Slough, which is part of designated critical habitat for green sturgeon. Barker Slough is a dead-end slough without any significant sources of inflow. It does not physically block a migratory corridor, nor does it occur in habitat that appears to be utilized extensively by green sturgeon based on the monitoring surveys mentioned previously. The primary effects of the NBA and the Barker Slough Pumping Plant are related to the entrainment of water from the Cache Slough complex of waterways. The entrainment of water from these waterways can affect the PCE concerned with preservation of the functionality of the migratory corridors for green sturgeon. However the effect the Barker Slough Pumping on this PCE is believed to be negligible because of the relatively small magnitude of the diversion (National Marine Fisheries Service 2009: 418), and there would be relatively little difference in diversions between the NAA and PA (see Table 5.B.5-35 in Appendix 5.B, *DSM2 Methods and Results*).

5.4.1.5.2.7 Other Facilities

5.4.1.5.2.7.1 Contra Costa Canal Rock Slough Intake

Rock Slough is not part of designated critical habitat for green sturgeon.

5.4.1.5.2.7.2 Clifton Court Forebay Aquatic Weed Control Program

Critical habitat for green sturgeon does not include Clifton Court Forebay. As previously described for salmonids, application of herbicides would be done in such a way that critical habitat outside the Forebay would not be affected.

5.4.2 Upstream Hydrologic Changes

For purposes of this analysis, “upstream” refers to waterways upstream of the legal Delta where flows, reservoir storage, and water temperatures and, as a result, listed fish species or critical habitat for such species may be affected by implementation of the PA. Therefore, this section assesses potential effects on listed aquatic species and critical habitat in the American River and Sacramento River upstream of the Delta. The potential effects on listed aquatic species and critical habitat in the Delta resulting from the proposed action (PA) are described in Section 5.4.1, *Proposed Delta Exports and Related Hydrodynamics*.

A preliminary screening analysis was conducted using model outputs of exceedance plots and mean reservoir storage, monthly flows, and water temperatures, where available, in the Trinity, Sacramento, American, San Joaquin, and Stanislaus Rivers and Clear Creek to determine whether modeled flows, storage, and water temperatures in any of these waterways would be clearly not affected by the PA and, therefore, no further analyses of effects on listed aquatic species or critical habitat for such species would be necessary in the waterway.

Results of this preliminary analysis indicated that there would be no effect of the PA on operations in the Trinity, San Joaquin, and Stanislaus Rivers and on Clear Creek (Appendix 5.C, *Upstream Water Temperature Methods and Results*). Accordingly, it was concluded that these areas are not part of the Action area (Chapter 4, *Action Area and Environmental Baseline*). As such, the following listed species or their critical habitat in these waterways are not evaluated in this effects analysis.

- Trinity River: Southern Oregon/Northern California Coastal coho salmon.

- San Joaquin River upstream of the Delta: California Central Valley (CCV) steelhead distinct population segment (DPS).
- Stanislaus River: CCV steelhead DPS.
- Clear Creek: Central Valley spring-run Chinook salmon, CCV steelhead DPS.

This preliminary analysis indicates that there is the potential for changes in reservoir operations, instream flows, and water temperatures in the Sacramento River and American River. Therefore, the analysis of potential effects in each of these rivers is described in detail here.

5.4.2.1 Sacramento River

5.4.2.1.1 Deconstruct the Action

The PA could cause changes in cold-water pool storage in Shasta Reservoir and in operations of Shasta Dam, which could cause changes to instream flows and water temperatures in the Sacramento River. Changes under the PA in the magnitude, duration, frequency, timing, and rate of change of flows in the Sacramento River can all affect habitat characteristics of the life stages of winter- and spring- run Chinook salmon, steelhead, and green sturgeon that are present.

For spawning, egg incubation, and alevins, this analysis evaluates flow-related effects on weighted usable area (WUA) of spawning habitat, redd dewatering, and redd scour. Changes in flow rates can affect the amount of WUA of spawning habitat, which is characterized by velocity, depth, and substrate type (U.S. Fish and Wildlife Service 2003b, 2005a, 2006). Redd dewatering occurs when flows are reduced while eggs and alevins are still in the gravel after a spawning event (U.S. Fish and Wildlife Service 2006). Redd scour and entombment can occur when flood flows are of a high enough magnitude to mobilize the gravel, although attempts are made to spread out flood control releases when possible.

For fry and juveniles, this analysis evaluates flow-related effects on WUA of rearing habitat and juvenile stranding. Changes in flow rates can affect the amount of WUA of rearing habitat, which is characterized by velocity, depth, and substrate type (U.S. Fish and Wildlife Service 2005b). Juvenile stranding can occur when flows are reduced rapidly and individuals are unable to escape an area that becomes isolated from the main channel or dewatered, often leading to mortality (U.S. Fish and Wildlife Service 2006). Appendix 5.D, *Quantitative Methods and Detailed Results for Effects Analysis of Chinook Salmon, Central Valley Steelhead, Green Sturgeon, and Killer Whale*,[28] provides detail on the methods used to evaluate flow effects of the PA.

As cold-water species, salmonids and sturgeon are sensitive to water temperatures. Changes to water temperatures may influence the suitability of habitat for each life stage present in the Sacramento River and can lead to sublethal impairments that include reduced growth, inhibited smoltification, altered migration, disease, and ultimately death. Appendix 5.D provides detail on the methods used to evaluate water temperature effects of the PA.

[28] For brevity, this appendix is cited as Appendix 5.D throughout.

5.4.2.1.2 Assess Species Exposure

The species in the Sacramento River upstream of the Delta that could be affected by implementation of the PA include winter-run and spring-run Chinook salmon, CCV steelhead, and green sturgeon.

5.4.2.1.2.1 Winter-Run Chinook Salmon

Implementation of the PA has the potential to expose winter-run Chinook salmon to different flows and water temperatures than those predicted to occur under the NAA throughout their presence in the Sacramento River upstream of the Delta. Table 5.4-23 presents the timing of the upstream presence of each life stage for winter-run Chinook salmon in the Sacramento River upstream of the Delta. The months included in this table (and in tables for other races and species of fish presented below) represent the periods during which the majority (more than approximately 90%) of fish in a life stage are present.

Table 5.4-23. Temporal Occurrence of Winter-Run Chinook Salmon by Life Stage, Sacramento River Upstream of the Delta.

Life Stage	J	F	M	A	M	J	J	A	S	O	N	D
Spawning, egg incubation, and alevins[1]				Low	Med	High	High	High	High	Low		
Fry and Juvenile rearing[2]							Med	Med	Med	Med	Med	
Juvenile emigration[3]	Low	Low	Low				Low	Med	High	High	Med	Med
Adult immigration[4]	Med	High	High	High	Med	Low	Low	Low				Low
Adult holding[5]	Low	Med	Med	High	High	High	Med	Low				
Legend: dark = High; medium grey = Med; light grey = Low												

Sources: [1] Vogel and Marine 1991; [2] Gaines and Martin 2002; [3] Vogel and Marine 1991; Poytress et al. 2014; [4] National Marine Fisheries Service 1997, Hallock and Fisher 1985, specific to Red Bluff Diversion Dam; [5] Inferred based on immigration and spawning timing

Winter-run Chinook salmon spawn in the Sacramento River and eggs and alevins are in the gravel primarily between April and October with a peak during June through September. Based on CDFW aerial redd surveys from 2003 through 2014, the vast majority (99.3%) of winter-run Chinook salmon spawning between 2003 and 2014 occurred upstream of Airport Road Bridge (RM 284; Table 5.4-24).

Table 5.4-24. Spatial Distribution of Spawning Redds in the Sacramento River Based on Aerial Redd Surveys, Winter-Run Chinook Salmon, 2003–2014 (Source: CDFW)

Reach	Mean Annual Percent of Total Redds Sighted
Keswick Dam to ACID Dam	45.0
ACID Dam to Highway 44 Bridge	42.1
Highway 44 Bridge to Airport Road Bridge	12.2
Airport Road Bridge to Balls Ferry Bridge	0.3
Balls Ferry Bridge to Battle Creek	0.1
Battle Creek to Jelly’s Ferry Bridge	0.1
Jelly’s Ferry Bridge to Bend Bridge	0.1
Bend Bridge to Red Bluff Diversion Dam	0.0
Downstream of Red Bluff Diversion Dam	0.1

ACID = Anderson-Cottonwood Irrigation District

Juvenile winter-run Chinook salmon rear in the Sacramento River primarily between July and November. Fry and juvenile rearing occurs from Keswick Dam to the Delta. Many juveniles apparently rear in the Sacramento River below Red Bluff Diversion Dam for several months before they reach the Delta (Williams 2006). Juveniles begin moving downstream towards the ocean beginning in July and continue until March, with a peak migration period of September and October observed at Red Bluff Diversion Dam. The peak of winter run juvenile emigration at Knights Landing is November through February, although this is not reflected in Table 5.4-23.

Adult winter-run Chinook salmon migrate upstream primarily during December through August, with a peak during February through April. Adults then hold from approximately January through August until they spawn, with a peak holding period of April through June.

5.4.2.1.2.2 Spring-Run Chinook Salmon

Implementation of the PA has the potential to expose spring-run Chinook salmon to different flows and water temperatures than those predicted to occur under the NAA throughout their presence in the Sacramento River upstream of the Delta. Table 5.4-25 presents the timing of the upstream presence of each life stage for spring-run Chinook salmon in the Sacramento River upstream of the Delta.

Table 5.4-25. Temporal Occurrence of Spring-Run Chinook Salmon by Life Stage, Sacramento River Upstream of the Delta.

Life Stage	J	F	M	A	M	J	J	A	S	O	N	D
Spawning, egg incubation, and alevins[1]								Med	High	High	Med	Low
Fry and Juvenile rearing[2]	Med	Med	Med	Med	Med	Med	Med	Med	Med	Med	High	High
Juvenile emigration[3]	Med	Low	Med	High	Med					High	High	High
Adult immigration[4]			Med	Med	High	High	Med	Med	Low			
Adult holding[5]				Med	High	High	High	High	Low			

Legend: (dark) High; (medium grey) Med; (light grey) Low

Sources: [1] Moyle 2002; CDFW aerial redd surveys; [2] Snider and Titus 2000; Poytress et al 2014; [3] California Department of Fish and Game 1998, Snider and Titus 2000; Poytress et al 2014; specific to Red Bluff Diversion Dam;[4] Yoshiyama et al. 1998, Moyle 2002; [5] Inferred based on timing of adjacent life stages

Spring-run Chinook salmon may spawn in the Sacramento River between RBDD and Keswick Dam in very low densities with only a total of 449 redds documented from 2001 through 2014 (average 35/year; range= 0-105; no data available for 2009 or 2011) in CDFW aerial redd surveys. Eggs and alevins remain in the gravel primarily between August and December, with a peak between September and October. The vast majority (more than 91%) of spawning between 2003 and 2014 occurred upstream of Battle Creek (River Mile 272; Table 5.4-26).

Table 5.4-26. Spatial Distribution of Spawning Redds in the Sacramento River Based on Aerial Redd Surveys, Spring-Run Chinook Salmon, 2003–2014 (Source: CDFW)

Reach	Mean Annual Percent of Total Redds Sighted
Keswick Dam to ACID Dam	12.4
ACID Dam to Highway 44 Bridge	32.8
Highway 44 Bridge to Airport Road Bridge	27.7
Airport Road Bridge to Balls Ferry Bridge	10.9
Balls Ferry Bridge to Battle Creek	7.3
Battle Creek to Jelly's Ferry Bridge	1.5
Jelly's Ferry Bridge to Bend Bridge	2.6
Bend Bridge to Red Bluff Diversion Dam	0.8
Downstream of Red Bluff Diversion Dam	4.1

ACID = Anderson-Cottonwood Irrigation District

Juvenile spring-run Chinook salmon rear in the Sacramento River year-round, with a peak between November and December. Fry and juvenile rearing occur from Keswick to the Delta. Juveniles begin moving downstream towards the ocean beginning in October and continue until May, with peak migration periods of April and October through December. The peak of spring run juvenile emigration at Knights Landing is February through May (Snider and Titus 2000), although this is not reflected in Table 5.4-25.

Adult spring-run Chinook salmon migrate upstream primarily as early as March with a peak between May and June. Temperatures in the mainstem and Delta are likely too warm for migrating salmon by summer, although holding spring-run Chinook likely hold and move throughout the upper Sacramento once they have ascended the river. Adults display these behaviors from approximately April through September until they spawn in September. It is uncertain how late into summer spring-run Chinook salmon migrate into the Sacramento River. On tributaries, typically spring-run Chinook salmon cannot ascend to cooler water later than May or early June. On the Feather River, hatchery spring run Chinook salmon are identified as fish entering the ladder no later than June. While Red Bluff Diversion Dam once blocked spring-run Chinook passage and significantly delay migration of spring run Chinook such that they passed throughout the summer, this broad migration pattern is likely not natural given spring-run Chinook migration patterns from Northern Valley tributaries and the Feather River.

5.4.2.1.2.3 California Central Valley Steelhead

Implementation of the PA has the potential to expose CCV steelhead to different flows and water temperatures than those predicted to occur under the NAA throughout their presence in the Sacramento River upstream of the Delta. Table 5.4-27 presents the timing of the upstream presence of each life stage for steelhead in the Sacramento River upstream of the Delta.

Table 5.4-27. Temporal Occurrence of California Central Valley Steelhead by Life Stage, Sacramento River Upstream of the Delta.

Life Stage	J	F	M	A	M	J	J	A	S	O	N	D
Spawning, egg incubation, and alevins[1]												
Kelt emigration[2]												
Juvenile rearing[3]												
Smolt emigration[3,4]												
Adult immigration[5]												
Adult holding[6]												
		High			Med				Low			

Sources:; [1] Reclamation 2008; [2] inferred from spawning period; [3] Gaines and Martin 2002; [4] Does not include migrant parr; [5] CDFW unpublished counts at RBDD 1966–1994; [6] Inferred from adjacent life stages

CCV steelhead may spawn in the Sacramento River and eggs and alevins remain in the gravel primarily between December and May. Recent steelhead monitoring data are scarce for the Upper Sacramento River system but numbers are considered low, and there is a strong resident component to the population (referred to as rainbow trout) that interacts with and produces both resident and anadromous offspring. Little is known about steelhead spawning locations in the Sacramento River, although it was assumed for this analysis that, because of constraints on water temperature and other habitat features, individuals spawn between Keswick Dam and Red Bluff Diversion Dam, where nearly all Chinook salmon spawn. After spawning, steelhead adults either die or kelts emigrate back to the ocean between February and May.

Juvenile steelhead rear for 1 to 3 years in the Sacramento River from Keswick Dam to the Delta. Therefore, individuals are present in the river throughout the year. Smolts begin migrating downstream towards the ocean beginning in November and continue until June, with a peak migration period of January through March.

Adult CCV steelhead migrate upstream during August and March with a peak between September and November. Adults then hold from September through November until they spawn.

5.4.2.1.2.4 Green Sturgeon

Implementation of the PA has the potential to expose green sturgeon to different flows and water temperatures than those predicted to occur under the NAA throughout their presence in the Sacramento River upstream of the Delta. Table 5.4-28 presents the timing of the upstream presence of each life stage for green sturgeon in the Sacramento River upstream of the Delta.

Table 5.4-28. Temporal Occurrence of Green Sturgeon by Life Stage, Sacramento River Upstream of the Delta

Life Stage	J	F	M	A	M	J	J	A	S	O	N	D
Spawning, egg incubation[1]			Low	High	High	High	Low					
Pre- and post-spawn adult holding[2]		Low	Med	Med	Med	Med	Med	Med	Med	Med	Med	Med
Post-spawn emigration[3]	Med			Med	Med	Med	Med	Med	Med	Med	Med	Med
Larval to juvenile rearing and emigration[4]	Low	Low	Low	Low	Med	High	High	Med	Med	Low	Low	Low
Adult immigration[5]		Low	Med	Med	Med	Med						

Legend: High | Med | Low

Sources: [1]; Poytress et al. 2009, 2010, 2011, 2012; [2] Israel and Klimley 2008; [3] Heublein et al. 2009; [4] National Marine Fisheries Service 2009; Poytress et al. 2014; [5] Reclamation 2008

Green sturgeon spawn and eggs incubate in the Sacramento River upstream of Hamilton City (RM 200) to as far upstream as Ink's Creek confluence (RM 281) and possibly up to the Cow Creek confluence (RM 280) (Brown 2007; Poytress et al. 2013) between March and July, with a peak between April and June. Larvae and juveniles rear and migrate year-round in much of the spawning reach and downstream. Therefore, individuals are present in this reach of the river throughout the year.

Adult green sturgeon migrate upstream primarily during February and June. Adults hold near spawning reaches beginning in February until they spawn and then after spawning until December. Post-spawning emigration occurs between April and January of the following year.

5.4.2.1.3 Assess Species Response to the Proposed Action

5.4.2.1.3.1 Winter-Run Chinook Salmon

5.4.2.1.3.1.1 Spawning, Egg Incubation, and Alevins

5.4.2.1.3.1.1.1 Flow-Related Effects

Estimated mean monthly flow rates and reservoir storage volumes were examined for the PA and NAA in the Sacramento River at the Keswick Dam to Red Bluff locations during the April through October spawning and egg incubation period, with peak occurrence during July through September, for winter-run Chinook salmon (Table 5.4-23). Changes in flow can affect the instream area available for spawning and egg incubation, along with the quality of the habitat, and can result in dewatering or scour of the redds. Shasta Reservoir storage volume at the end of May can influence flow rates below the dam during much of the winter-run salmon spawning and egg incubation period. Mean Shasta May storage volume under the PA would be similar (less than 5% difference) to storage under NAA for all water year types (Appendix 5.A, *CALSIM Methods and Results*, Table 5.A.6-3). During the majority of months and water year types of the winter-run spawning period, the PA would result in minor changes (less than 5% difference) in mean flow in the Sacramento River at the Keswick Dam to Red Bluff locations (Appendix 5.A, *CALSIM Methods and Results*, Table 5.A.6-10, Table 5.A.6-35). However, at both locations, flows under the PA would be 5% to 7% higher than the NAA during May of dry years and June of all water year types except wet years, and would be up to 17% higher in October of below normal and dry years. Flows under the PA would be 5% to 11% lower than the NAA in September of all except wet water year types, October of wet years, and August of below normal water years. The flow reductions in August and September occur within the peak winter-run spawning period (July through September). The results given here indicate that the PA would reduce flow in some months and water year types, although this does not consider real-time operational management described in Section 3.1.5, *Real-Time Operations Upstream of the Delta*, and Section 3.3.3, *Real-Time Operational Decision-Making Process*, that would be used to avoid and minimize any modeled effects. Further discussion regarding flow-related effects during the June through November period is provided in Section 5.4.2.3, *Summary of Upstream Effects*.

5.4.2.1.3.1.1.1.1 Spawning WUA

Spawning weighted usable area (WUA) provides a metric of spawning habitat availability that accounts for the spawning requirements of the fish with respect to water depth, flow velocity, and substrate. Spawning WUA for winter-run Chinook salmon was determined by USFWS (2003a, 2006) for a range of flows in three segments of the Sacramento River between Keswick Dam and the Battle Creek confluence (Appendix 5.D, Section 5.D.2.2, *Spawning Flows Methods*). Segment 4 stretches 8 miles from Battle Creek to the confluence with Cow Creek; Segment 5 reaches 16 miles from Cow Creek to the A.C.I.D. Dam; and Segment 6 covers 2 miles from A.C.I.D. Dam to Keswick Dam. The Cow Creek confluence is about midway between the Airport Road Bridge and Balls Ferry and, therefore, based on CDFW aerial survey results (Table 5.4-24), 45% of winter-run Chinook salmon redds occur within Segment 6 and most of the remainder are found within Segment 5. To estimate changes in spawning WUA that would result from the PA, the flow-versus-spawning habitat WUA relationship developed for each of these segments was used with mean monthly CALSIM II flow estimates for the midpoint of each segment under the PA and the NAA during the winter-run spawning and egg incubation period. Further information on the WUA analysis methods is provided in Appendix 5.D, Section 5.D.2.2, *Spawning Flows Methods*.

Differences in winter-run spawning WUA under the PA and NAA were examined using exceedance plots of monthly mean WUA for the winter-run spawning period in each of the river segments for each water year type and all water year types combined. The exceedance curves for the PA generally match those of the NAA for all water year types in all three segments (Figure 5.4-30–Figure 5.4-47).

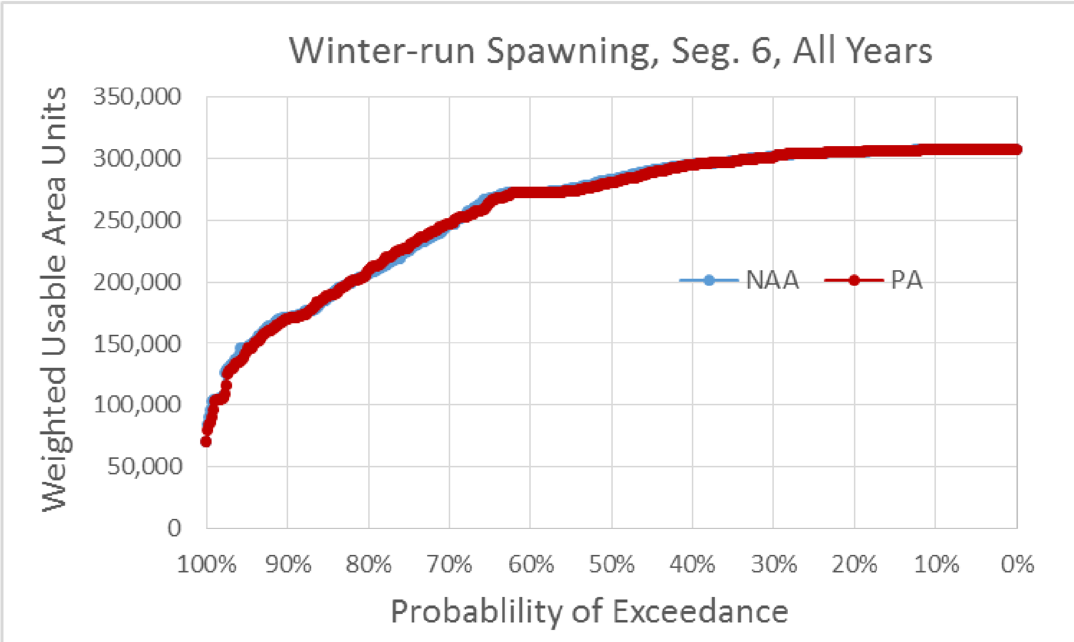

Figure 5.4-30. Exceedance Plot of Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) for NAA and PA Model Scenarios in River Segment 6, All Water Years

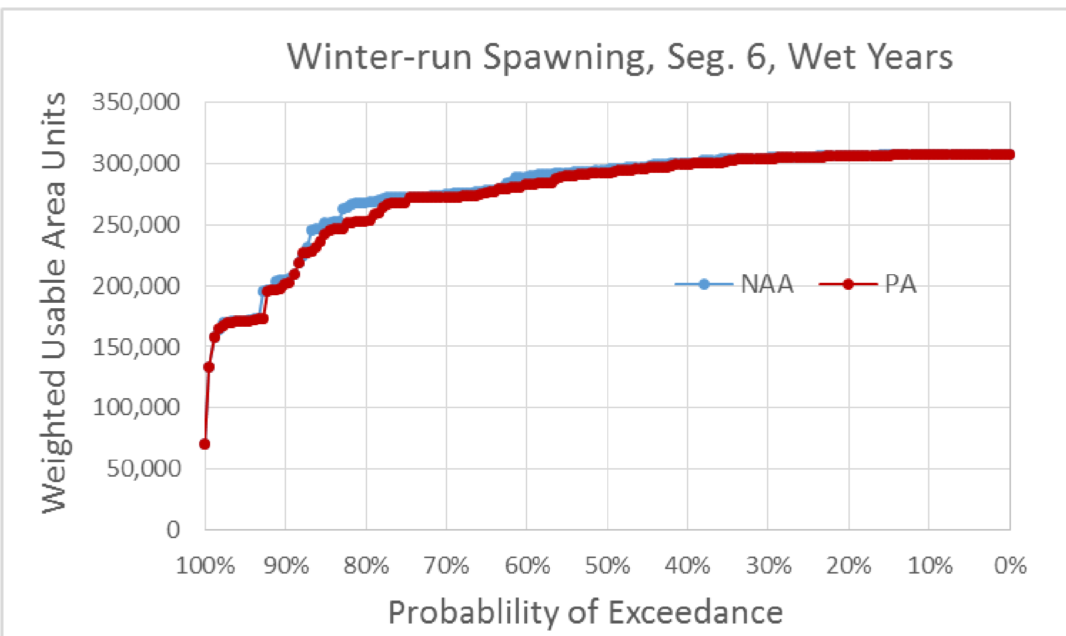

Figure 5.4-31. Exceedance Plot of Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) for NAA and PA Model Scenarios in River Segment 6, Wet Water Years

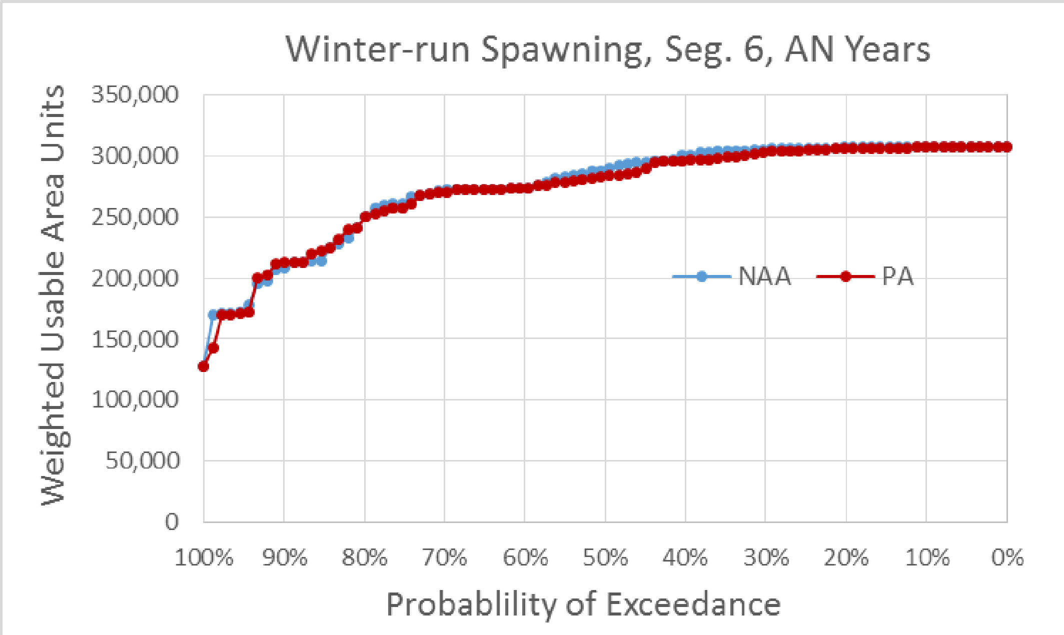

Figure 5.4-32. Exceedance Plot of Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) for NAA and PA Model Scenarios in River Segment 6, Above Normal Water Years

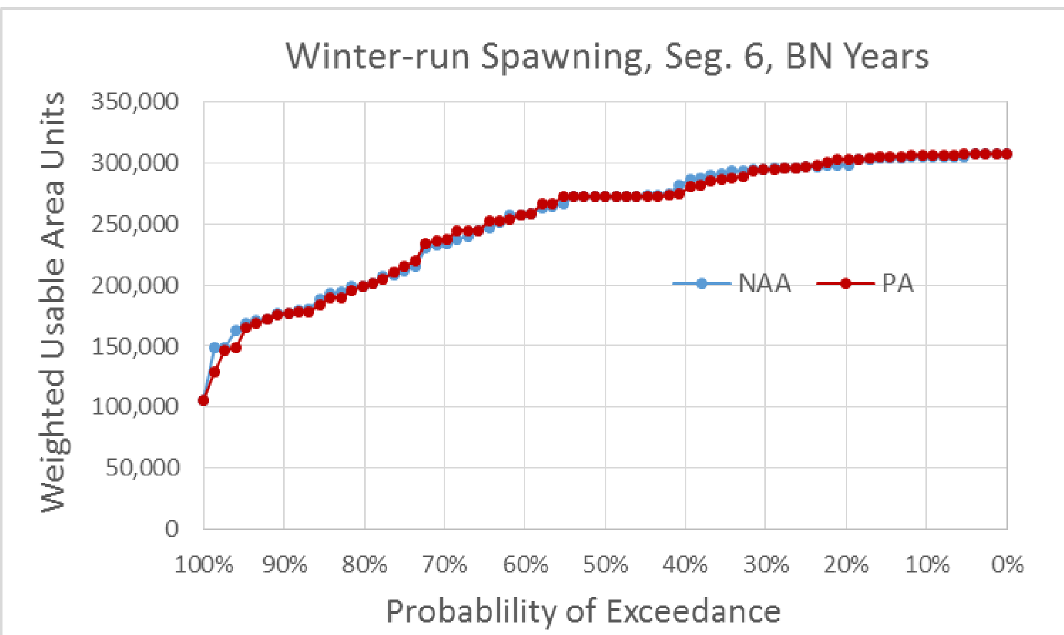

Figure 5.4-33. Exceedance Plot of Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) for NAA and PA Model Scenarios in River Segment 6, Below Normal Water Years

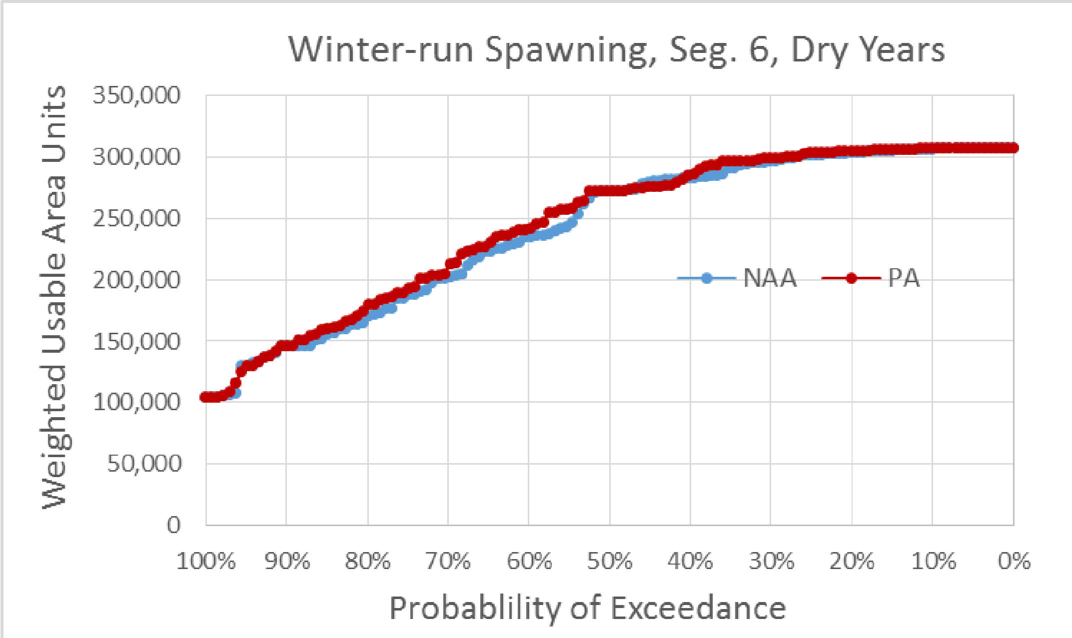

Figure 5.4-34. Exceedance Plot of Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) for NAA and PA Model Scenarios in River Segment 6, Dry Water Years

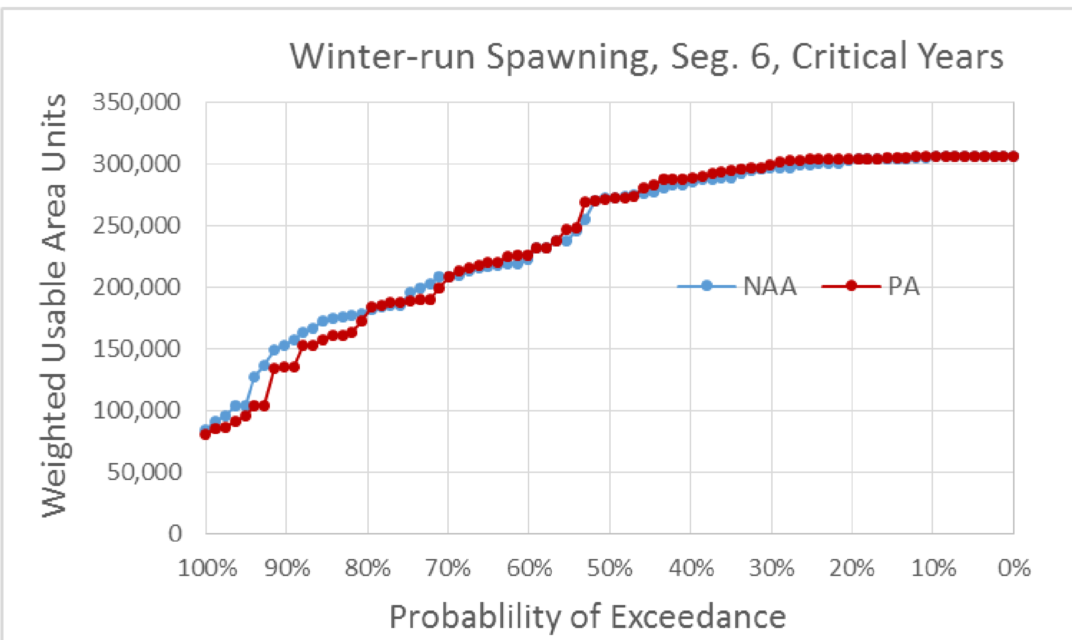

Figure 5.4-35. Exceedance Plot of Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) for NAA and PA Model Scenarios in River Segment 6, Critical Water Years

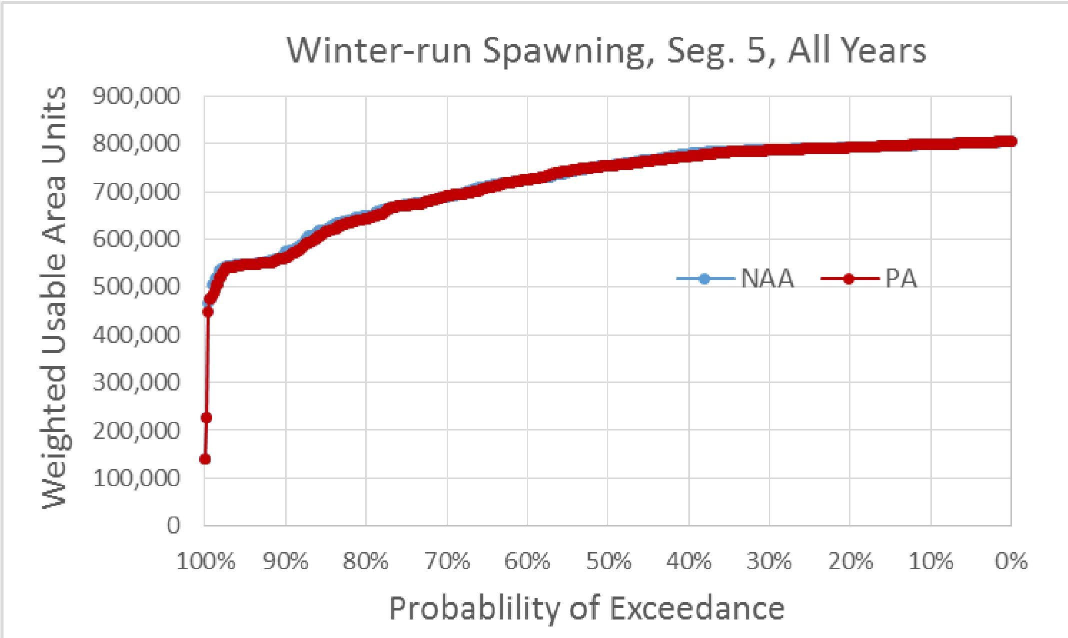

Figure 5.4-36. Exceedance Plot of Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) for NAA and PA Model Scenarios in River Segment 5, All Water Years

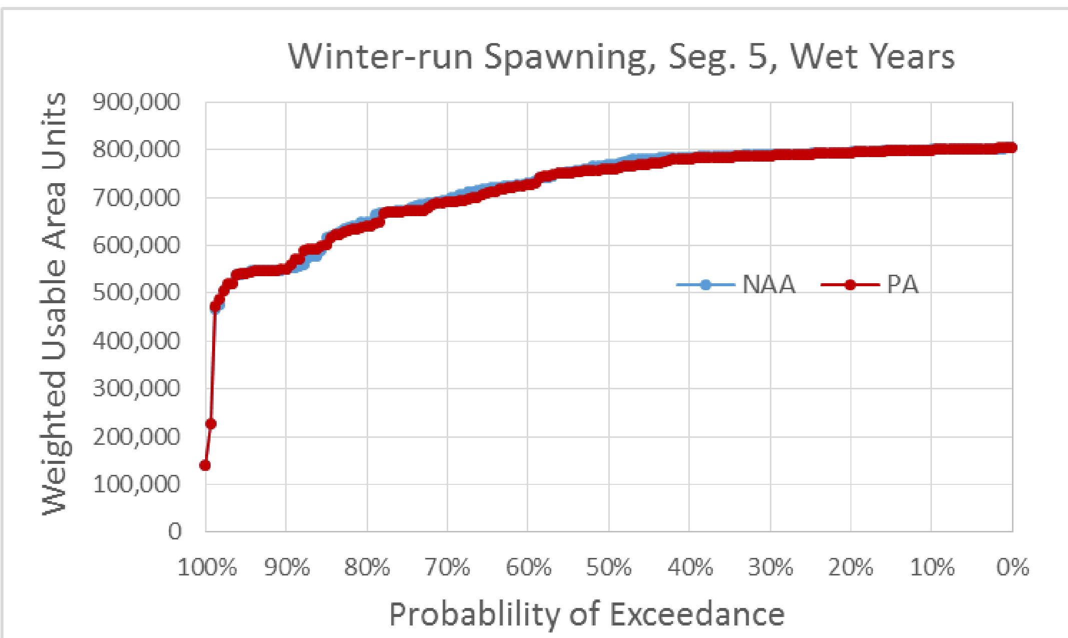

Figure 5.4-37. Exceedance Plot of Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) for NAA and PA Model Scenarios in River Segment 5, Wet Water Years

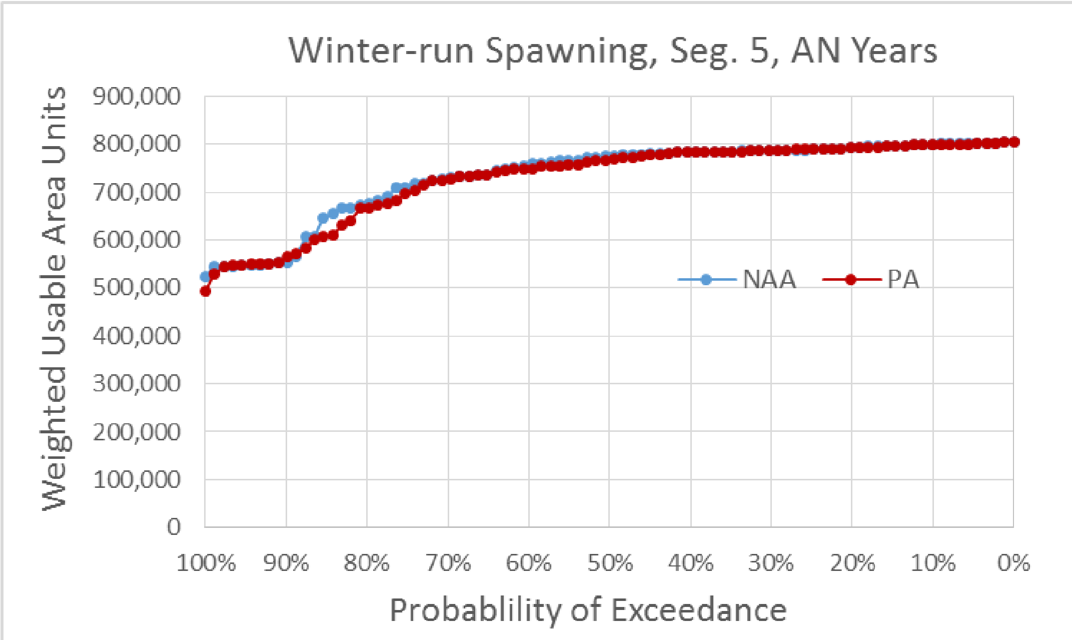

Figure 5.4-38. Exceedance Plot of Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) for NAA and PA Model Scenarios in River Segment 5, Above Normal Water Years

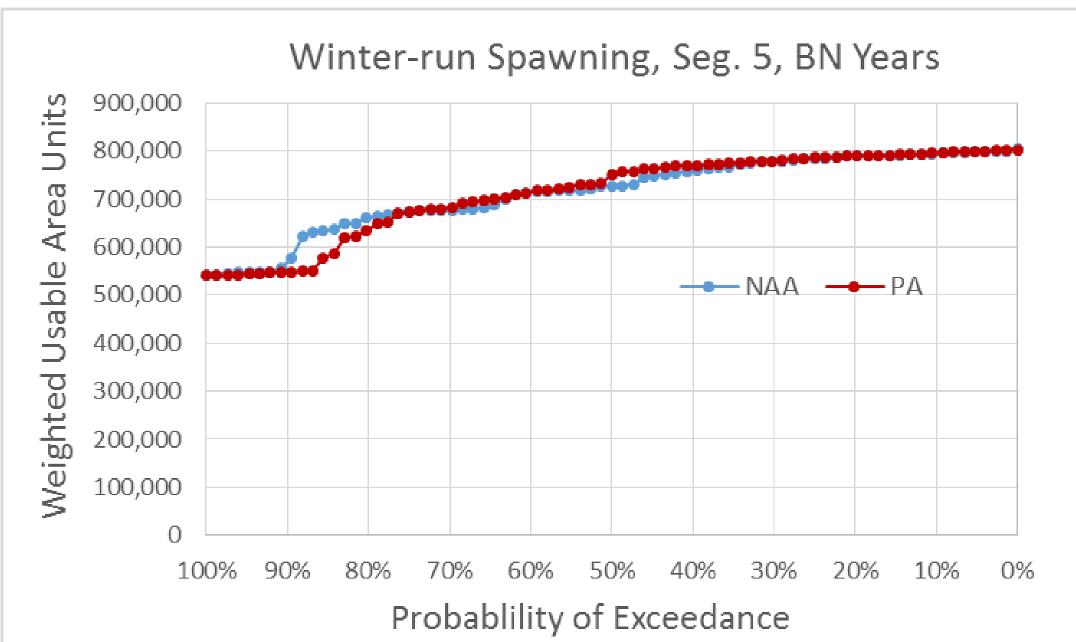

Figure 5.4-39. Exceedance Plot of Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) for NAA and PA Model Scenarios in River Segment 5, Below Normal Water Years

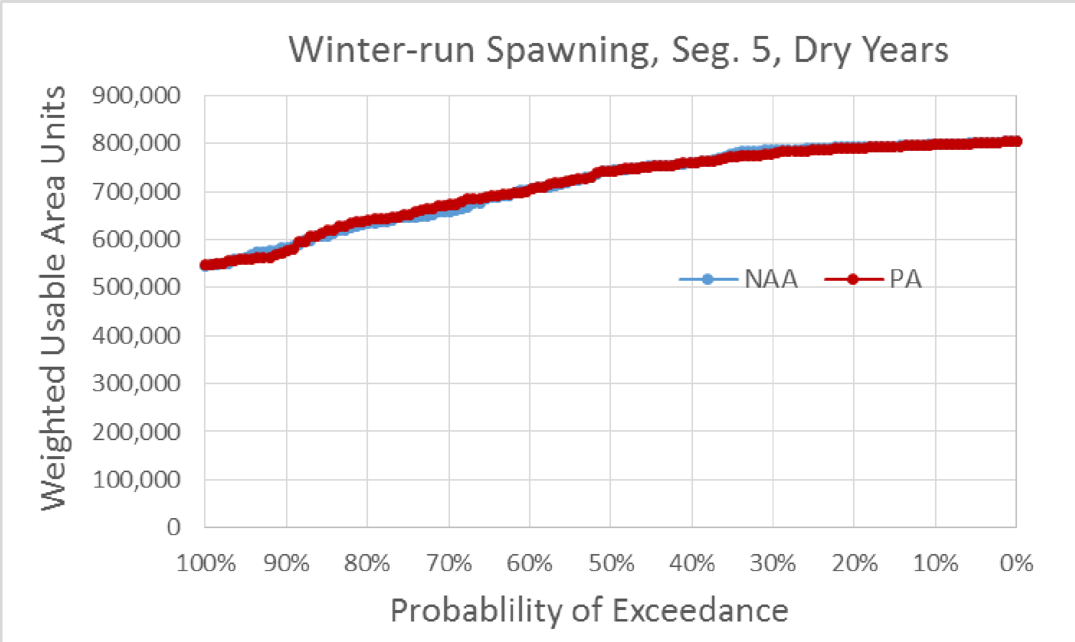

Figure 5.4-40. Exceedance Plot of Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) for NAA and PA Model Scenarios in River Segment 5, Dry Water Years

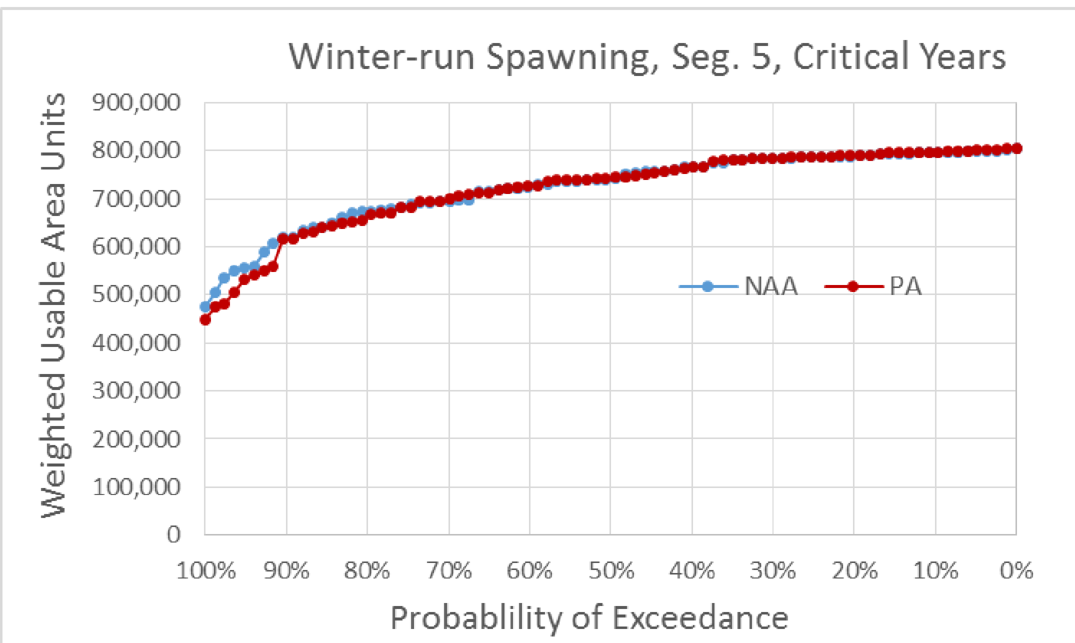

Figure 5.4-41. Exceedance Plot of Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) for NAA and PA Model Scenarios in River Segment 5, Critical Water Years

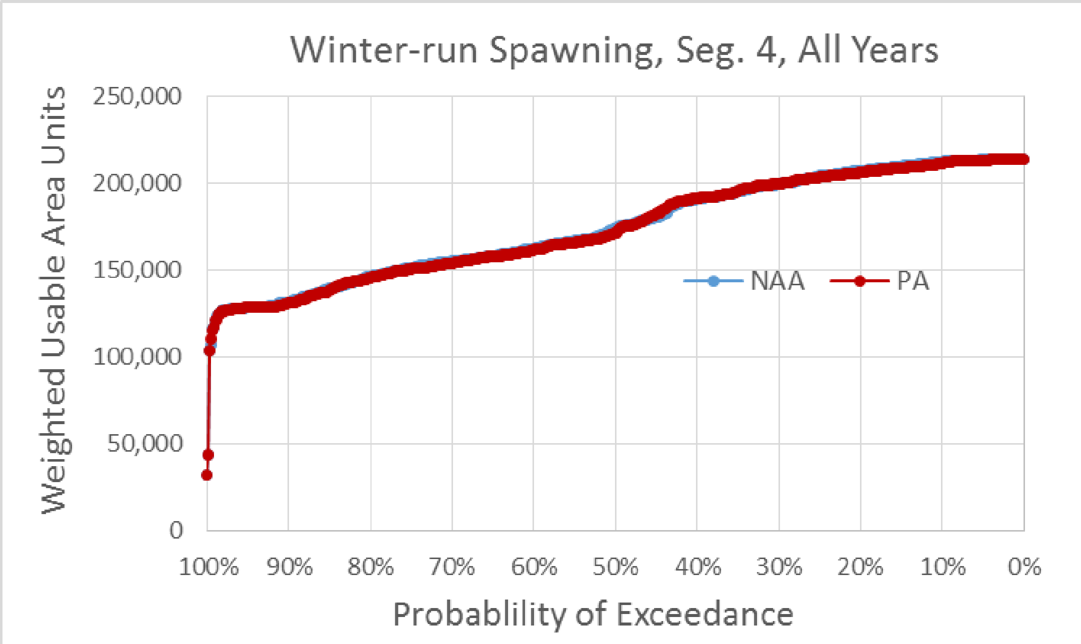

Figure 5.4-42. Exceedance Plot of Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) for NAA and PA Model Scenarios in River Segment 4, All Water Years

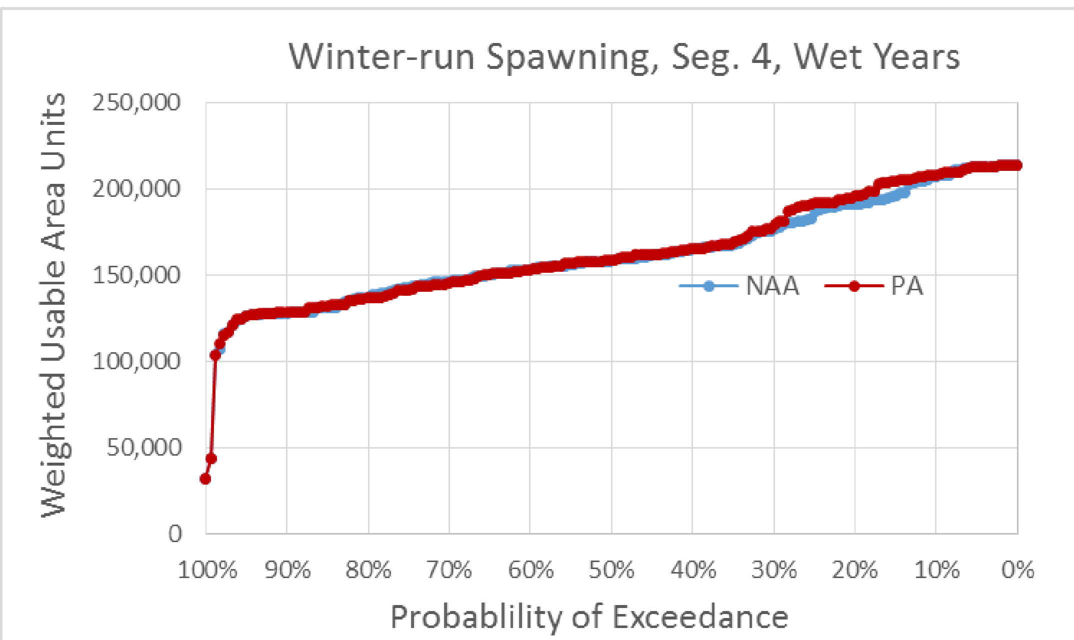

Figure 5.4-43. Exceedance Plot of Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) for NAA and PA Model Scenarios in River Segment 4, Wet Water Years

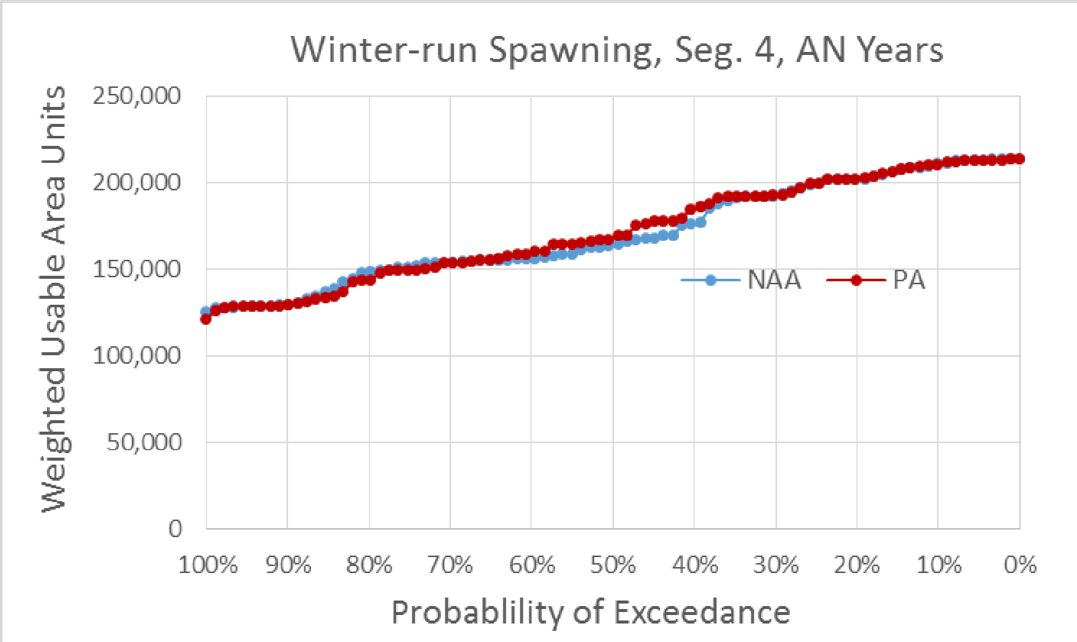

Figure 5.4-44. Exceedance Plot of Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) for NAA and PA Model Scenarios in River Segment 4, Above Normal Water Years

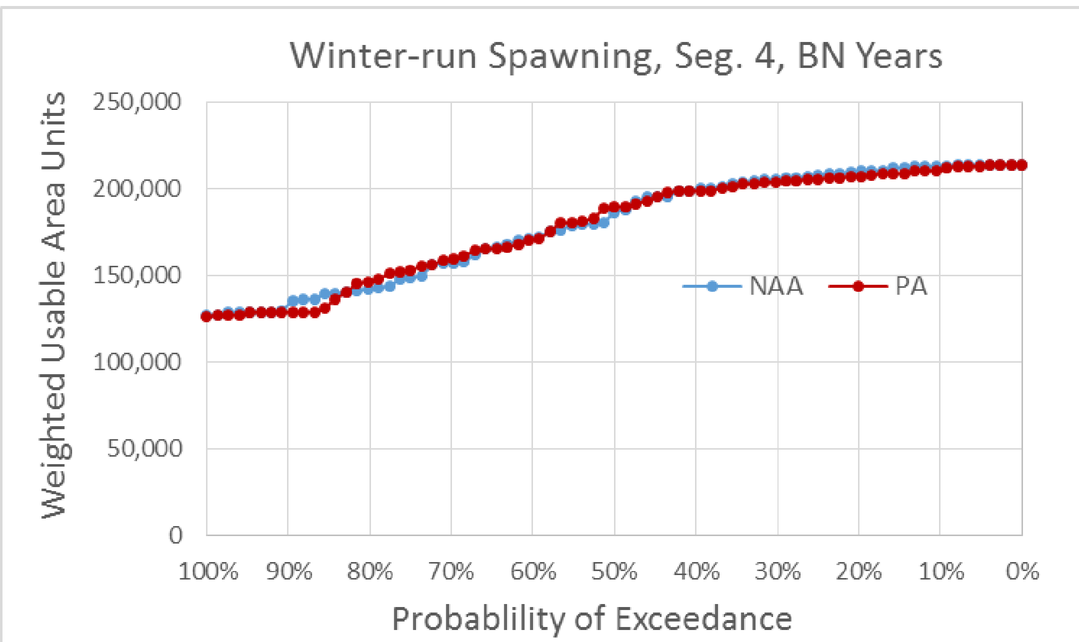

Figure 5.4-45. Exceedance Plot of Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) for NAA and PA Model Scenarios in River Segment 4, Below Normal Water Years

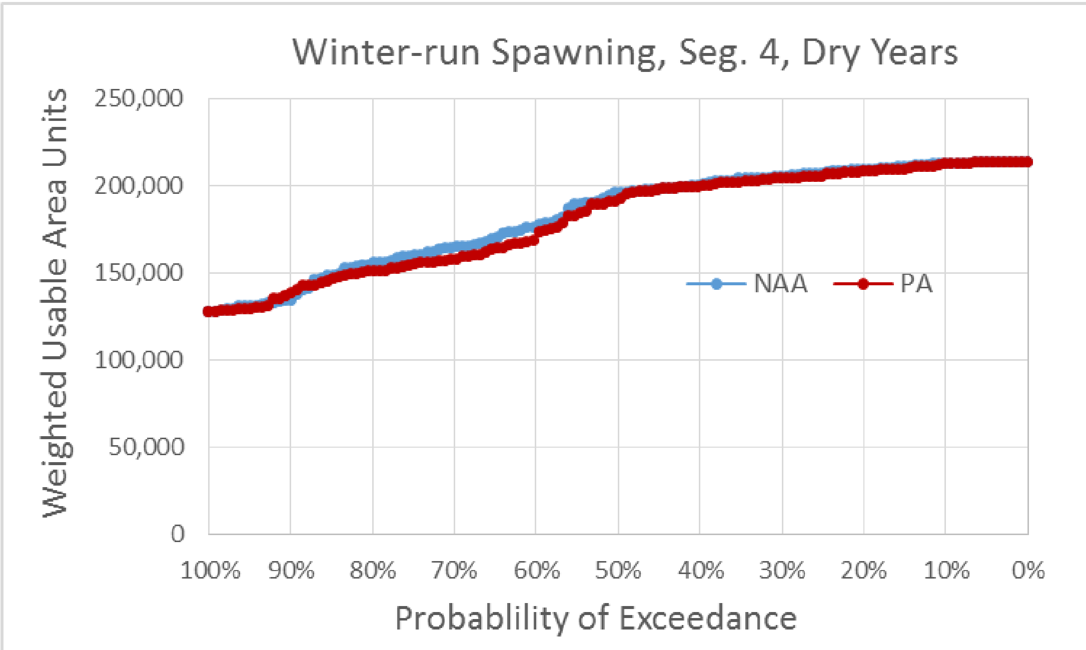

Figure 5.4-46. Exceedance Plot of Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) for NAA and PA Model Scenarios in River Segment 4, Dry Water Years

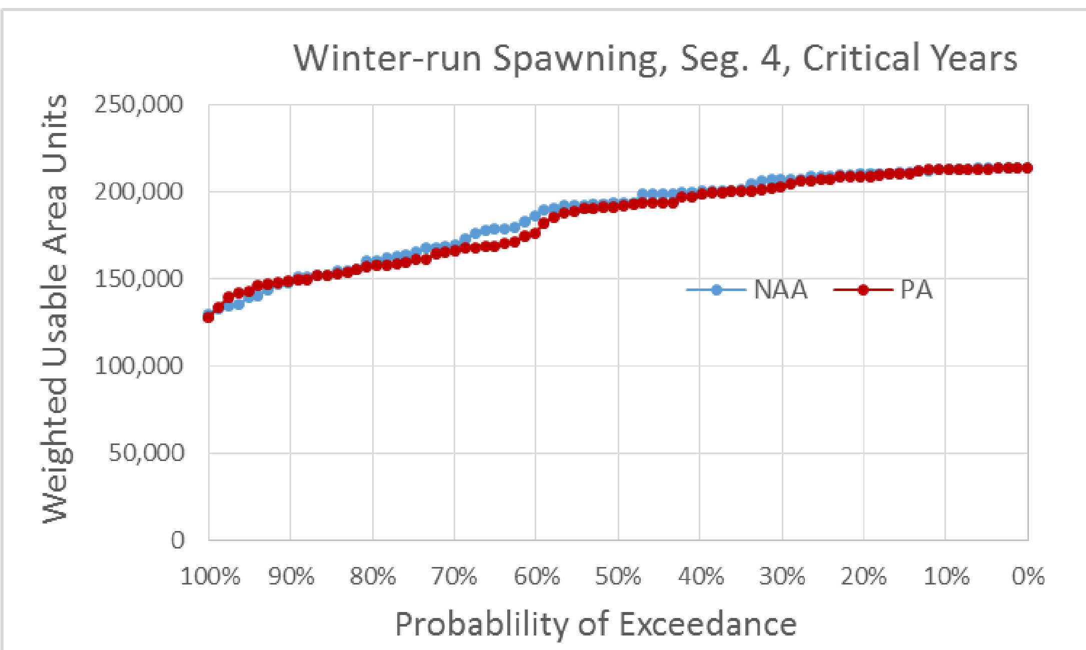

Figure 5.4-47. Exceedance Plot of Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) for NAA and PA Model Scenarios in River Segment 4, Critical Water Years

Differences in spawning WUA in each segment under the PAA and NAA were also examined using the grand mean spawning WUA for each month of the spawning period under each water year type and all water year types combined (Table 5.4-29 to

Table 5.4-31). The means differed by less than 5% for most months and water year types, but mean WUA in Segment 6 under the PA was up to 12% lower than that under the NAA in September (below normal years) and up to 15% higher in October (below normal years). In the other two segments, the largest differences in mean WUA between the PA and NAA were 6%, except for an 8% higher WUA for the PA in Segment 4 in September of above normal years. Further discussion regarding flow-related effects during the June through November period is provided in Section 5.4.2.3, *Summary of Upstream Effects*.

Table 5.4-29. Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) and Differences (Percent Differences) in River Segment 6 between Model Scenarios (green indicates PA is at least 5% higher [raw difference] than NAA; red indicates PA is at least 5% lower)

Month	WYT	NAA	PA	PA vs. NAA
April	Wet	216,522	217,519	997 (0.5%)
	Above Normal	221,764	222,044	280 (0.1%)
	Below Normal	215,429	211,200	-4,229 (-2%)
	Dry	178,104	184,522	6,418 (4%)
	Critical	227,592	231,978	4,386 (2%)
	All	209,456	211,457	2,001 (1%)
May	Wet	276,320	275,628	-692 (-0.3%)
	Above Normal	262,042	263,867	1,825 (1%)
	Below Normal	265,550	264,156	-1,394 (-1%)
	Dry	245,321	253,132	7,812 (3%)
	Critical	244,786	248,484	3,699 (2%)
	All	260,436	262,766	2,330 (1%)
June	Wet	300,750	299,713	-1,037 (-0.3%)
	Above Normal	303,673	299,032	-4,641 (-1.5%)
	Below Normal	299,363	292,133	-7,230 (-2%)
	Dry	300,122	298,338	-1,785 (-1%)
	Critical	298,345	300,412	2,067 (1%)
	All	300,522	298,355	-2,167 (-1%)
July	Wet	288,622	287,598	-1,024 (-0.4%)
	Above Normal	275,604	276,013	408 (0.1%)
	Below Normal	281,204	278,891	-2,313 (-1%)
	Dry	289,472	291,323	1,851 (1%)
	Critical	295,595	299,558	3,964 (1%)
	All	286,791	287,252	461 (0.2%)
August	Wet	304,239	304,335	96 (0.03%)
	Above Normal	305,230	306,481	1,252 (0.4%)
	Below Normal	299,726	304,102	4,376 (1%)
	Dry	296,651	299,775	3,124 (1%)
	Critical	289,022	286,724	-2,298 (-1%)
	All	299,713	300,955	1,241 (0.4%)

Month	WYT	NAA	PA	PA vs. NAA
September	Wet	285,342	288,294	2,952 (1%)
	Above Normal	293,397	283,485	-9,912 (-3%)
	Below Normal	202,678	178,020	-24,658 (-12%)
	Dry	176,018	164,981	-11,038 (-6%)
	Critical	172,765	156,462	-16,303 (-9%)
	All	232,391	223,370	-9,021 (-4%)
October	Wet	272,932	253,563	-19,368 (-7%)
	Above Normal	249,434	248,612	-822 (-0.3%)
	Below Normal	215,956	248,266	32,310 (15%)
	Dry	205,448	223,098	17,650 (9%)
	Critical	166,658	160,394	-6,264 (-4%)
	All	229,306	230,785	1,479 (0.6%)

Table 5.4-30. Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) and Differences (Percent Differences) in River Segment 5 between Model Scenarios (green indicates PA is at least 5% higher [raw difference] than NAA; red indicates PA is at least 5% lower)

Month	WYT	NAA	PA	PA vs. NAA
April	Wet	668,066	669,812	1,746 (0.3%)
	Above Normal	723,965	724,219	255 (0.04%)
	Below Normal	721,025	716,821	-4,204 (-1%)
	Dry	673,244	680,144	6,900 (1%)
	Critical	728,344	733,481	5,137 (1%)
	All	694,116	696,581	2,465 (0%)
May	Wet	764,672	764,118	-554 (-0.07%)
	Above Normal	760,631	762,898	2,266 (0.3%)
	Below Normal	772,514	771,235	-1,279 (-0.2%)
	Dry	746,462	754,220	7,758 (1%)
	Critical	758,547	760,080	1,533 (0.2%)
	All	759,746	761,874	2,128 (0.3%)
June	Wet	770,985	761,269	-9,715 (-1%)
	Above Normal	755,863	719,160	-36,703 (-5%)
	Below Normal	732,040	690,204	-41,836 (-6%)
	Dry	747,713	717,986	-29,728 (-4%)
	Critical	767,702	758,858	-8,844 (-1%)
	All	757,207	734,150	-23,056 (-3%)
July	Wet	641,046	634,097	-6,949 (-1%)
	Above Normal	565,302	568,741	3,440 (1%)
	Below Normal	591,210	582,317	-8,893 (-2%)
	Dry	651,436	662,086	10,650 (2%)
	Critical	700,751	729,890	29,139 (4%)
	All	633,624	637,635	4,011 (1%)

Month	WYT	NAA	PA	PA vs. NAA
August	Wet	777,517	775,814	-1,702 (-0.2%)
	Above Normal	782,416	788,046	5,630 (1%)
	Below Normal	739,346	785,280	45,935 (6%)
	Dry	784,795	785,457	662 (0.1%)
	Critical	781,243	776,562	-4,681 (-0.6%)
	All	775,493	781,485	5,991 (0.8%)
September	Wet	640,986	653,779	12,793 (2%)
	Above Normal	788,726	783,990	-4,736 (-1%)
	Below Normal	710,530	681,581	-28,949 (-4%)
	Dry	673,713	659,064	-14,649 (-2%)
	Critical	669,275	642,375	-26,900 (-4%)
	All	685,859	677,772	-8,088 (-1%)
October	Wet	776,954	764,281	-12,674 (-2%)
	Above Normal	762,221	759,184	-3,036 (-0.4%)
	Below Normal	734,311	764,065	29,754 (4%)
	Dry	716,970	739,011	22,041 (3%)
	Critical	662,073	642,143	-19,930 (-3%)
	All	737,150	739,163	2,012 (0.3%)

Table 5.4-31. Winter-Run Chinook Salmon Spawning Weighted Usable Area (WUA) and Differences (Percent Differences) in River Segment 4 between Model Scenarios (green indicates PA is at least 5% higher [raw difference value] than NAA; red indicates PA is at least 5% lower)

Month	WYT	NAA	PA	PA vs. NAA
April	Wet	173,839	173,836	-4 (0%)
	Above Normal	193,016	192,951	-65 (-0.03%)
	Below Normal	202,334	203,129	796 (0.4%)
	Dry	205,148	203,986	-1,162 (-0.6%)
	Critical	195,967	195,628	-339 (-0.2%)
	All	191,577	191,339	-238 (-0.1%)
May	Wet	174,435	174,717	281 (0.2%)
	Above Normal	191,050	190,875	-176 (-0.09%)
	Below Normal	191,405	192,361	956 (0.5%)
	Dry	194,209	189,802	-4,408 (-2%)
	Critical	201,976	200,657	-1,319 (-0.7%)
	All	188,199	187,121	-1,078 (-0.6%)
June	Wet	158,988	157,577	-1,411 (-0.9%)
	Above Normal	152,276	147,609	-4,667 (-3%)
	Below Normal	153,552	148,988	-4,564 (-3%)
	Dry	155,038	149,189	-5,849 (-4%)
	Critical	168,125	161,557	-6,568 (-4%)
	All	157,569	153,381	-4,187 (-3%)