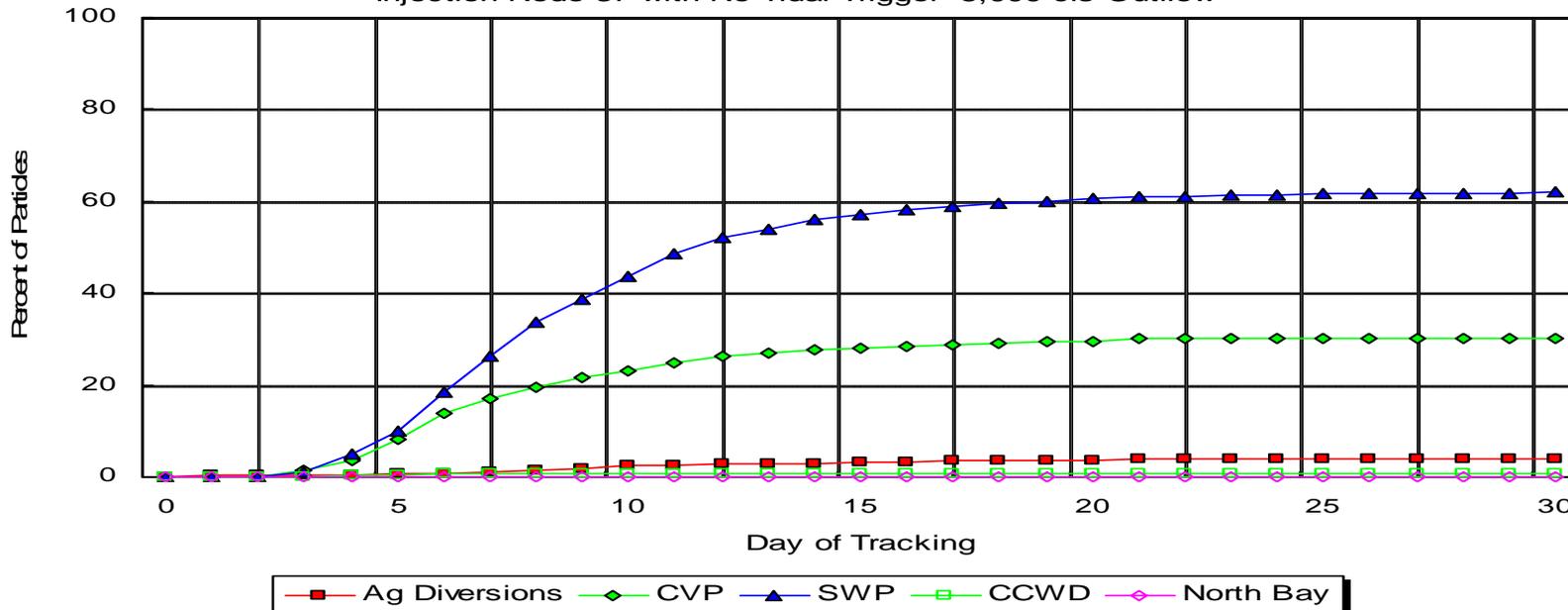
PTM Daily Results File: Injection at Node 37 (Prisoners Point); 4,600 cfs CVP and 6,680 cfs SWP; Passive Drift

Time	CVP	SWP	CCC	NB	AG	CHIPPS	CHIPPS_2	MTZ	SD_US_Bc	SD_DS_Bc	SJR_to_Tu	SJR_to_Je	Mokelumnt	Sac_Yolo	Confluence	Suisun	
31-Jul-97	0	0	0	0	0	0	0	0	0	0	9.7	0	85.2	3.7	0	0.5	0
1-Aug-97	0	0	0	0	0	0.1	0	0	0	0	23.9	0	71.1	4.7	0	0.2	0
2-Aug-97	0	0	0	0	0	0.1	0	0	0	0	40.1	0	54.5	4.7	0	0.6	0
3-Aug-97	0.6	0.2	0	0	0	0.2	0	0	0	0	55.2	0	39	3.9	0	0.9	0
4-Aug-97	2.4	1.1	0.1	0	0	0.2	0	0	0	0	63.1	0	29.5	2.7	0	0.9	0
5-Aug-97	4.9	4	0.2	0	0	0.2	0	0	0	0.2	66.8	0	20	2.5	0	1.2	0
6-Aug-97	9.8	8.4	0.4	0	0	0.5	0	0	0	0.4	62	0	16.3	1.2	0	1	0
7-Aug-97	14.7	15.8	0.6	0	0	0.6	0	0	0	0.7	54	0	11	1.5	0	1.1	0
8-Aug-97	17.6	21.4	0.7	0	0	0.9	0	0	0	0.5	48.2	0.3	8.3	1.2	0	0.9	0
9-Aug-97	19.4	27.3	0.8	0	0	0.9	0	0	0	0.6	42.2	0.4	7.1	0.4	0	0.9	0
10-Aug-97	21.7	32.2	0.8	0	0	1.3	0	0	0	0.7	35.2	0.4	6.3	0.5	0	0.9	0
11-Aug-97	23.7	36.9	0.8	0	0	1.4	0.1	0	0	0.5	30.2	0.8	4.5	0.3	0	0.8	0.1
12-Aug-97	26.1	41.2	0.9	0	0	1.7	0.1	0	0	0.6	24.6	1.1	2.9	0.2	0	0.6	0.1
13-Aug-97	27.4	45.8	0.9	0	0	1.9	0	0	0	0.2	18.7	1.2	2.6	0.4	0	0.8	0.1
14-Aug-97	28.6	47.8	0.9	0	0	2	0	0	0	0.2	15.6	1.1	2.6	0.3	0	0.9	0
15-Aug-97	29.4	49.6	0.9	0	0	2	0	0	0	0.3	13.1	0.8	2.9	0.1	0	0.9	0
16-Aug-97	30.5	51.9	0.9	0	0	2.2	0.1	0	0	0.2	9.8	0.8	2.3	0.2	0	1.1	0.1
17-Aug-97	30.9	53.7	0.9	0	0	2.2	0.1	0	0	0.2	7.6	0.6	2.5	0.1	0	1.2	0.1
18-Aug-97	31.3	55.1	0.9	0	0	2.4	0.2	0	0	0.1	5.6	0.5	2.7	0	0	1.2	0.2
19-Aug-97	31.7	55.5	0.9	0	0	2.5	0.2	0	0	0.1	4.9	0.7	2.2	0	0	1.3	0.2
20-Aug-97	32	55.8	0.9	0	0	2.6	0.3	0	0	0	4.6	0.5	2.2	0	0	1.1	0.3
21-Aug-97	32.2	56.1	0.9	0	0	2.6	0.3	0	0	0	4.7	0.7	1.6	0.1	0	0.8	0.3
22-Aug-97	32.5	56.4	0.9	0	0	2.6	0.3	0	0	0	3.9	0.8	1.6	0.1	0	0.9	0.3
23-Aug-97	32.7	56.7	0.9	0	0	2.8	0.3	0	0	0.1	3.3	0.9	1.4	0	0	0.9	0.3
24-Aug-97	32.7	57.2	0.9	0	0	3	0.3	0	0	0.1	3.2	1.1	0.6	0	0	0.9	0.3
25-Aug-97	33	57.5	0.9	0	0	3	0.2	0	0	0.1	2.6	1.1	0.5	0.1	0	1	0.2
26-Aug-97	33	58	0.9	0	0	3	0.1	0	0	0.1	1.9	1.1	0.8	0	0	1.1	0.1
27-Aug-97	33	58.2	0.9	0	0	3	0.3	0	0.1	0.1	1.9	1.1	0.6	0	0	0.9	0.2
28-Aug-97	33.3	58.3	0.9	0	0	3	0.2	0	0.2	0.1	1.4	1.1	0.6	0.1	0	1	0
29-Aug-97	33.3	58.4	0.9	0	0	3.1	0.4	0	0.2	0	1.4	1	0.6	0	0	0.8	0.3
30-Aug-97	33.3	58.4	0.9	0	0	3.1	0.6	0.1	0.2	0	1.4	1	0.6	0	0	0.5	0.6

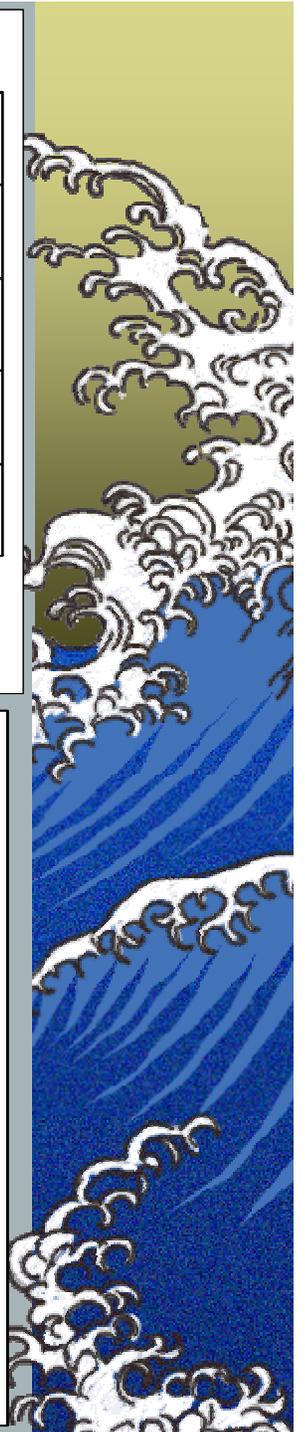
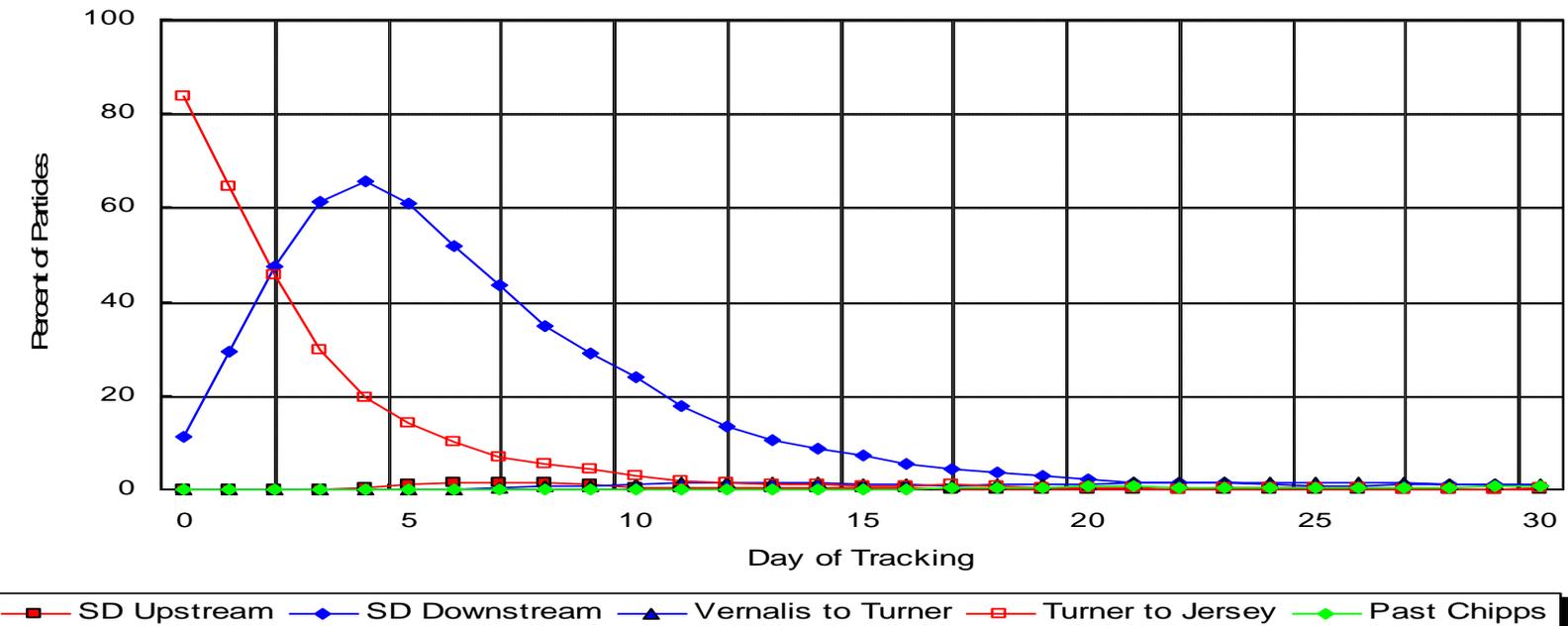
PTM Daily Results File: Injection at Node 37 (Prisoners Point); 4,600 cfs CVP and 6,680 cfs SWP; Tidal Surfing

Injection N	37																
Time	CVP	SWP	CCC	NB	AG	CHIPPS	CHIPPS_2	MTZ	SD_US_B	SD_DS_B	SJR_to_Tu	SJR_to_Je	Mokelum	Sac_Yolo	Confluence	Suisun	
31-Jul-97	0	0	0	0	0	0	0	0	0	0	7.4	0	88.5	2.9	0	0.3	0
1-Aug-97	0	0	0	0	0	0	0	0	0	0	20	0	74.3	4.7	0	1	0
2-Aug-97	0	0	0	0	0	0.1	0	0	0	0	29	0	66	2.1	0	2.8	0
3-Aug-97	0	0.1	0	0	0	0.1	0	0	0	0	33.6	0	57.5	1.2	0	7.5	0
4-Aug-97	0.6	0.3	0	0	0	0.3	0.1	0	0	0	36.8	0	48.3	0.3	0	13.2	0.2
5-Aug-97	1.7	1	0.1	0	0	0.3	0.2	0	0	0.1	38.5	0	38.6	1.7	0	17.8	0.2
6-Aug-97	3.1	3	0.2	0	0	0.3	1	0.1	0.1	0	38.5	0	32.7	1.1	0	19.9	1.1
7-Aug-97	4.8	4.5	0.3	0	0	0.5	2.8	0	0.1	0.1	37.8	0	28.5	0.8	0	19.9	2.7
8-Aug-97	6.3	6.6	0.3	0	0	0.5	3.9	0	0.1	0.3	35.3	0	25.3	0.4	0	21.1	3.8
9-Aug-97	7.3	8	0.8	0	0	0.8	5.8	0	0.1	0.2	32.1	0	21.6	0.5	0	22.5	6.1
10-Aug-97	8.3	10.2	0.8	0	0	0.8	7.9	0.2	0.6	0.1	30.2	0	17.3	0.3	0	23.7	7.7
11-Aug-97	9.2	11.8	0.9	0	0	1	9.5	0.1	1.6	0.3	27.4	0	14.8	0.4	0	24.3	8.3
12-Aug-97	10.6	13.5	0.9	0	0	1.1	12.1	0.3	2.3	0.2	23.9	0	12.9	0.5	0	24	10.1
13-Aug-97	11.3	14.9	1	0	0	1.2	13.6	0.3	4	0.2	19.8	0	12	0.2	0	25.3	10.1
14-Aug-97	11.9	16.5	1	0	0	1.4	17.5	0.3	6.7	0.2	17.2	0	8.2	0.1	0	25.6	11.2
15-Aug-97	12.6	17	1	0	0	1.4	21.9	0.3	10.4	0.2	14.1	0	6.3	0.2	0	24.9	11.9
16-Aug-97	13	17.9	1.1	0	0	1.6	26.7	0.4	13.6	0.1	12.6	0	3.6	0.1	0	22.8	13.6
17-Aug-97	13.2	18.6	1.2	0	0	1.7	32.9	0.5	17.8	0.1	10.6	0	2.1	0.1	0	19	15.6
18-Aug-97	13.6	19.5	1.2	0	0	1.7	39.8	0.8	22.1	0.1	9.1	0	1.6	0	0	12.6	18.5
19-Aug-97	13.9	20.3	1.2	0	0	1.7	44.1	0.5	25.1	0.1	7.5	0	1.2	0	0	9.4	19.6
20-Aug-97	14.1	20.5	1.2	0	0	1.7	46.7	0.5	28.2	0.2	6.8	0	1	0	0	7.3	19
21-Aug-97	14.3	21.5	1.2	0	0	1.7	48.2	0.5	32.5	0.2	5.4	0	1	0	0	6	16.2
22-Aug-97	14.5	22	1.3	0	0	1.8	50	0.5	37	0.2	4.7	0	0.4	0.1	0	4.5	13.5
23-Aug-97	14.6	22.7	1.3	0	0	1.9	50.5	0.5	39.6	0.1	3.7	0	0.6	0.1	0	3.9	11.5
24-Aug-97	14.6	23.2	1.3	0	0	1.9	50.8	0.6	42.9	0.1	3.3	0	0.7	0	0	3.5	8.5
25-Aug-97	14.7	23.4	1.3	0	0	1.9	50.9	0.6	44.6	0.1	3.1	0	0.7	0	0	3.2	7
26-Aug-97	14.8	23.8	1.3	0	0	2	51.2	0.6	46.9	0	2.2	0	0.7	0	0	3.3	5
27-Aug-97	14.9	24.1	1.3	0	0	2	52	0.6	48.3	0	1.5	0	0.8	0	0	2.8	4.3
28-Aug-97	15	24.2	1.3	0	0	2	53.1	0.6	49.3	0	1.1	0	0.5	0	0	2.2	4.4
29-Aug-97	15	24.2	1.3	0	0	2	53.6	0.7	50.2	0	1.2	0	0.3	0	0	1.7	4.1
30-Aug-97	15	24.2	1.3	0	0	2	54.2	0.7	51.4	0	1.1	0	0.3	0	0	1.2	3.5

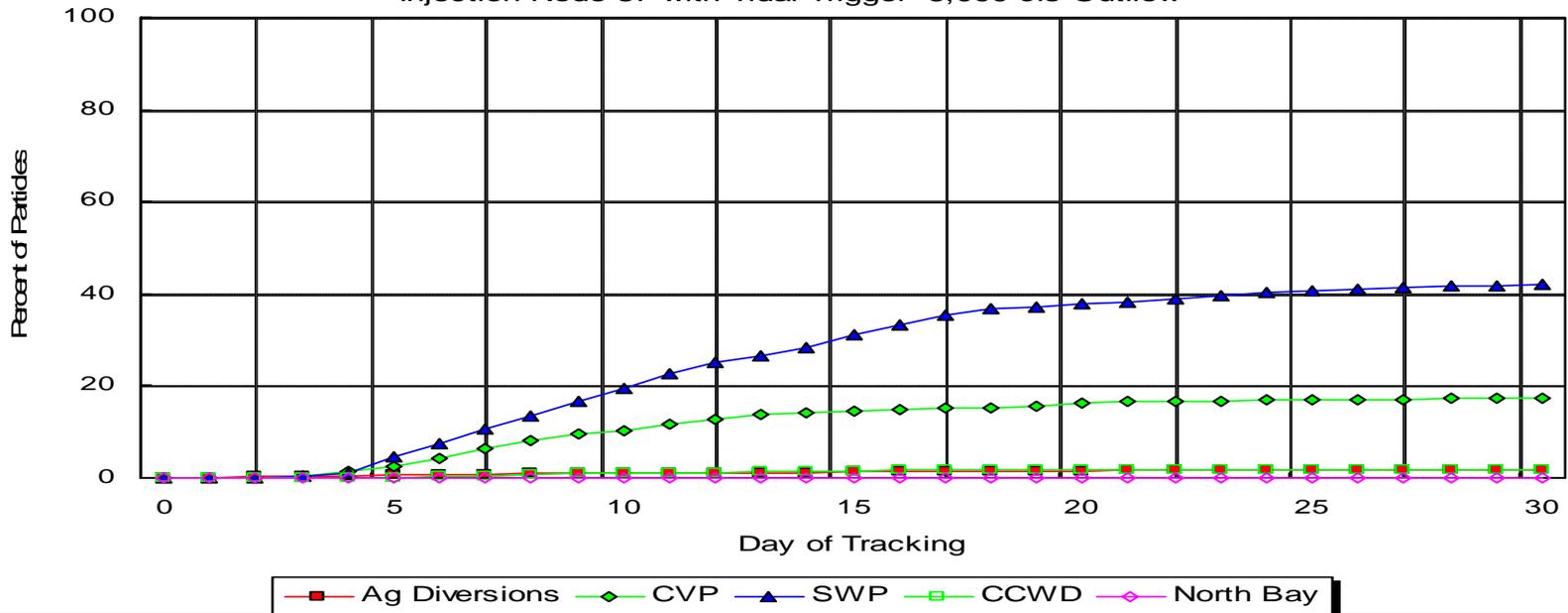
Fish Tracking for 4600 CVP & 8500 SWP
 Injection Node 37 with No Tidal Trigger- 5,000 cfs Outflow



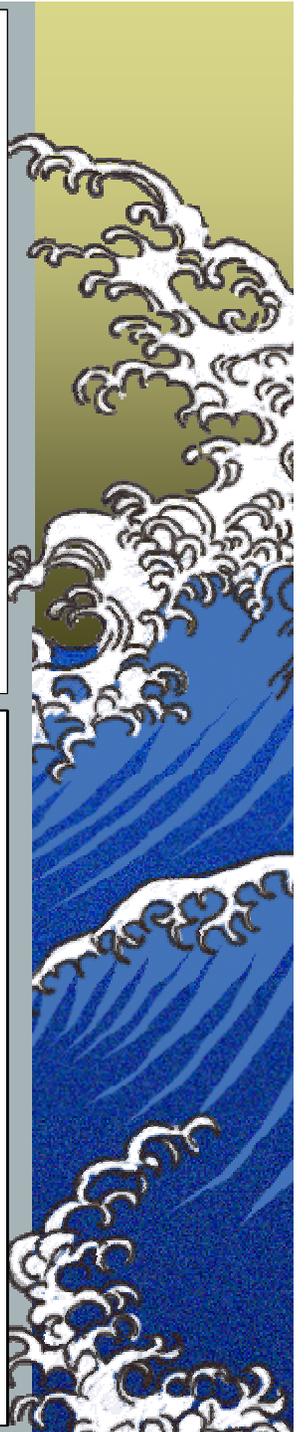
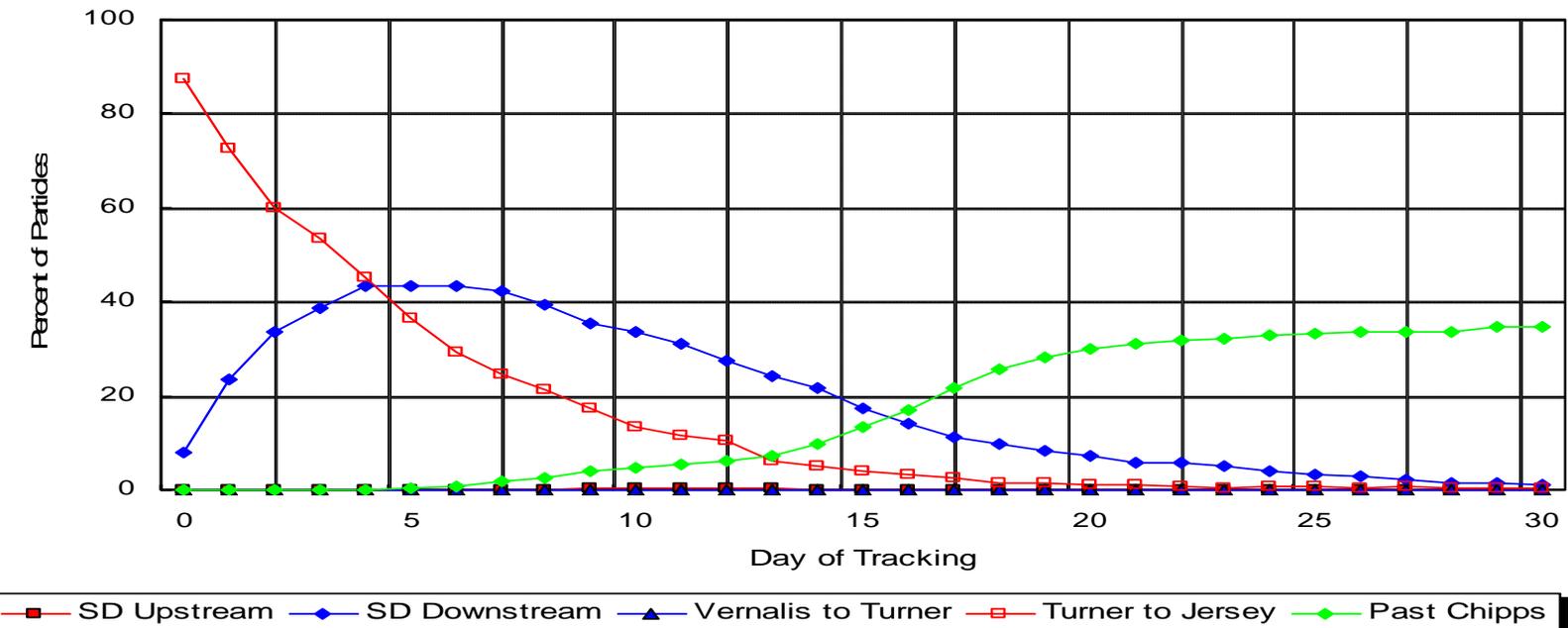
Fish Tracking for 4600 CVP & 8500 SWP
 Injection Node 37 with No Tidal Trigger- 5,000 cfs Outflow



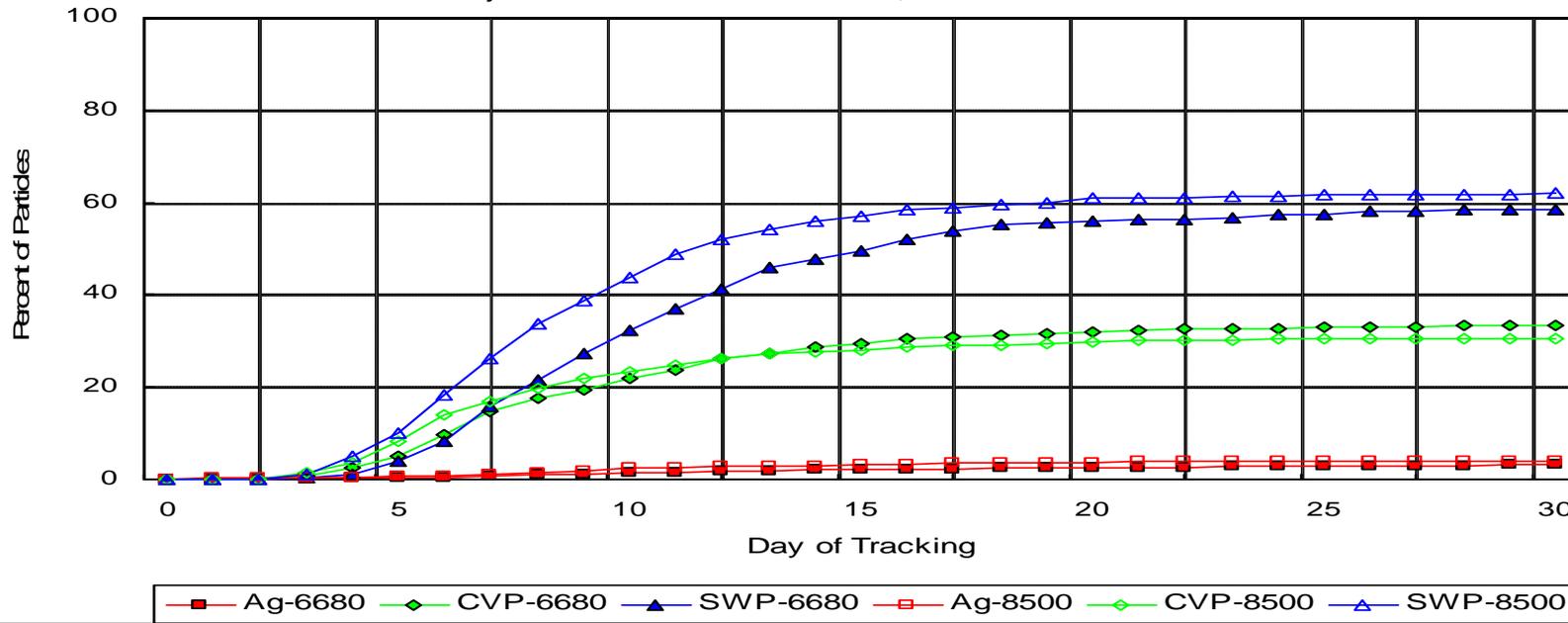
Trigger (Surfing) Fish Tracking for 4600 CVP & 8500 SWP
 Injection Node 37 with Tidal Trigger- 5,000 cfs Outflow



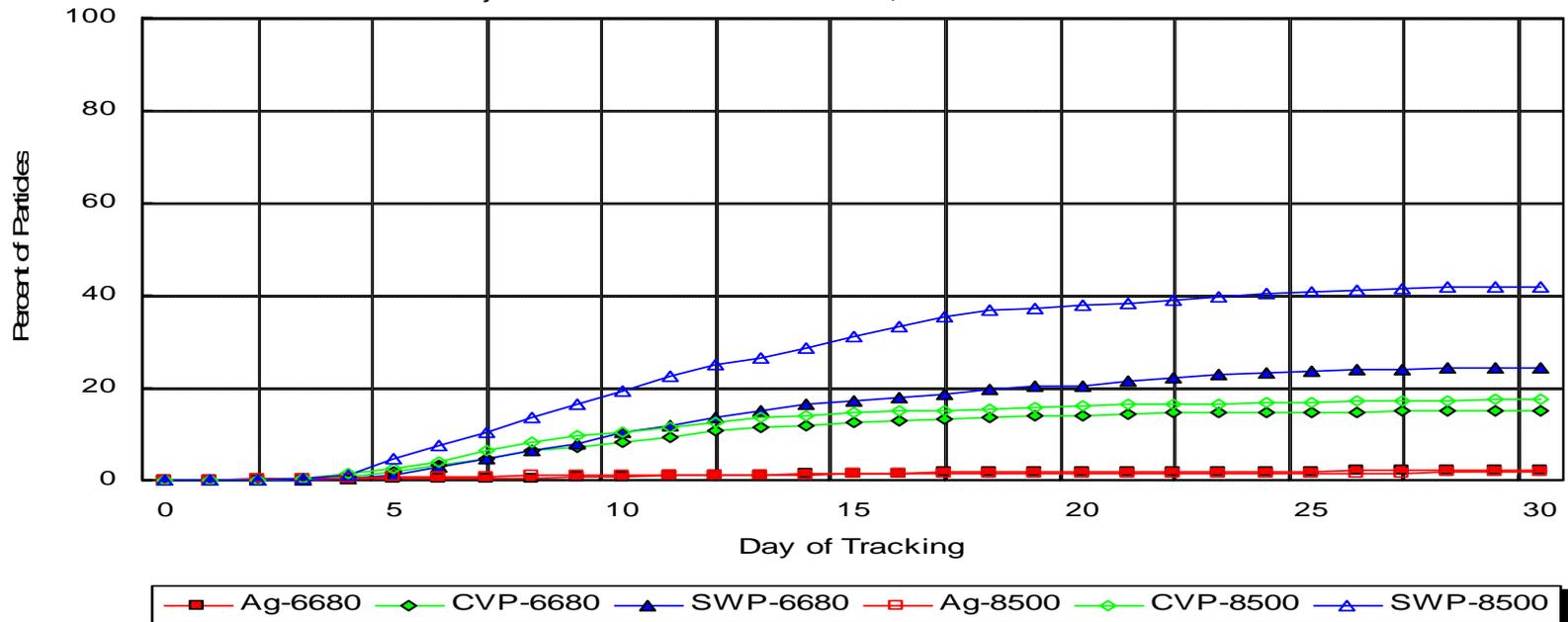
Trigger (Surfing) Fish Tracking for 4600 CVP & 8500 SWP
 Injection Node 37 with Tidal Trigger- 5,000 cfs Outflow



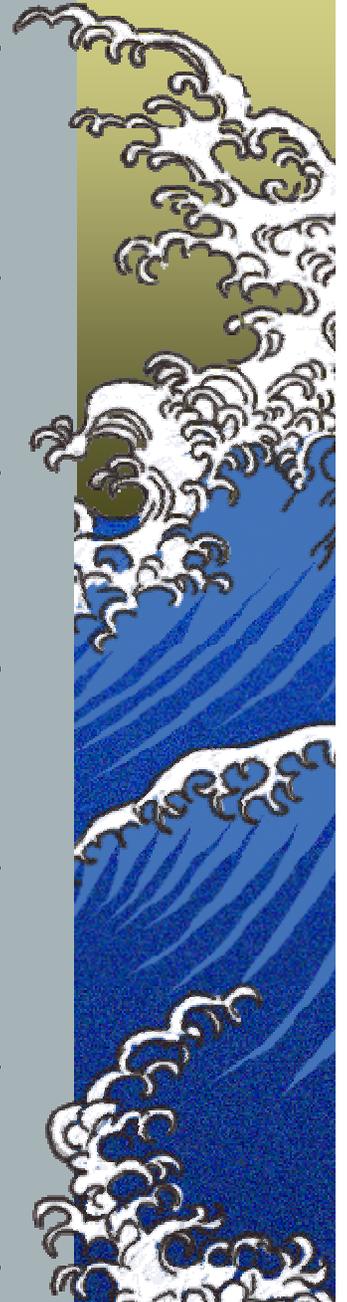
Passive Fish Tracking for 4600 CVP & 6680/8500 SWP
 Injection at Prisoners Point- 5,000 cfs Outflow



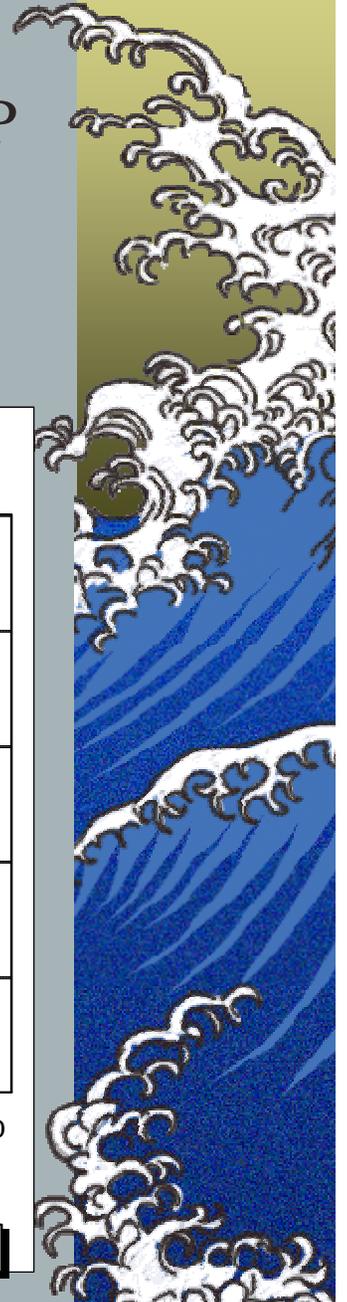
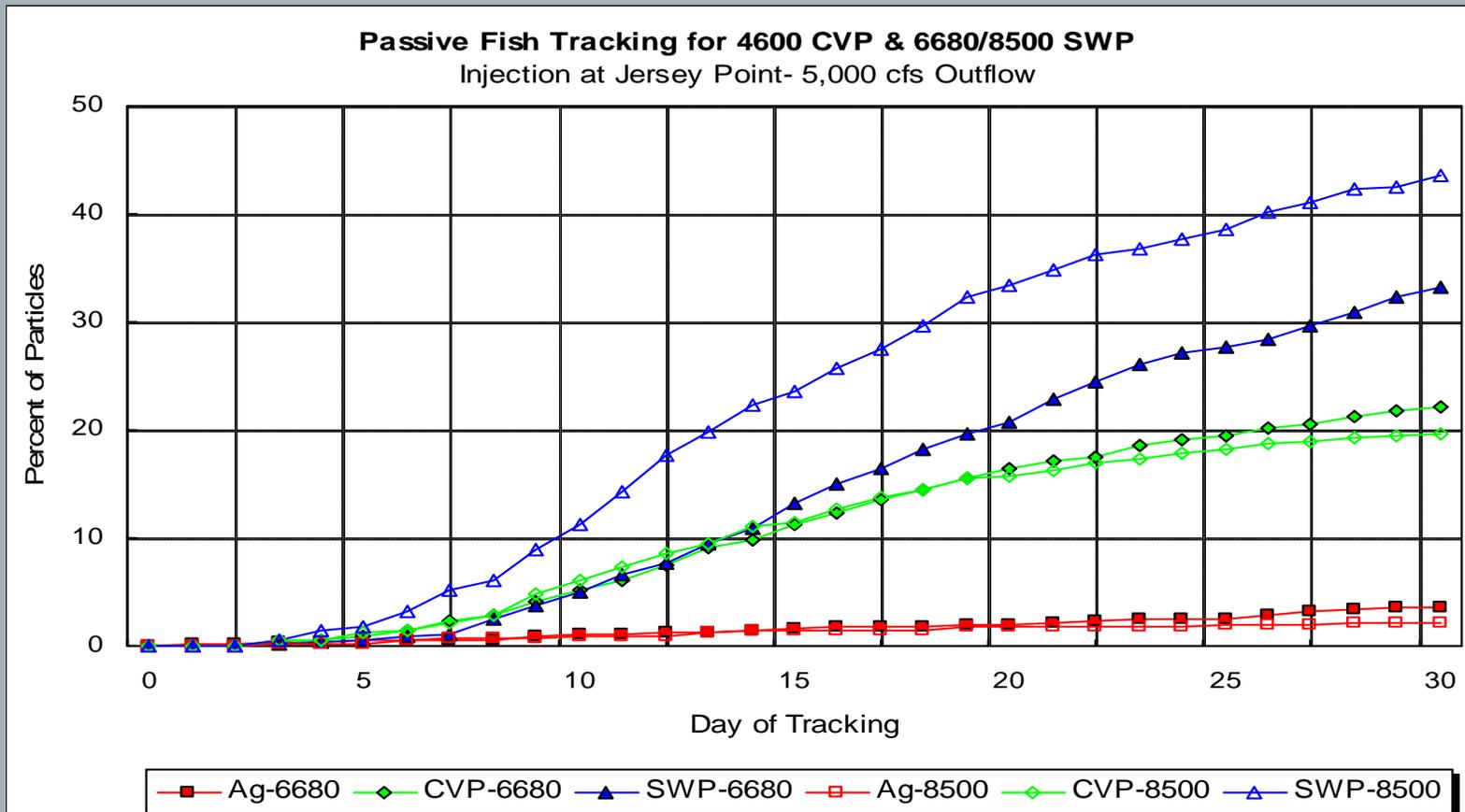
Trigger (Surfing) Fish Tracking for 4600 CVP & 6680/8500 SWP
 Injection at Prisoners Point- 5,000 cfs Outflow



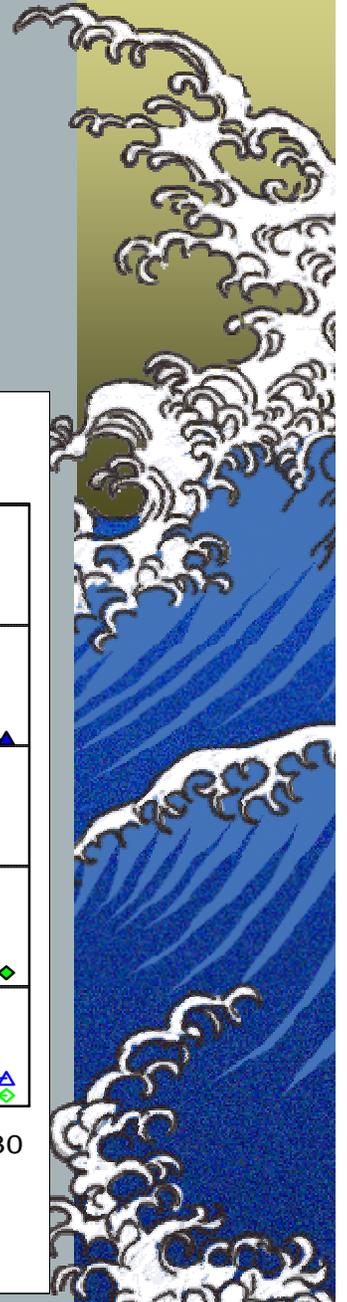
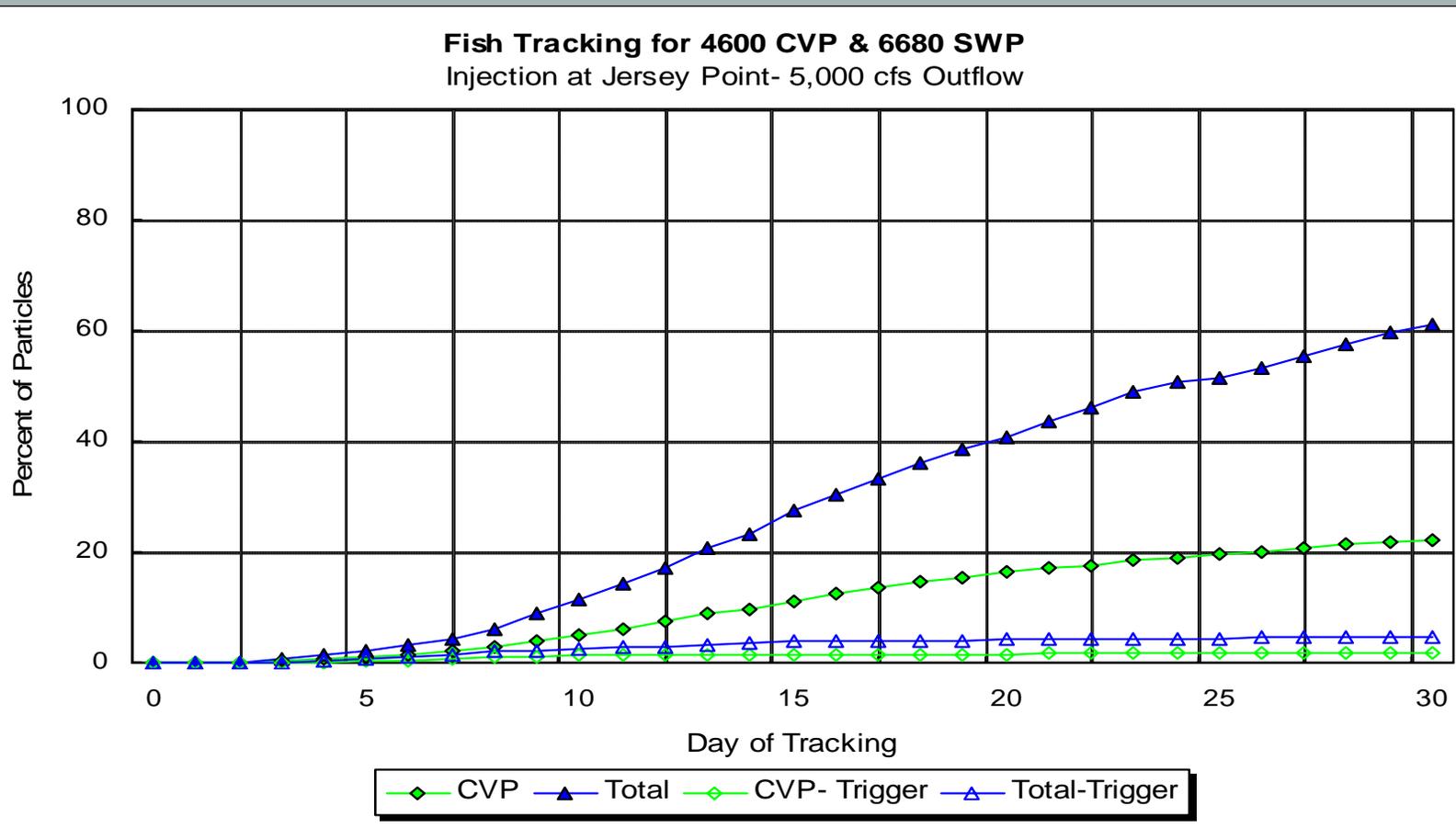
	Prisoners Point Release		Net Delta Outflow	CVP Entrained	SWP Entrained	CCC Entrained	Ag Diversions Entrained	Total Entrained
No Trigger	No	CVP	SWP					
	0	0	5,000	0.0	0.0	1.1	2.1	3.2
	4,600	0	5,000	61.4	0.0	2.5	3.9	67.8
	4,600	3,340	5,000	47.0	36.8	1.4	3.6	88.8
	4,600	6,680	5,000	33.3	58.4	0.9	3.1	95.7
	4,600	8,500	5,000	30.3	61.9	0.8	3.8	96.8
	4,600	10,300	5,000	27.1	66.9	0.4	3.5	97.9
	0	0	7,000	0.0	0.0	1.8	1.3	3.1
	4,600	0	7,000	62.4	0.0	2.6	3.7	68.7
	4,600	3,340	7,000	46.5	36.7	1.6	3.6	88.4
	4,600	6,680	7,000	34.8	55.8	1.0	3.9	95.5
	4,600	8,500	7,000	29.5	63.3	0.6	3.3	96.7
	4,600	10,300	7,000	23.8	69.1	0.6	3.0	96.5
	0	0	12,000	0.0	0.0	1.1	1.5	2.6
	4,600	0	12,000	59.5	0.0	2.4	3.3	65.2
4,600	3,340	12,000	44.7	36.2	1.9	3.7	86.5	
4,600	6,680	12,000	34.2	55.8	1.1	3.3	94.4	
4,600	8,500	12,000	27.1	64.6	0.8	3.7	96.2	
4,600	10,300	12,000	23.8	70.2	0.5	2.3	96.8	
Tidal Trigger	0	0	5,000	0.0	0.0	0.0	0.5	0.5
	4,600	0	5,000	2.4	0.0	0.9	0.7	4.0
	4,600	3,340	5,000	9.8	6.9	1.2	1.0	18.9
	4,600	6,680	5,000	15.0	24.2	1.3	2.0	42.5
	4,600	8,500	5,000	17.4	41.9	1.7	1.8	62.8
	4,600	10,300	5,000	17.4	50.2	1.6	1.5	70.7
	0	0	7,000	0.0	0.0	0.0	0.6	0.6
	4,600	0	7,000	3.7	0.0	0.5	0.7	4.9
	4,600	3,340	7,000	9.9	7.6	1.4	0.9	19.8
	4,600	6,680	7,000	13.5	25.1	1.9	1.0	41.5
	4,600	8,500	7,000	17.5	38.7	2.0	1.4	59.6
	4,600	10,300	7,000	16.3	51.3	1.7	1.8	71.1
	0	0	12,000	0.0	0.0	0.0	0.3	0.3
	4,600	0	12,000	2.8	0.0	0.6	0.5	3.9
	4,600	3,340	12,000	9.6	9.0	0.9	1.3	20.8
4,600	6,680	12,000	12.9	23.0	1.4	1.2	38.5	
4,600	8,500	12,000	17.2	35.5	1.3	1.1	55.1	
4,600	10,300	12,000	15.5	51.4	1.4	1.7	70.0	



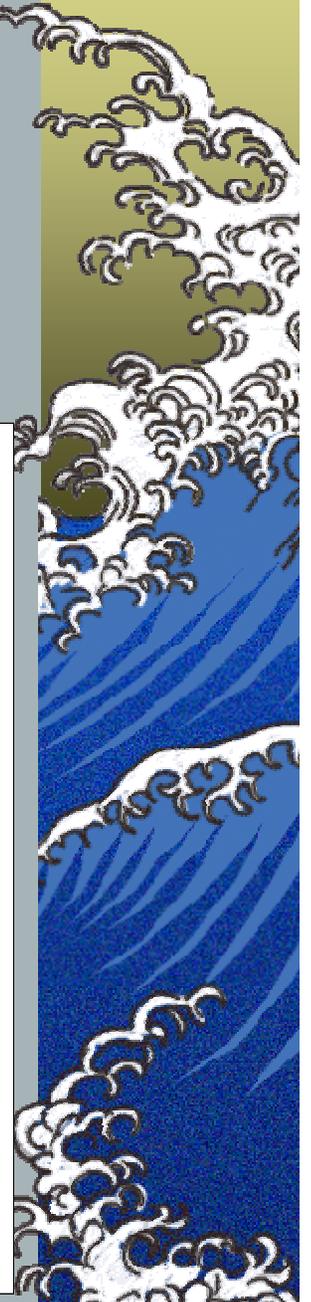
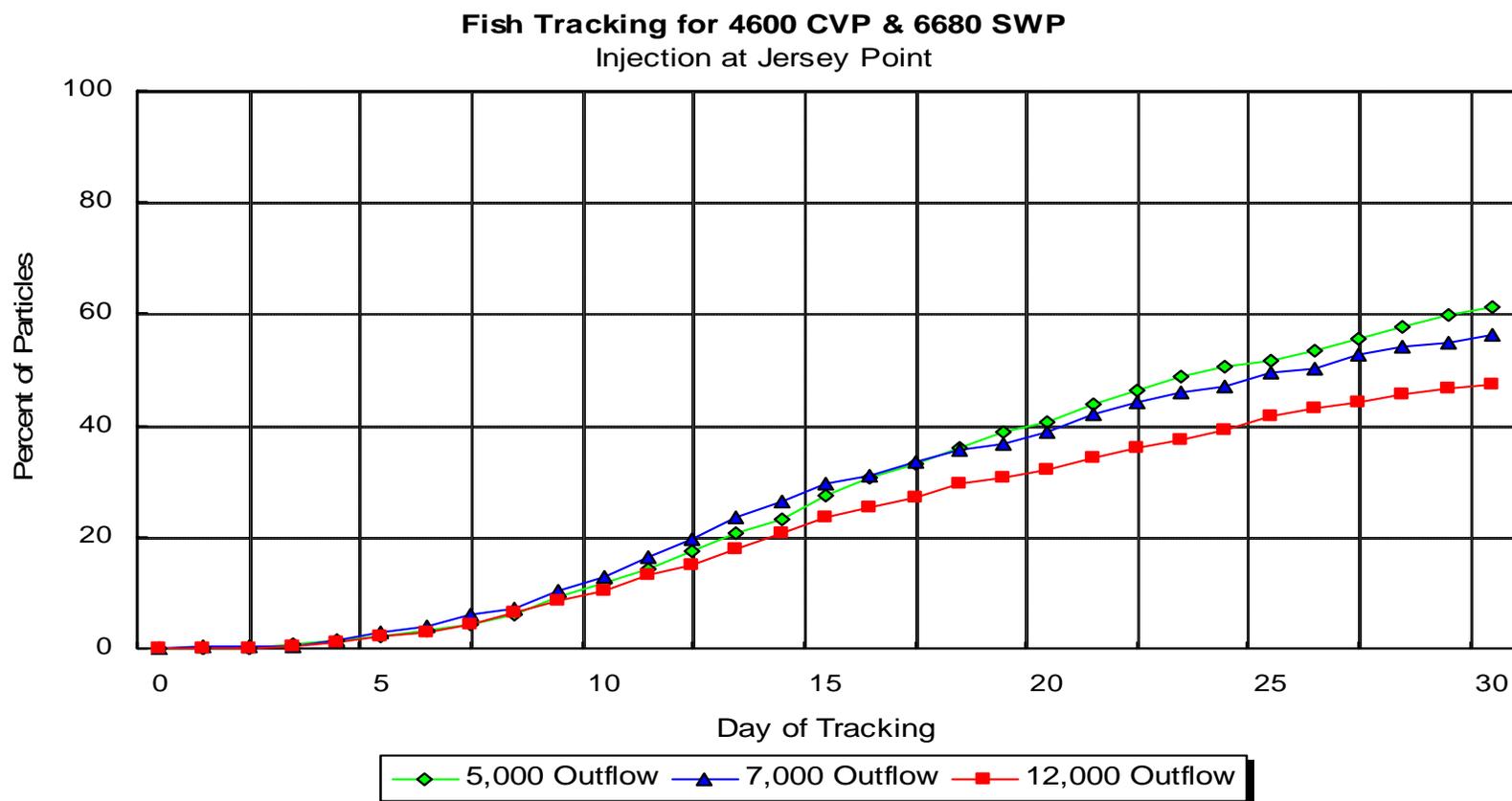
Passive particles released at Jersey Point have a 30-day entrainment of 61% with 6,680 cfs of SWP pumping (and 4,600 cfs of CVP pumping) and 67% with 8,500 cfs of SWP pumping



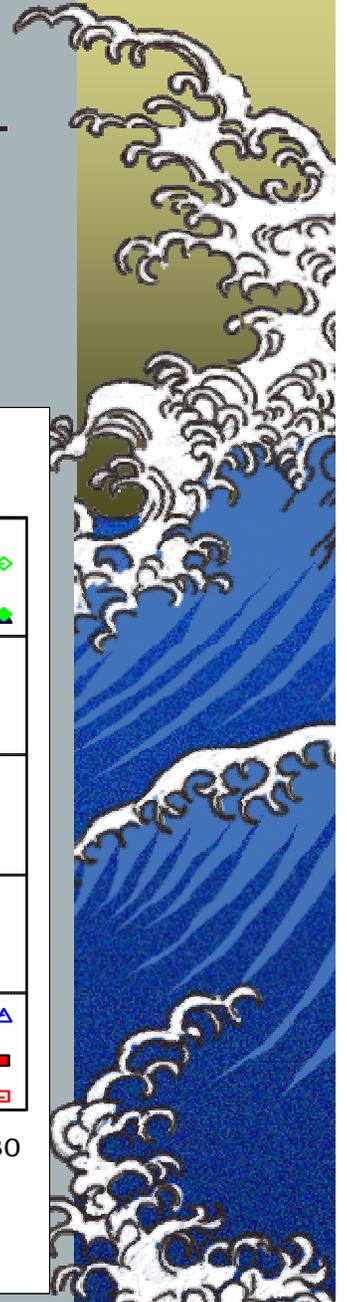
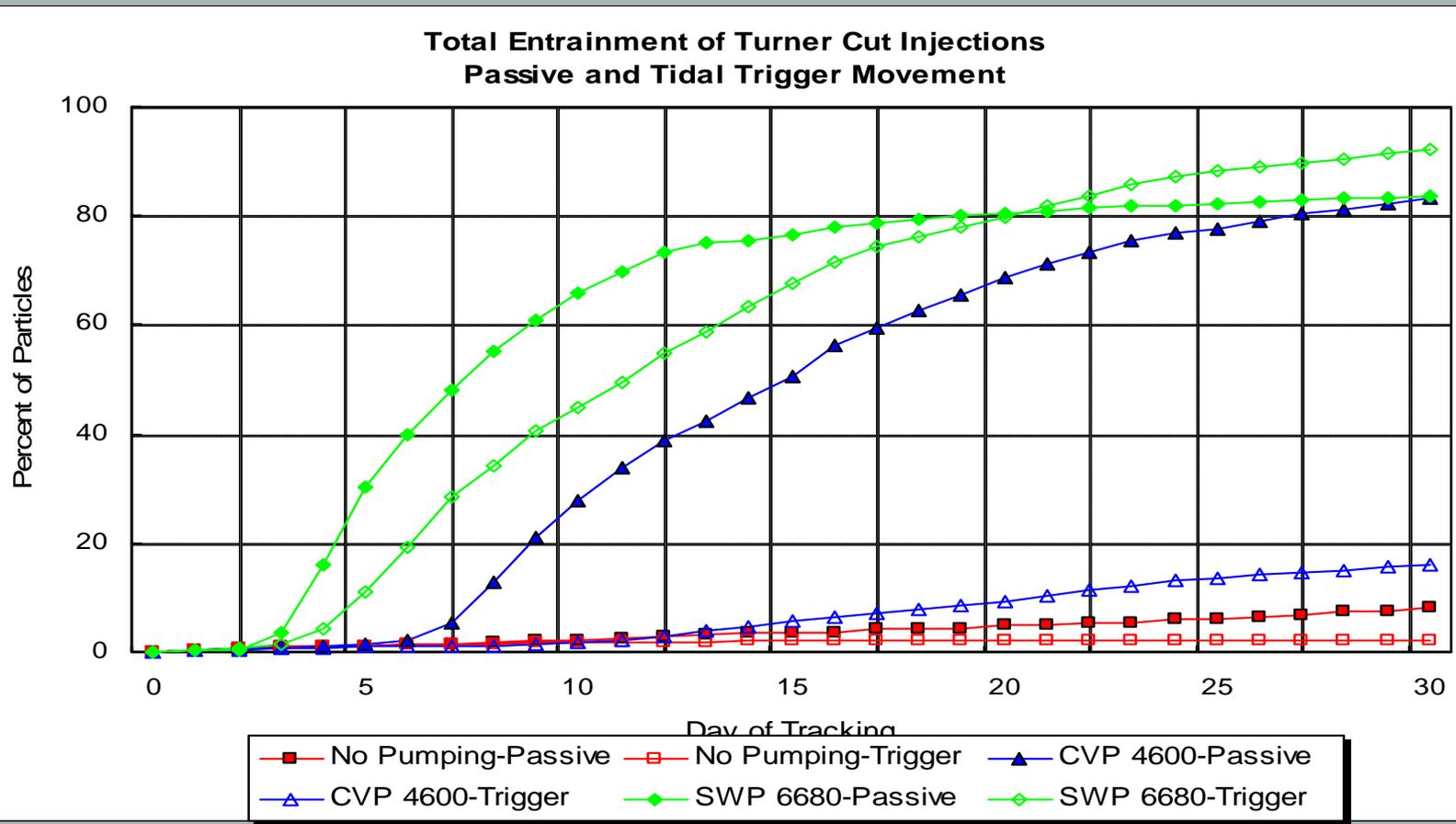
Release at Jersey Point with tidal trigger (surfing) behavior will reduce the 30-day entrainment from 60% to 5% with 6,680 cfs of SWP pumping and 4,600 cfs of CVP pumping



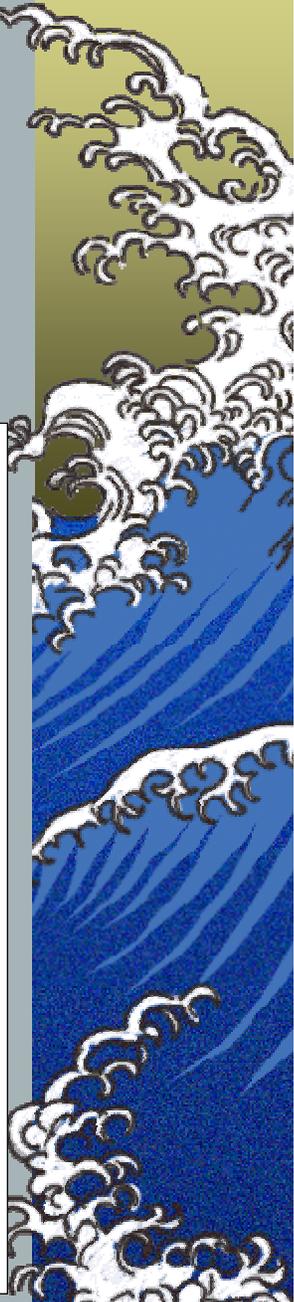
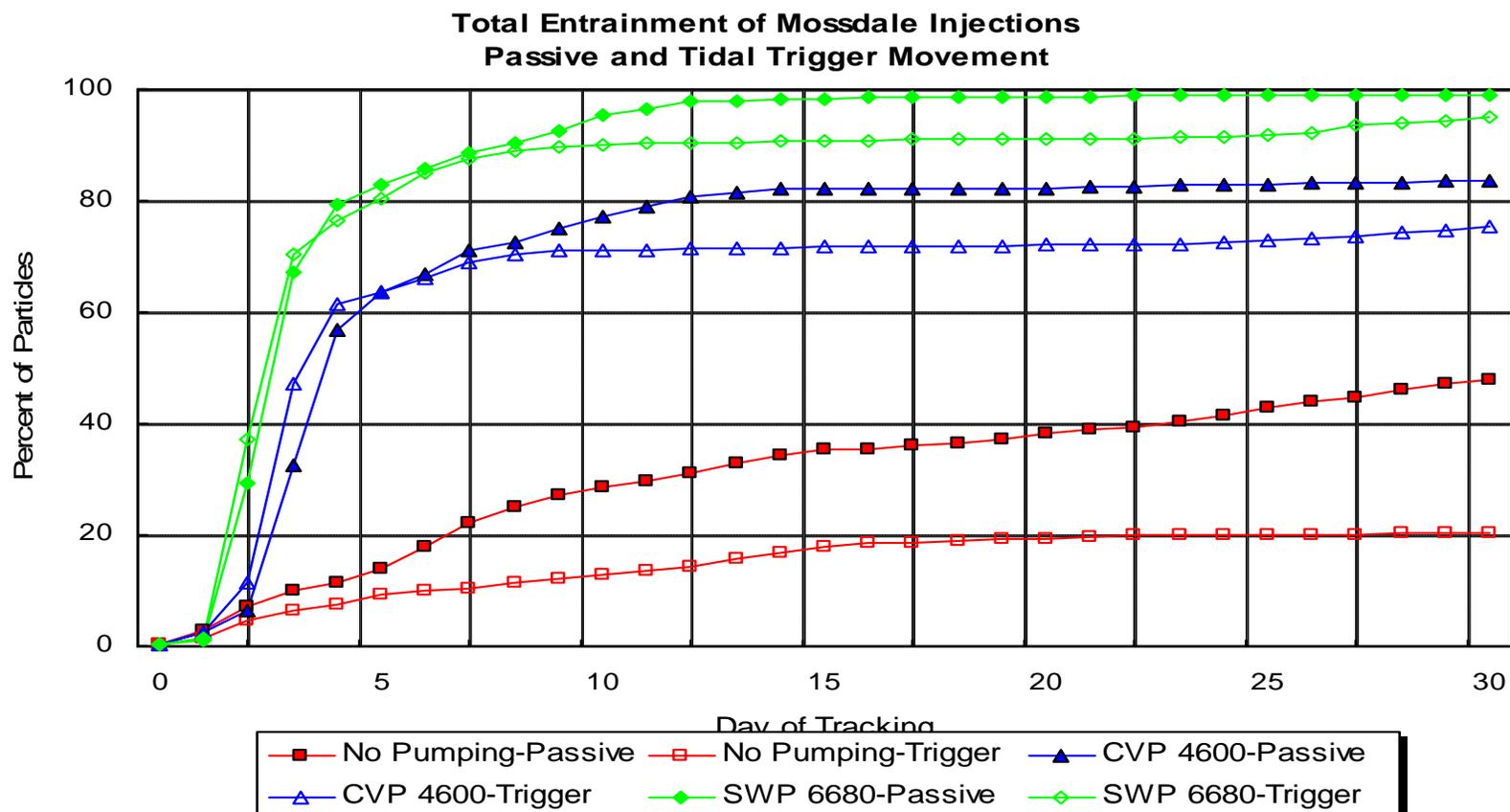
Outflow will reduce the 30-day entrainment of passive particles released from Jersey Point from 60% at 6,680 cfs SWP with 5,000 cfs outflow to 45% with 12,000 cfs outflow



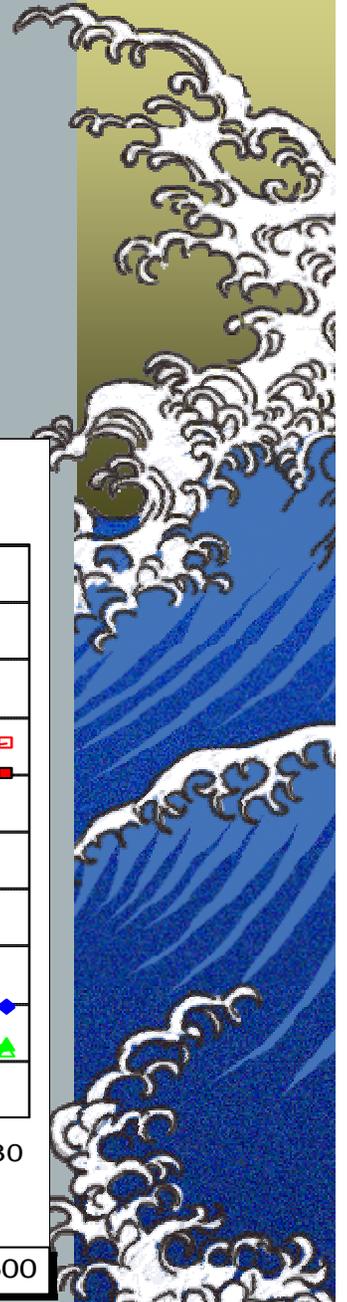
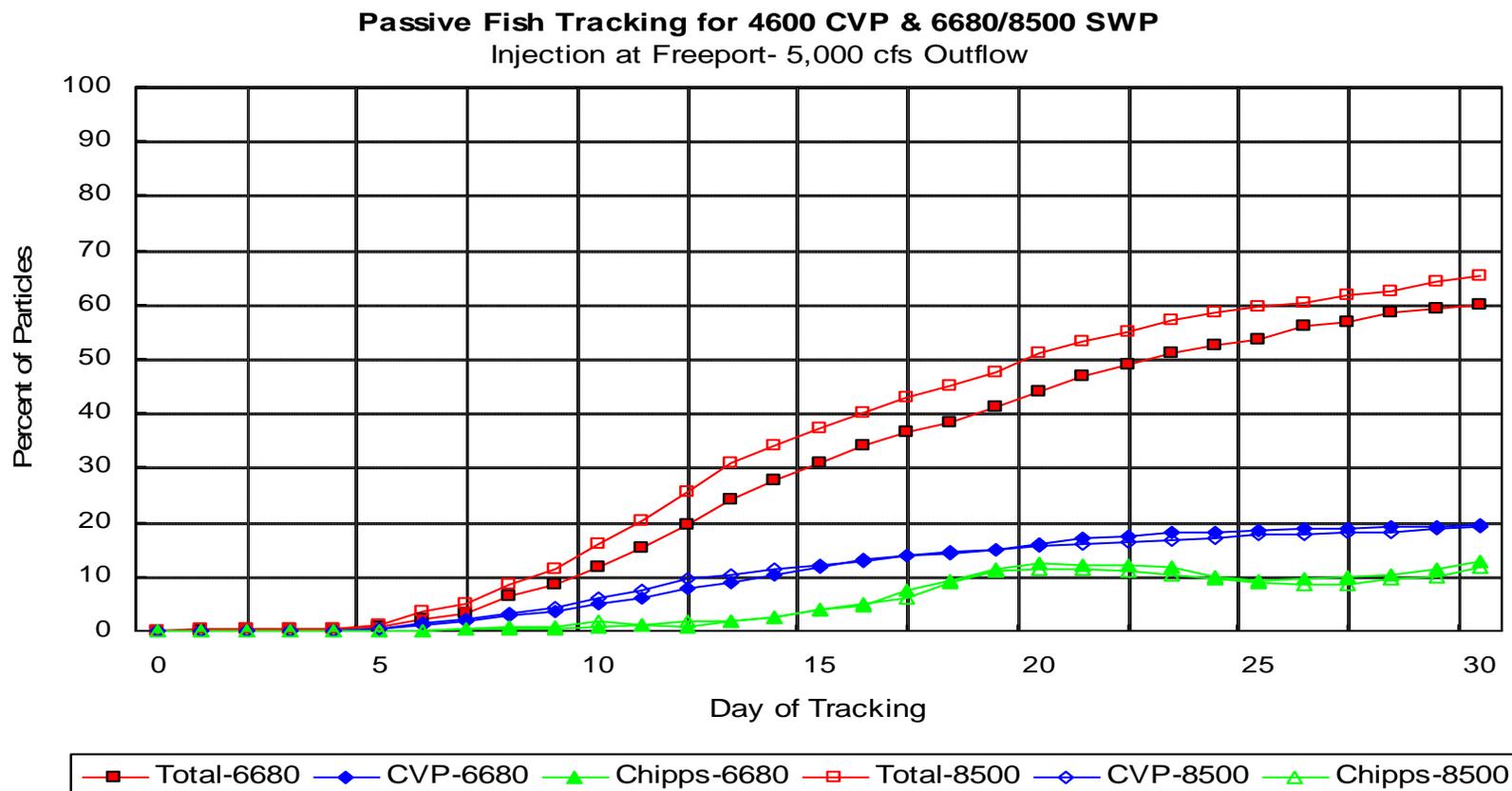
30-day entrainment of particles released from Turner Cut is high; 85% for exports of more than 4,600 cfs; 10-day and 15-day entrainment is reduced by tidal surfing behavior; 30-day entrainment switches from CVP to SWP with tidal surfing but total entrainment remains at 100%



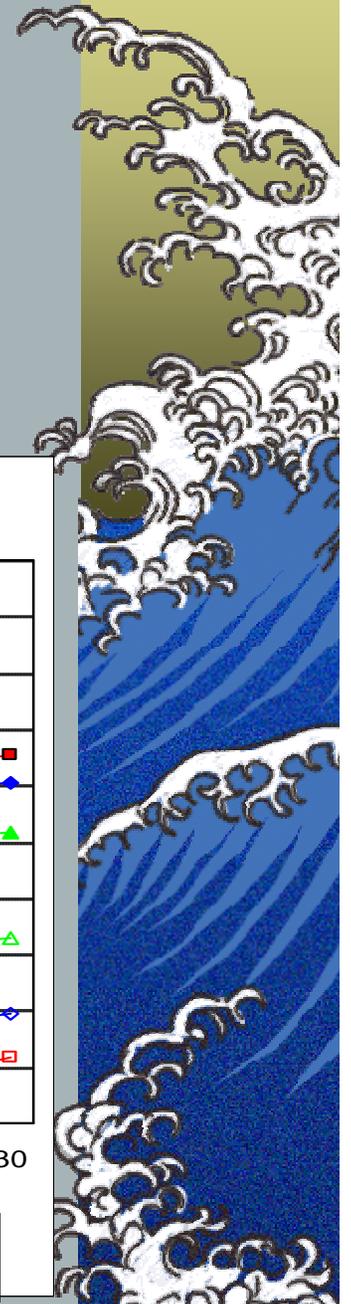
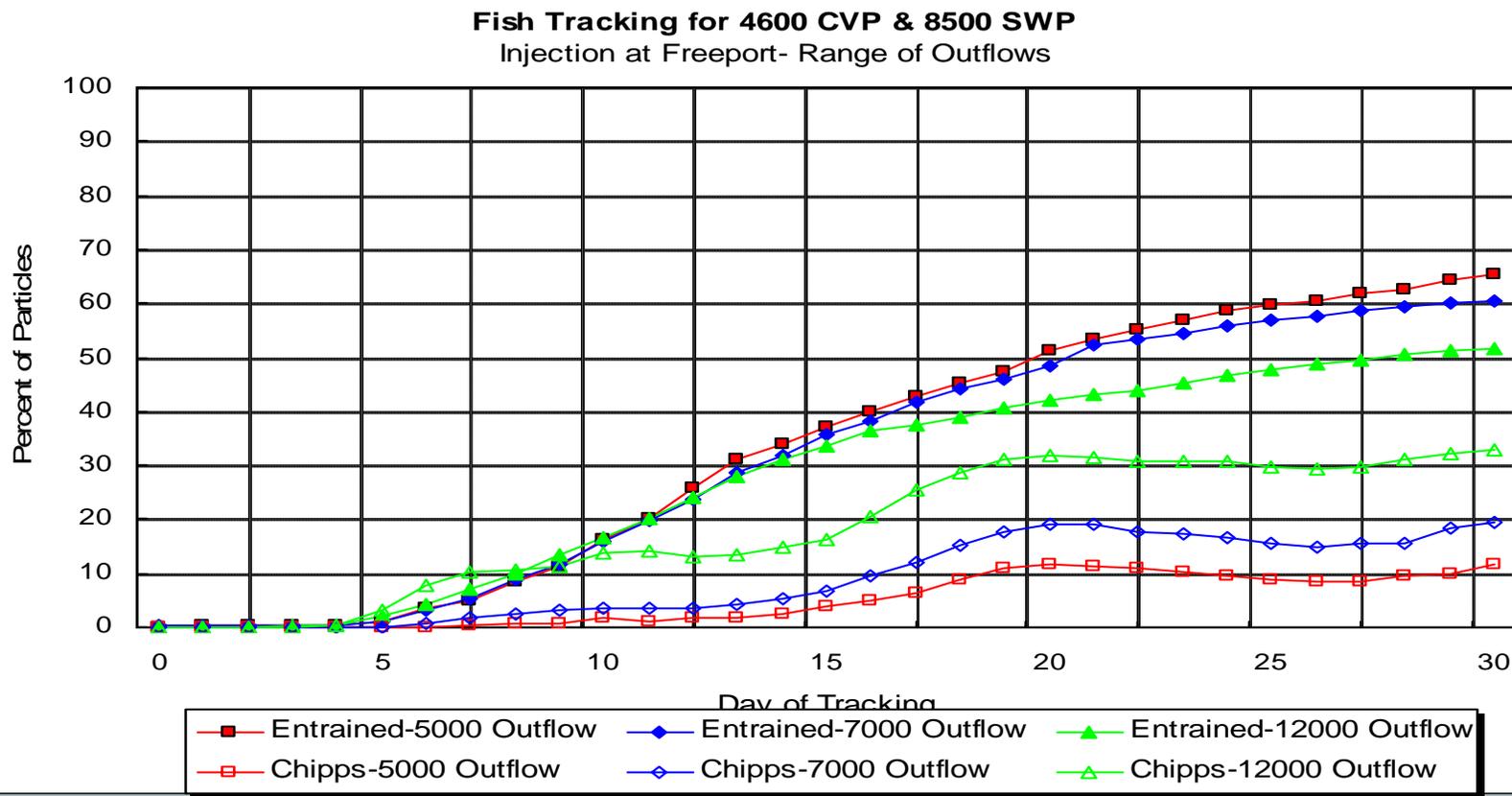
30-day entrainment of particles released from Mosssdale is high; 15-day entrainment is 80% for CVP pumping of 4,600 cfs; 5-day entrainment cannot be reduced by surfing behavior; tidal surfing can only reduce 30-day entrainment by 5%



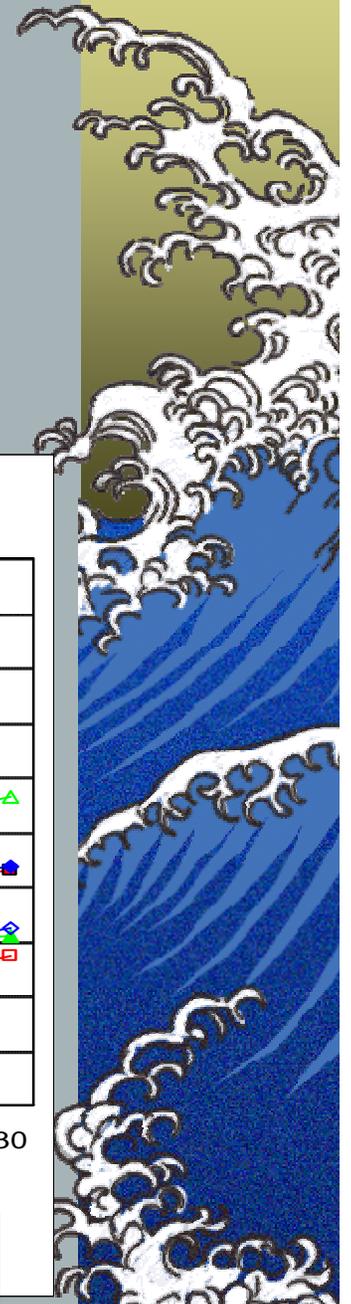
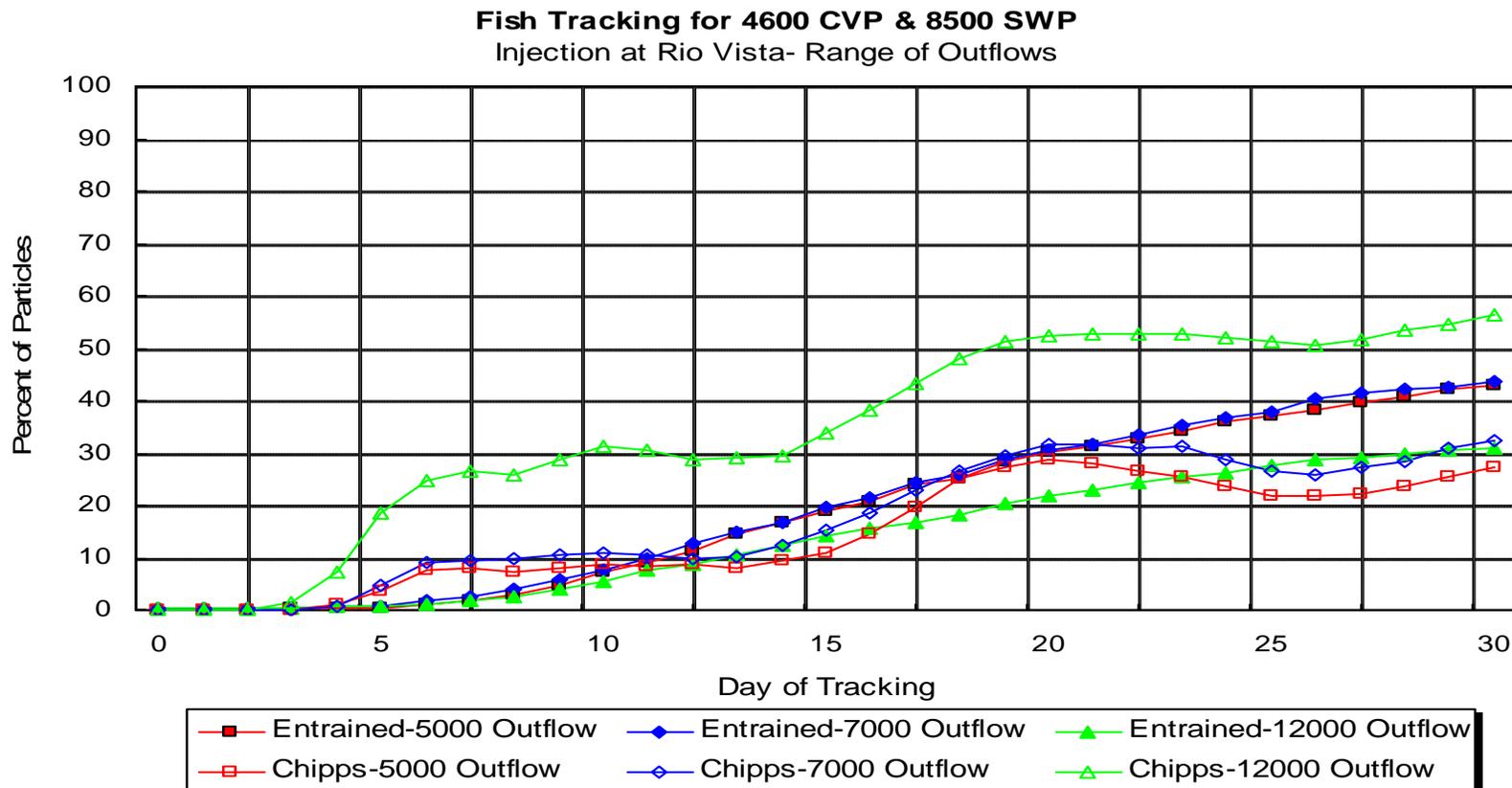
30-day entrainment of particles released from Freeport (with DCC open) increases from 60% with SWP pumping at 6,680 cfs to 65% with 8,500 cfs SWP pumping; 15-day entrainment shows about same increase; about 10% of Freeport particles move past Chipps Island regardless of pumping



30-day entrainment of passive particles released from Freeport is reduced from 65% at 5,000 cfs outflow to 50% at 12,000 cfs outflow; particles moving past Chipps Island increases from 10% at 5,000 cfs outflow to 30% at 12,000 cfs outflow



30-day entrainment of passive particles released from Rio Vista is about 40% at 5,000 cfs or 7,000 cfs outflow; reduced to 30% at 12,000 cfs outflow; particles moving past Chipps Island increases from 25% at 5,000 cfs outflow to 55% at 12,000 cfs outflow



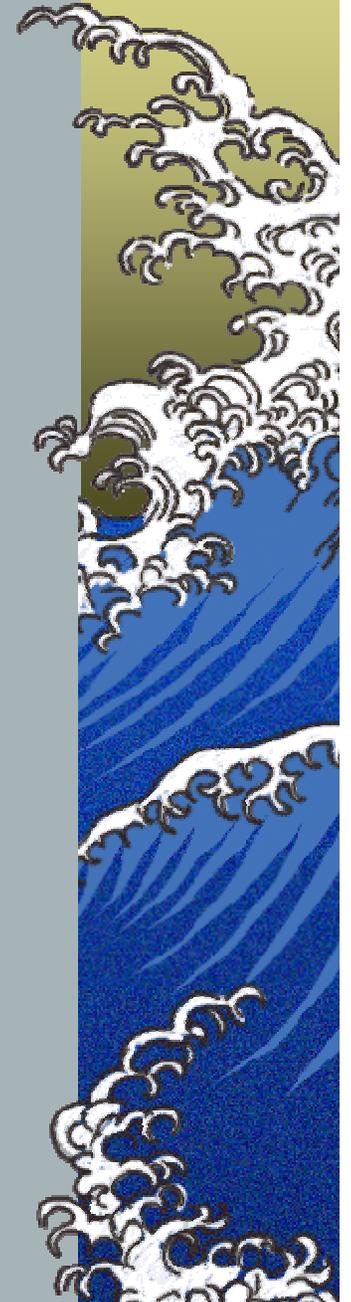
Passive and Tidal Surfing DSM2-PTM Results

- ▶ *Passive or tidal surfing escape from the SJR upstream of Prisoners Point is unlikely: small impacts expected from additional SWP pumping because entrainment is already high*
- ▶ *Passive escape from Jersey Point depends on outflow/exports: 8,500 cfs SWP export will entrain 6% more than 6,680 cfs SWP export: entrainment impacts depend on the percentage of population near Jersey Point*



Passive and Tidal Surfing DSM2-PTM Results

- ▶ *Entrainment of passive particles from Freeport (with DCC open) depends on exports and outflow: 60 % with 6,680 cfs SWP and 65% with 8,500 cfs SWP at 5,000 cfs outflow*
- ▶ *5% less entrainment with 8,500 cfs SWP at 7,000 cfs outflow and 15% less entrainment at 12,000 cfs outflow*



Passive and Tidal Surfing DSM2-PTM Results

- ▶ *Entrainment of tidal surfing particles from Freeport or Jersey Point (or downstream) will be much less than entrainment of passive particles*
- ▶ *impacts of increased SWP pumping depends on export/outflow ratio and tidal trigger (surfing) behavior*



References

Miller, Aaron. (2000). "Chapter 5: DSM2 Particle Tracking Model Development." *Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh. 21st Annual Progress Report to the State Water Resources Control Board.* California Department of Water Resources. Sacramento, CA.

Miller, Aaron. (2002). "Chapter 2: Particle Tracking Model Verification and Calibration." *Methodology for Flow and Salinity Estimates in the Sacramento-San Joaquin Delta and Suisun Marsh. 23rd Annual Progress Report to the State Water Resources Control Board.* California Department of Water Resources. Sacramento, CA.

DWR & Reclamation (2005) SDIP EIS/EIR
Appendix J "Methods for Assessment of Fish
Entrainment in CVP and SWP Exports"

