FINAL REPORT
Adaptive Environmental Management for the Columbia River Channel Improvement Project:

Annual Report for 2009

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1 Introduction

The 2009 annual report continues the series of annual reports produced by of the Adaptive Environmental Management (AEM) Program for the Columbia River Channel Improvement Project (CRCIP). The 2009 annual report documents the activities and results of the AEM CRCIP for Project construction and ecosystem mitigation activities completed through January 31, 2009.

Each CRCIP AEM annual report is developed as a separate stand-alone document for the convenience of the reader. Therefore, the previously developed background materials that describe the adaptive management process for the CRCIP AEM Program are presented in each annual report.

To provide some continuity from year-to-year, the 2009 annual report also briefly reviews the major AEM results and decisions for calendar year 2008. The details can be found in the 2008 CRCIP AEM Program annual report.

1-1 CRCIP Construction Progress

Figure 1-1.1 outlines the progress and plans for completion of the entire CRCIP. Approximately 99% of the Project construction was completed by the end of calendar 2009. Construction efforts in 2009 focused primarily on the removal of sand from CRM 27–32, 48–58, and 62–63. The dredge Oregon completed this work in early May 2009.

As a result of the efforts in 2009, Project construction is essentially complete with the exception of the ongoing rock removal and some minor dredging. Completion of the blasting might take up to February 20, 2010, –the entire work window. There is no scheduled end date for Project construction, although construction will likely be done by the end of December 2010. A summary of the current Project construction status has been developed in the form of an excel spreadsheet that indicates progress to date and work remaining.

Disposal of Project dredged materials in 2009 is addressed in detail in the report section for Monitoring Action 2 (MA-2). During 2009 there were concerns expressed about the volume of materials actually disposed at the DWS compared to the original volumes estimated for the Project construction. Comparisons have been summarized in Monitoring Action 2 (i.e., Table 3-2.1). Some overwidth work was performed in the estuary by the Great Lakes dredge during 2009 as part of Operations and Maintenance (O&M) activities. This resulting material was deposited at the Deep Water Site (DWS).

A summary of the current Project construction status has been developed in the form of an electronic spreadsheet that indicates progress to date and remaining work. The spreadsheet has been posted on the CRCIP AEM website (www.e2tm.com) maintained by E2 Consulting Engineers, Inc.

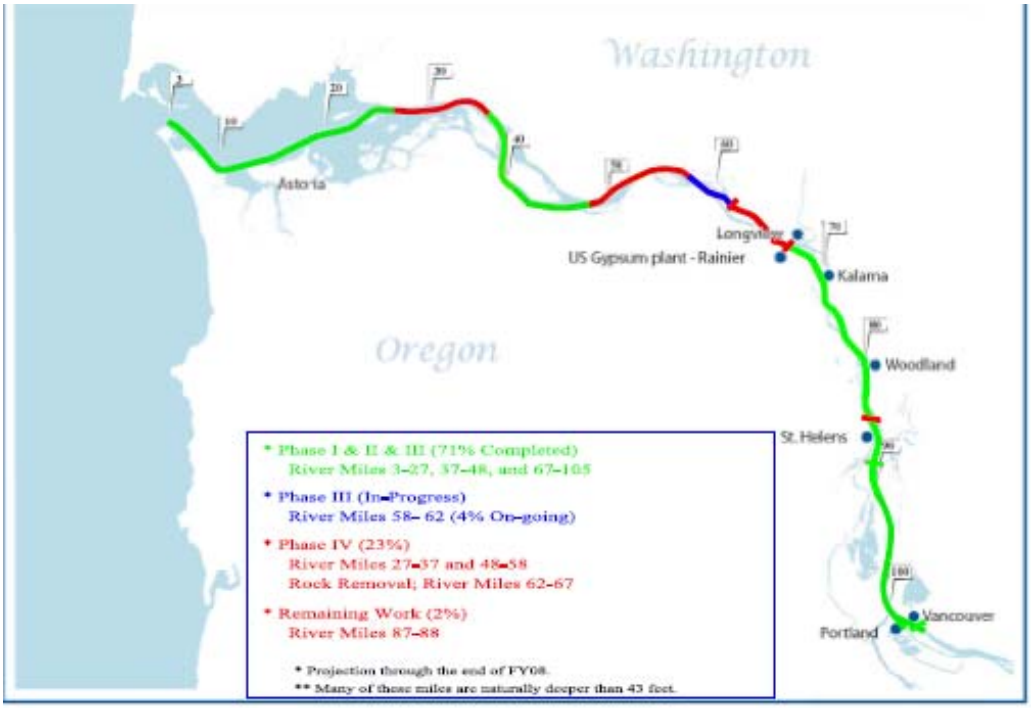


Figure 1-l. 1. Construction Progress of the Columbia River Channel Improvement Project.

1-2 CRCIP Rock Removal

Activities for rock removal necessary for Project completion began early in 2009. Rock removal entails a complex technical and organizational process that involved participation of the CRCIP Adaptive Management Team.

A public meeting was held during the week of February 9, 2009 in order for the USACE to obtain inputs from diverse stakeholders regarding issues of concern associated with rock removal (i.e., blasting) at locations near Warrior Rock and Longview. Representatives of the AMT attended the February public meeting to determine how the AMT might usefully engage the rock removal process in relation to the AEM Program. The stakeholder inputs provided during this meeting were used to help develop a contract that was issued for bid. The intent of the USACE was to combine the rock removal at Longview and Warrior Rock into a single contract. The selected contractor would bring a blasting barge including drill rigs and excavators to the site to perform the work. In response to the solicitation, submitted proposals were evaluated in terms of technical merit and cost. The AMT was informed that the selection process was not necessarily a least cost award.

The USACE provided several documents to the AMT that described the general process for rock removal, presented the current schedule for the contractual process, and outlined issues of concern to be addressed by prospective contractors in their proposals. These documents have been posted in the folder for MA-2 in the CRCIP AEM Workbook on the E2 Consulting Engineers website (www.e2tm.com). In addition, Gordon Reevey (Reevey Associates, Inc.)

provided supporting information to the AMT and described important aspects of underwater demolition and specified necessary considerations in selecting a contractor to perform the rock removal. Reevey described various technologies and methods used for underwater blasting, with an emphasis on approaches that were most effective with minimal environmental impacts. Reevey's presentation was uploaded to the E2 website and placed in the Supporting Data folder.

Reevey also participated in review of the rock removal proposals. The USACE specifications for blasting were essentially the same requirements for structural demolition and were more stringent than those typically associated with underwater demolition. The USACE imposed strict requirements in order to minimize potential environmental, ecological, and structural impacts of rock removal.

Following review of the proposals received in response to the bid, the USACE notified the AMT of the contract award and provided the contractor's proposal to the AMT. The rock removal was anticipated to require between 60 and 90 detonations. The actual rock removal work began in early November 2009 and might be completed in January – February 2010.

At the November 2009 AMT meeting, John Cannon and Karen Garmire described the procedures being used to remove rock. Efforts were then underway near St. Helens, WA (CRM 87+25 – 88+25). Additional rock removal will be necessary at the Longview dredging area (CRM 65+00 – 67+05). The blasting contractor (J.E. McAmis, Inc.) attempts to perform two blasting events per day, although conditions sometime limit daily removal to a single blast. The process basically entails drilling a matrix of holes carefully located in the rock, filling the holes with an explosive (Hydromite), covering the holes with stemming materials, and detonating the explosives. When sufficient materials have been excavated by blasting, a separate dredge (Megan Renee) collects that rock fragments. The materials are currently being disposed at the Ross Island site. The presentation emphasized the many procedures used to ensure safety to the ~45 personnel directly involved in the blasting process.

In addition to worker safety, comprehensive attempts have been implemented to minimize the potential impacts of blasting on marine mammals, fish and other wildlife. Battelle Pacific Northwest National Laboratory (PNNL) continues to assess the environmental impacts of blasting. Results of the environmental monitoring are summarized within hours of each blast. The environmental monitoring program focuses on marine mammals, listed salmonids, Eulachon (smelt), and sturgeon. Spreadsheet calculations provide estimates of take based on numbers of observed mortalities. The results are posted daily to a secure website. In 2009, two sturgeon were apparently killed by the blasting. Marine mammals (e.g., Stellar sea lions, harbor seals) were routinely observed within the blasting area, which is patrolled by PNNL before and after blasting events to avoid or report impacts on these organisms. As of the November 2009 AMT quarterly meeting, marine mammals had not been harmed by rock removal. River entry for smelt begins in early December. Spawning continues through early May. Smelt mortalities were not observed in relation to rock removal in 2009. During 2009, minimal ecological impacts were observed in relation to the continued rock removal.

In addition to monitoring, PNNL performed field experiments using caged hatchery fish to further quantify relationships between pressures produced by individual blasts, distance from the blast, and associated impacts on fish. The results of these studies will augment current understanding of the effects of pressure and negative effects on fish and increase the accuracy of

take estimates based on observed fish mortalities. A report of the environmental monitoring of the rock removal is anticipated by the end of calendar 2010.

1-2 Ecosystem Restoration and Mitigation

Ecosystem restoration and mitigation actions are components of the AEM CRCIP. These components primarily serve as sources of additional information for overall evaluation of the Project by the adaptive management team (AMT). However, these components do not enter directly into the decision-making aspects of the AEM Program and decision criteria have not been developed for restoration or mitigation activities.

Several restoration and mitigation actions were discussed during the 2009 quarterly meetings of the AMT. Mitigation activities were underway at Chumley Island and Cottonwood Island. The USACE had purchased a portion of Cottonwood Island for both disposal of Project construction materials and ecosystem restoration. The proposed mitigation actions include introduction of Columbia white-tailed deer to the island, as well as conversion of selected areas from pasture to riparian forested wetlands.

Following cultivation of current pasture areas, native riparian trees and shrubs were planted to replace current pasture on Chumley Island. Physical excavations of swales and removal of overburden were completed to alter the hydrology of parts of Cottonwood Island (120 acre site). Changes in hydrology favor the germination of native plants and facilitate efforts to convert areas currently dominated by reed canary grass to riparian forested wetlands. Plans describing the proposed ecosystem restoration actions were provided to the Washington Department of Ecology for review.

During 2009, ecosystem mitigation work progressed at the Chumley and Cottonwood Island locations. Site preparation at Chumley Island included control of reed canary grass prior to planting of local trees and shrubs. Plant growth is being monitored for three years followed by routine maintenance. The success to date observed at Chumley suggested that similar approaches would likely work at Cottonwood Island and work began there in the autumn of 2009.

During 2009 at Cottonwood Island, wetland areas were prepared for planting riparian forest species in the spring of 2010. Water control systems are in place to regulate water in ~1,000 acres of wetlands. Depths up to 3½ feet can be controlled using this system for wetlands located within the dike system. Salmon foraging habitat will also be created through water regulation in these wetlands. In addition, Cottonwood Island white-tailed deer will be transplanted to the island and the Washington Department of Fish and Wildlife will collaborate with the USACE to facilitate deer introduction to the island.

In other 2009 mitigation activities relevant to the CRCIP AEM Program, Paul Schmidt (USACE) presented an assessment of biocontrol agents currently being used in the Columbia River estuary. The current studies focus on the effectiveness of several insects introduced throughout the estuary in controlling purple loosestrife (*Lythrum salicaria*). This work is being conducted by Earth Design Consultants, Inc. Results of this continuing project indicate that populations of several of the biocontrol agents have become established at several locations in the estuary. The agents have demonstrably affected the growth of purple loosestrife at several locations, although

the factors that contribute to effective control remain largely unknown. Work to date has also examined the effects of tidal inundation on the survival and population dynamics of the control agents at 15 release sites. Surveys of the distribution and abundance of the control agents and measures of plant damage will continue beyond 2009. Additional work will examine impacts of purple loosestrife on (1) habitat quality for fish and wildlife, (2) nutrient and carbon flux, (3) sediment quality, and (4) water quality. It remains unknown whether control of purple loosestrife will assist in reestablishment of native vegetation or facilitate success of other invasive plant species that are already present in many of the survey sites.

1-3 Annual Report Structure

Following a brief description of the CRCIP AEM process, each monitoring action of the adaptive management effort is addressed. Summaries of the monitoring results for 2009 are provided along with comparisons of the results with AEM decision criteria. Decisions concerning adaptive management for each of the monitoring actions recorded by the AMT during the assessment year are also reported.

In addition, detailed accounts of the actions of the AMT, minutes of the quarterly AMT meetings and additional supporting information are documented in the CRCIP AEM workbook. The workbook is updated as additional monitoring data becomes available and serves as ongoing documentation of the AEM process. The workbook is reviewed by the AMT at each of the quarterly meetings. An electronic working version of the workbook is available to the AMT at the E2 website.

1-4 CRCIP AEM Process

The AEM process includes the following steps for adaptively managing the environmental resources of concern in relation to channel deepening (Bartell 2004):

1. Results of the ongoing monitoring programs are summarized and reported quarterly to the AMT.

2. The AMT evaluates monitoring results in relation to the consensus management decision criteria (see Appendix D in Bartell 2004).

3. If none of the decision criteria are exceeded, the AEM process can continue with the current monitoring programs until the next evaluation (i.e., Step 1).

4. If decision criteria are exceeded, the AMT can request the Corps to explain the variances or offer a mitigation plan.

5. Based on an evaluation of the Corps submission, the AMT may (a) determine that there is no justification for changing the current management practices, or (b) recommend changes to the current management practices and/or modifications to the decision criteria.
6. Following resolution of the proposed adaptive management actions and possible revisions to monitoring and criteria recommended by the AMT, the AEM process cycles back to analysis and review of new data and information at the next quarterly meeting.

The steps in the above described AEM process are schematically illustrated in the following AEM plan flowchart (Figure 1-4.1).

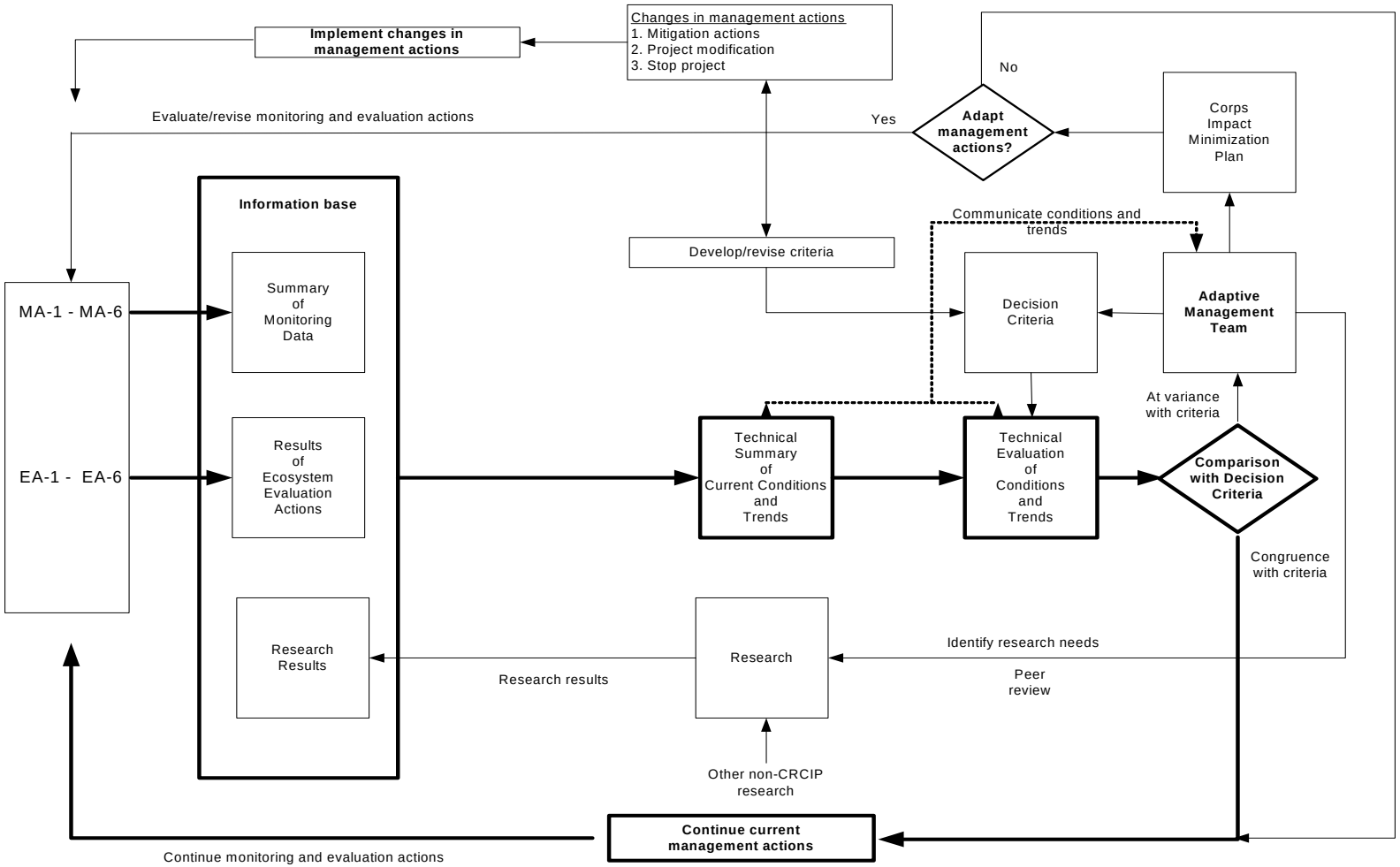


Figure 1-4.1. Flowchart describing the AEM process for the CRCIP.

1-5 Post-Construction Transition of the AEM Program

The July 2009 meeting of the AMT witnessed the recognition by team participants that the Project construction would be completed in 2010. Upon completion, the CRCIP would move from project status to an operations and maintenance (O&M) phase. The AMT recognized that the adaptive management process is itself adaptive. Modifications to the management process and AM program can be made during the process. Movement from construction to O&M provides an excellent time to review and evaluate the CRCIP Adaptive Management program.

The AMT therefore began discussions during the July 2009 meeting about possible modifications to the channel improvement adaptive management program in relation to this change in status. Subsequent AMT meetings in 2009 began to address each of the AM program components in relation to possible modifications. The CRCIP Adaptive Management Plan might be amended to reflect any changes in the AM program.

MA-1 Physical, Chemical Monitoring

The benefits and limitations of continuing the MA-1 monitoring activities were discussed at the November 2009 AMT meeting. The main limitations are logistics, costs, and the recognition that MA-1 results obtained to date have not demonstrated any impacts on temperature, salinity, or depth that could be unequivocally attributed to channel improvement. However, the terms and conditions of the biological opinion and 401 certifications specify continuation of MA-1 for 3 years following completion of project construction. Experience demonstrates that the CORIE stations are difficult to maintain, which results in gaps in available data as well as at least a one-month time lag in obtaining the most recent data in relation to the quarterly scheduled AMT meetings. Participants also expressed concerns over a possible lag effect in terms of observing Project impacts in relation to construction. Another suggestion was to perhaps reduce the number of stations included in MA-1. In addition, AMT participants noted the opportunity for the MA-1 analysis to be relevant to other management efforts underway in the Lower Columbia River.

Following discussion, the 2009 consensus decision of the CRCIP AMT was to continue the MA-1 monitoring through the December 31, 2013 or 3-y post construction. This decision was also documented in the AEM Workbook for MA-1.

MA-6 Fish Stranding Studies

The USACE suggested that the results of follow-up fish stranding studies would likely recommend beach nourishment as a remedy for any demonstrated increases in fish stranding. If this is the case, why not simply go ahead with beach nourishment and forego the follow-up experiments? It would be more economical to use the post-construction fish stranding study funds to do the beach nourishment. It was further noted that one of the prime sites for nourishment (Barlow Point) was also one of the stranding study sites. Using this site for beach nourishment would remove it from the three pre-project study locations. Several AMT members were concerned that the proposed beach nourishment would not be able to move forward pending completion of the follow-up stranding studies.

AMT members emphasized that the purpose of conducting the post-construction fish stranding studies was to determine whether or not construction of the navigation channel results in an increase in fish stranding. If the post fish stranding study is not conducted, then this question cannot be answered. As for remedies, beach nourishment is only one option that would be considered, but it should not be assumed that beach nourishment is the only remedy. The first step should be to follow through with the post-construction study to determine if fish stranding increased, the percentage of increase above baseline, and the possible extent of the problem. If the study results suggest an increase in stranding, a full range of remedies could then be considered to address this concern.

The USACE could not guarantee that beach nourishment would be permitted in exchange for not completing the post-construction phase of the stranding studies. Following discussion, the 2009 consensus decision of the CRCIP AMT was to perform the post-project fish stranding studies. This decision was also documented in the AEM Workbook for MA-6.

2 Monitoring Action 1—Physical, Chemical Data

The following figures and tables summarize the MA-1 results of monitoring depth, temperature, and salinity values in relation to channel improvements for calendar 2009. The results are based on analyses of verified data downloaded from the CORIE public website. The monitoring data are obtained from three sampling stations located in the lower river and estuary: tansy, grays, and cbnc3 (Figure 2-1). The tansy station replaced the red26 station used in previous years of the AEM Program. The red26 instrumentation was physically lost from the CORIE network during 2008.

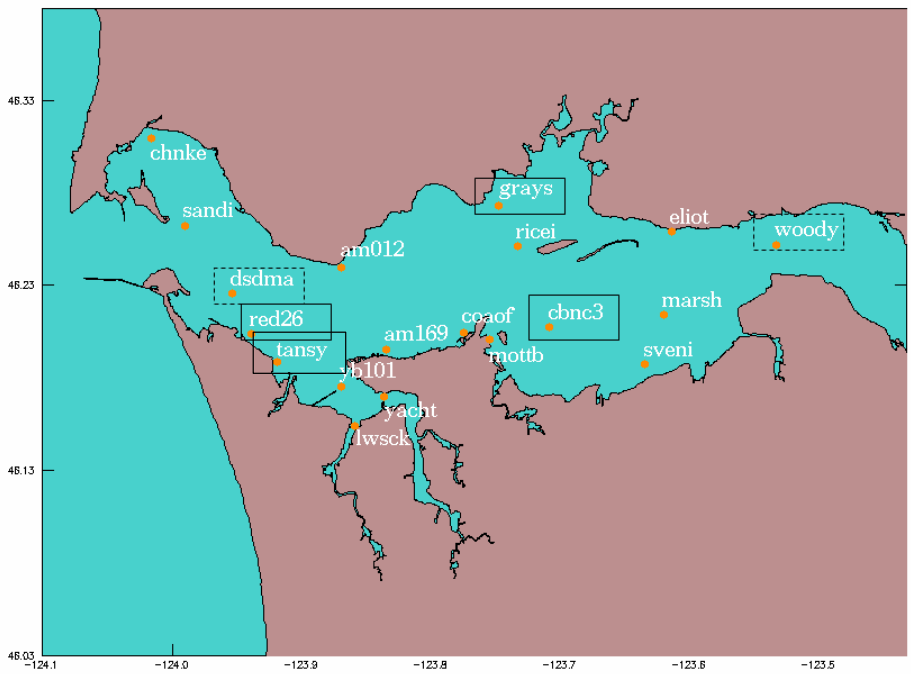


Figure 2-1. Location of CORIE monitoring stations in the Lower Columbia River (LCR) and estuary. The three stations (tansy, grays, and cbnc3) indicated by the solid rectangles provide data for MA-1. The two stations indicated by the dashed rectangle provide salinity (dsdma) and temperature (woody) data used in normalization of the data collected at the three MA-1 stations.

CORIE monitoring data collected from 1996–2004 provided the pre-Project (baseline) physical chemical data. Decision criteria were defined for depth, temperature, and salinity through analyses of these data. Two sets of criteria were defined during the development of the AEM plan in calendar 2004–2005: (1) the upper and lower 90th percentile criteria were defined by the 5th and 95th percentile values computed for each month, and (2) the upper and lower 60th percentile criteria were defined by the 20th and 80th percentile computed monthly values. These values were approved as AEM decision criteria by the AMT

2-1 Depth

As in previous years (2006–2008), depth data were only available for the grays sampling station in 2009 (Figure 2-1.1).

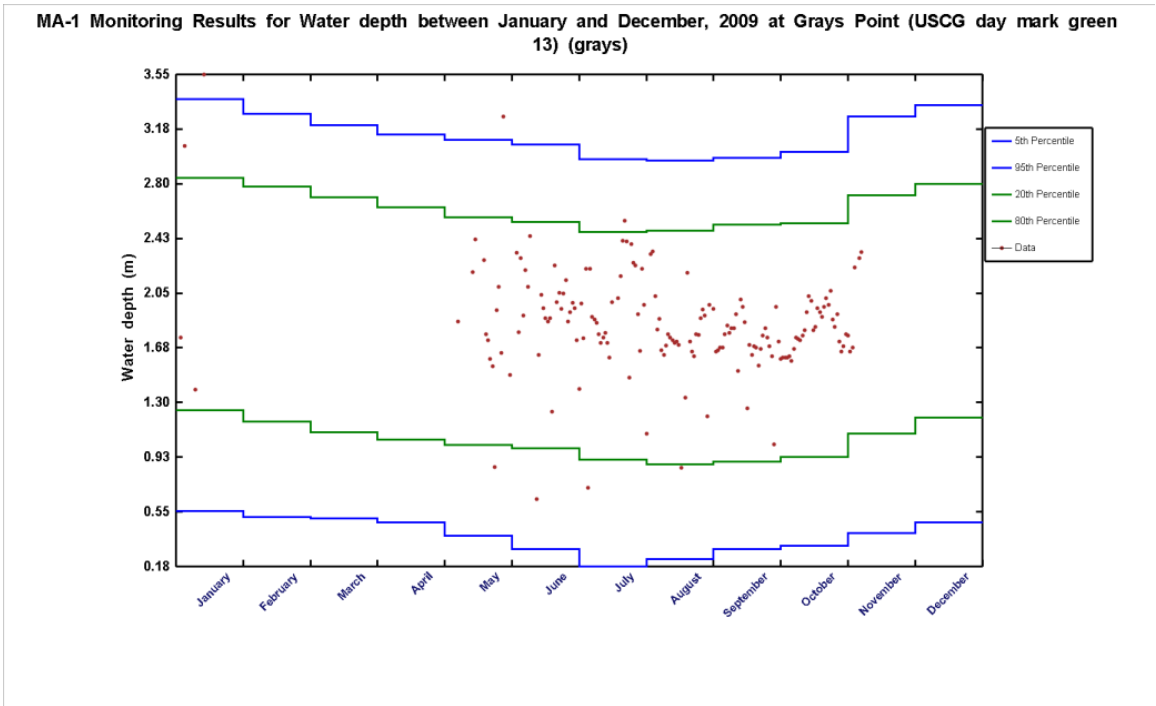


Figure 2-1.1. Daily median values of depth for the grays sampling location for 2009 plotted in relation to the CRCIP AEM decision criteria.

The daily median values of depth calculated for the grays CORIE station were predominantly within the MA-1 decision criteria. Except for one day in May, the median daily depths were within the 5th–95th percentile decision criteria that were derived from the baseline data. Values were sometimes observed outside the 20th and 60th percentile decision criteria. However, most of the daily median depth values reported for the grays station in 2009 were within the 20th and 60th percentile decision criteria. Data were not available for February–April or for December.

Table 2-1.1 lists the monthly median depth values calculated using the 2009 data from the grays station. All reported 2009 monthly values were within the 20–80th percentile range of the decision criteria derived from the 1996–2004 pre-Project data.

Table 2.1.1. Summary of 2009 monthly median depth values (bold numbers) for grays station in relation to AEM percentile decision criteria.

	Monthly Median Depth (m)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
5	0.6	0.5	0.5	0.5	0.4	0.3	0.2	0.2	0.3	0.3	0.4	0.5
20	1.3	1.2	1.1	1.1	1.0	1.0	0.9	0.9	0.9	0.9	1.1	1.2
	2.0	**No data**	**No data**	**No data**	**1.8**	**1.8**	**1.9**	**1.8**	**1.7**	**1.8**	**2.0**	**No data**
80	2.8	2.8	2.7	2.6	2.6	2.5	2.5	2.5	2.5	2.5	2.7	2.8
95	3.4	3.3	3.2	3.1	3.1	3.1	3.0	3.0	3.0	3.0	3.3	3.3

2-2 Temperature

Figure 2-2.1(a,b,c) shows the daily median temperature values calculated for 2009 for the three CORIE stations: tansy, grays, and cbnc3. The daily values are plotted in relation to the 60th and 90th percentile decision criteria established prior to the Project construction by the AMT. These decision criteria were estimated using CORIE data from 1996–2004 (i.e., pre-Project).

Water temperature data were available for January and February for tansy (Figure 2-2.1a), grays (Figure 2-2.1b), and cbnc3 (Figure 2-2.1c). Daily median temperatures were less than the 5th percentile decision criteria for several days in late January and mid-February for both grays and cbnc3 stations. Daily temperatures were also low for these periods at tansy, but the values were within the decision criteria for tansy. Temperatures were somewhat below the decision criteria for all three stations for several days in the first week of April. Temperatures were slightly lower than the decision criteria in early April at cbnc3. Daily median values of temperature through May were largely within the monthly decision criteria for all three stations (tansy, grays, and cbnc3). However, there was a period of missing data in mid-May for the tansy station. Daily median temperature values were within the decision criteria for the 2009 3rd quarter period of interest (July – September) with the exception of several values at the end of September for cbnc3 and grays. Daily median temperature values were within the decision criteria for the 4th quarter period of interest (October–December) with the exception of several values at the end of December for tansy and cbnc3. December data were not available for the grays station. Initial assessment of December weather data available for Astoria indicated cold weather during this time.

Tables 2-2.1–2-2.3 list the calculated monthly median values for 2009 and the corresponding temperature decision criteria derived from analysis of the pre-Project data (1996–2004). The monthly average temperatures for both January and February were within the 20th and 80th percentile values defined for tansy (Table 2-2.1). Monthly average temperatures for grays were between the 20th and 5th decision criteria for January and February (Table 2-2.2). The January average for cbnc3 was within the 20th and 80th percentile values (Table 2-2.3). The February mean value was equal to the 5th percentile value defined for cbnc3. The monthly average temperatures used in the decision-making process were all within the decision criteria for all three stations through May 2009. The monthly average temperatures used in the decision-making process were all within the decision criteria for all three stations in the July – September period. Despite variances in the daily temperature data, the monthly average temperatures used in the decision-making process were all within the decision criteria for all three stations in the October–December 2009 period.

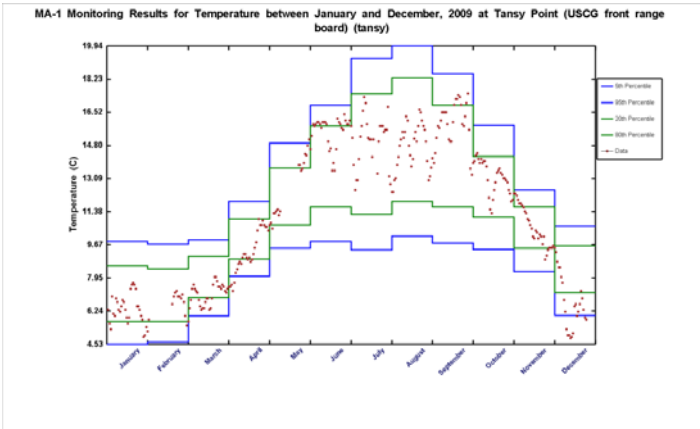
To further evaluate the potential impacts of channel modification on water temperatures, the daily median values for 2009 (black dots) were plotted against corresponding baseline (gray dots) values (1996–2004) for the upriver "woody" (Woody Island) sampling location (Figure 2-2.2). Water temperatures at woody are primarily determined by river flows. Explicit decision criteria were not formulated by the AMT to evaluate the nature of the MA-1 temperature values relative to the woody baseline data. However, the Team agreed that if the MA-1 results were essentially included in the baseline cluster of points then it could be concluded that the channel

modifications likely did not alter the complex relationships between river flow and tidal mixing in the lower river and estuary.

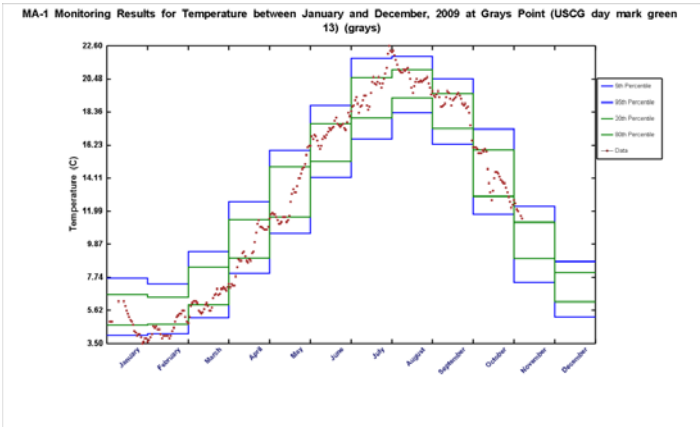
The plots of daily median temperature values of all three stations versus the temperatures recorded for the woody station demonstrated that the data available through December 2009 were consistent with the relationships established using the 1996–2004 pre-Project construction data.

The overall conclusion from the analysis of water temperatures was that no discernible impact of Project construction was evident for 2009.

(a)



(b)



(c)

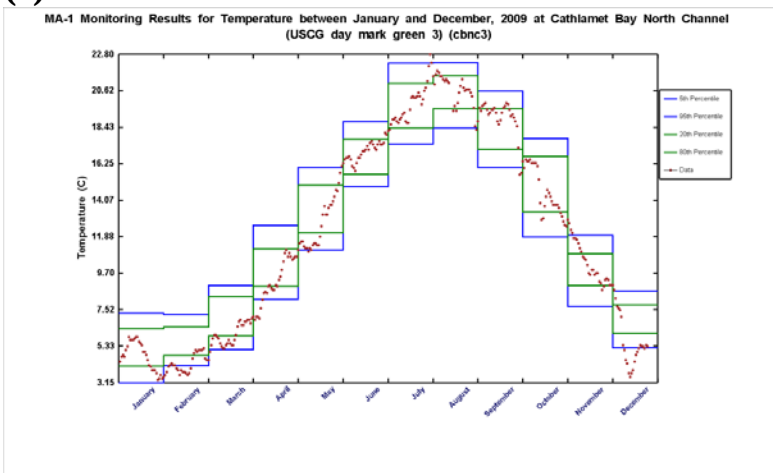


Figure 2-2.1. Daily median values of water temperature for (a) tansy, (b) grays, and (c) cbnc3 sampling stations for 2009 plotted in relation to the CRCIP AEM decision criteria.

Table 2-2.1. Summary of 2009 Monthly Median Temperature Values (bold numbers) for tansy Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Temperature (C)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
5	4.5	4.6	6.0	7.0	9.5	9.8	9.4	10.1	9.8	9.4	8.3	6.0
												6.8
20	5.7	5.7	8.9	8.9	10.7	11.6	11.2	11.9	11.6	11.1	9.5	7.2
	6.3	**6.8**	**7.2**	**9.1**	**11.6**	**15.6**	**14.9**	**15.1**	**16.0**	**13.0**	**10.4**	
80	8.9	8.4	9.1	11.0	13.6	15.8	17.5	18.3	16.9	14.2	11.6	9.6
95	9.8	9.7	9.9	11.9	14.5	16.9	19.3	19.9	18.5	15.8	12.5	10.6

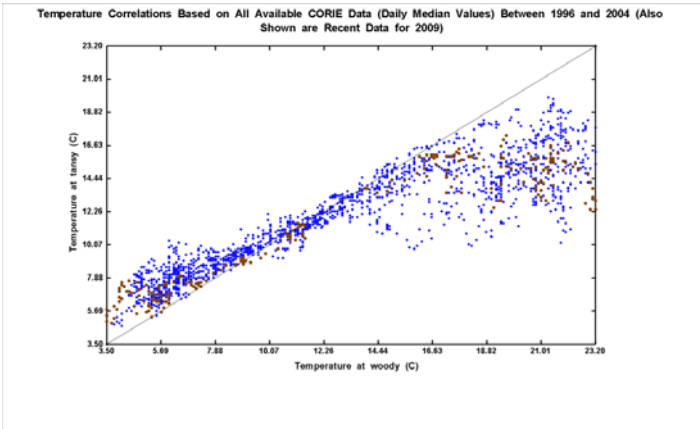
Table 2-2.2. Summary of 2009 Monthly Median Temperature Values (bold numbers) for grays Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Temperature (C)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
5	4.0	4.1	5.2	8.0	10.5	14.1	16.6	18.3	16.3	11.8	7.4	5.2
	4.4	**4.5**										
20	4.7	4.7	6.0	9.0	11.6	15.2	18.0	19.3	17.3	12.9	9.0	6.2
			6.2	**9.3**	**12.7**	**17.2**	**19.6**	**20.5**	**19.0**	**14.1**		**No data**
80	6.6	6.5	8.4	11.4	14.8	17.6	20.6	21.1	19.5	15.9	11.3	8.0
											11.9	
95	7.7	7.3	9.4	12.6	15.9	18.8	21.8	21.9	20.5	17.3	12.3	8.8

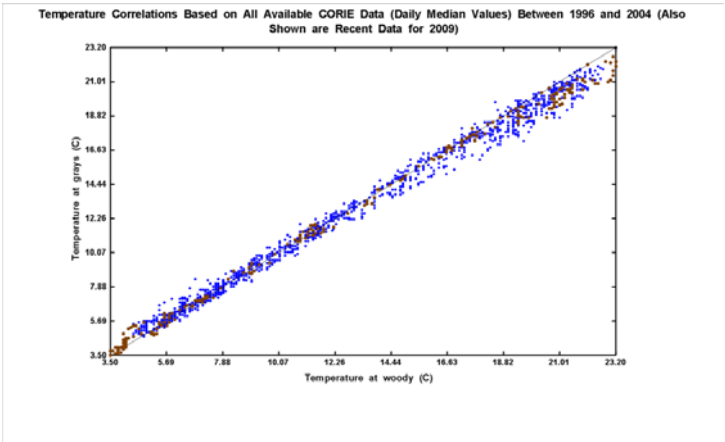
Table 2-2.3. Summary of 2009 Monthly Median Temperature Values (bold numbers) for cnbc3 Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Temperature (C)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
		4.2										**5.2**
5	3.2	4.2	5.1	8.1	11.1	14.9	17.4	18.4	16.0	11.9	7.7	5.2
			5.9									
20	4.1	4.8	6.0	8.9	12.1	15.6	18.4	19.5	17.1	13.4	9.0	6.1
	4.8			**9.2**	**12.7**	**19.5**	**19.1**	**20.7**	**19.2**	**14.0**	**9.8**	
80	6.4	6.5	8.3	11.2	15.0	17.7	21.1	21.5	19.5	16.7	10.9	7.6
95	7.3	7.2	9.0	12.6	16.0	18.8	22.3	22.3	20.6	17.8	12.0	8.6

(a)



(b)



(c)

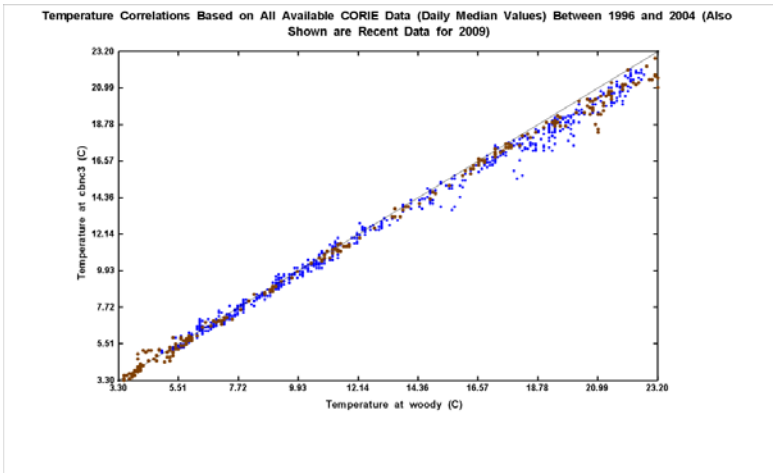


Figure 2-2.2. Median daily water temperatures for (a) tansy, (b) grays, and (c) cbnc3 stations plotted for 2009 against median daily water temperatures for the "woody" station.

2-3 Salinity

MA-1 importantly includes an analysis of potential Project impacts on salinity values in the Lower Columbia River and estuary. The analyses are based on the CORIE data and preformed and presented in a manner analogous to those previously presented for water temperatures. The issue of concern for salinity is that channel modifications might increase the likelihood of salt water intrusions and elevate salinity values, which can impact habitat quality for juvenile salmon. Figure 2-3.1 (a, b, c) presents the daily median values of salinity measured in 2009 at the three MA-1 sampling locations: tansy, grays and cbnc3. The corresponding decision criteria developed from pre-Project salinity data (i.e., 1996–2004) by the AMT are also plotted for convenient comparison with the monitoring results. Importantly, the plotted results also identify periods when data were not available from the monitoring stations. In 2009, tansy and cbnc3 did not have data for January. Data for the grays station were missing for December.

The greatest daily variations in salinity values were observed for tansy in 2009. Daily values ranged from near 0.7 to ~26 psu during the year. This station is strongly influenced by tidal flows (Figure 2-3.1a). The greatest ranges of values occurred in February–March, June–July, and August. Despite these daily variations, the monthly mean salinity values reported for tansy did not exceed the 5–95th percentile decision criteria during 2009.

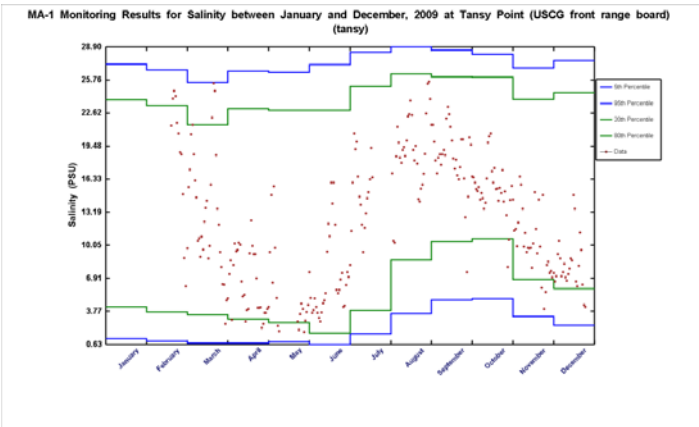
Salinity values reported in 2009 for the grays station are illustrated in Figure 2-3.1 b. This station is located sufficiently upriver and its characteristically lower salinity values are determined primarily by the dominance of river flows. Daily median salinity values ranged from 0 to ~6 psu. Circulation of more highly saline tidal waters exhibits lesser influence at this station than observed for tansy, although tidal influence can increase salinity values at grays during periods of very low river flow (e.g., October 2009). Several February daily median values of salinity exceeded the 5th and 95th percentile decision criteria for the grays station during 2009. Salinities near zero were prevalent during the months of April–June in 2009. Several daily values exceeded the 80th percentile during September and October in 2009.

Salinity values were near zero for the months of February through most of July, as well as for most of November and December for the cbnc3 station (Figure 2-3.1 c). Salinity values were most variable during the months of August through October in 2009. four daily median values exceeded the 5th percent decision criteria during these months; ~20 daily median value exceeded the 20th percent criteria during this same time period.

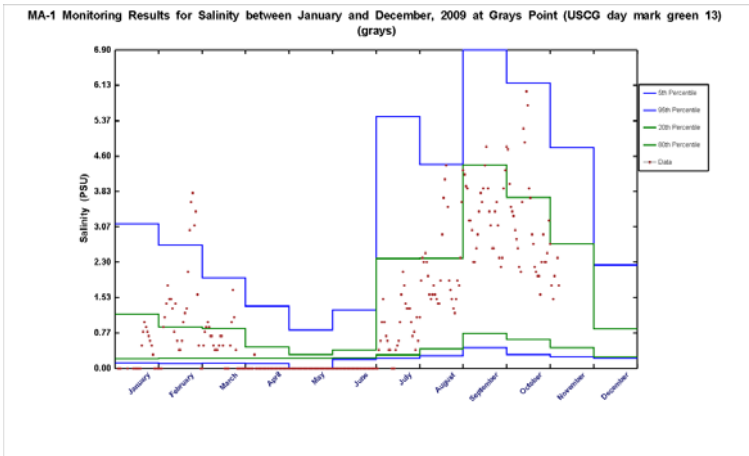
The dsdma station did not operate through much of 2009. Because the salinity values from this station are used to compute the normalized plots for tansy, grays, and cbnc3, the results illustrated in Figures 2-3.2 a, b, c for 2009 only represent data for August through October, when data were available for the dsdma station. Consistent with the results of previous years MA-1 monitoring (e.g., 2005-2007), the values of salinity associated with these three stations do not appear to deviate in any compelling way from the clusters of points defined by the pre-Project data, although there are several points that appear higher than previously computed for grays (Figures 2-3.2 b) and cbnc3 (Figures 2-3.2 c). The points for tansy are somewhat clustered towards lower salinities in relation to dsdma (Figures 2-3.2 a).

Tables 2-3.1–2-3.3 lists the monthly median salinity values calculated for 2009 and the decision criteria developed by the AMT for MA-1. The monthly values at tansy were within the 20–80th percentile values for all months for which data were available (Tables 2-3.1). The monthly median values for grays were less than the 5th percentile decision criteria for January, April, May, and June (Table 2-3.2). The monthly median values at grays for July through November lie within the 20–80th percentile decision criteria for this station. Monthly median salinity for grays was slightly greater than the 80th percentile decision criterion in February 2009. Salinity values were effectively zero from February through July, November, and December at cbnc3 (Table 2-3.3). Values for the remaining months (August – October) were within the 20–80th percentile decision criteria for this station.

(a)



(b)



(c)

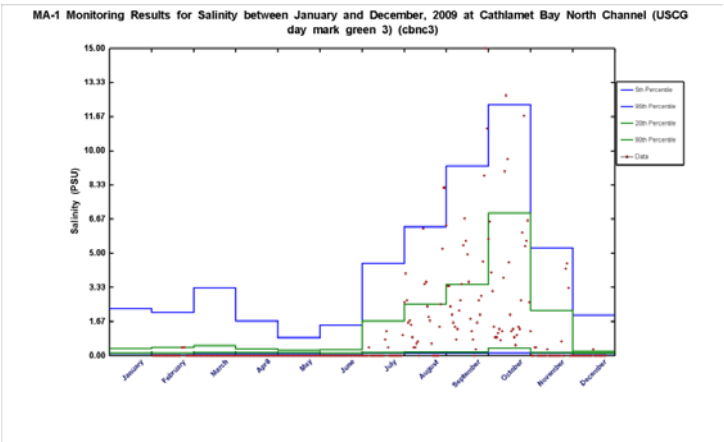
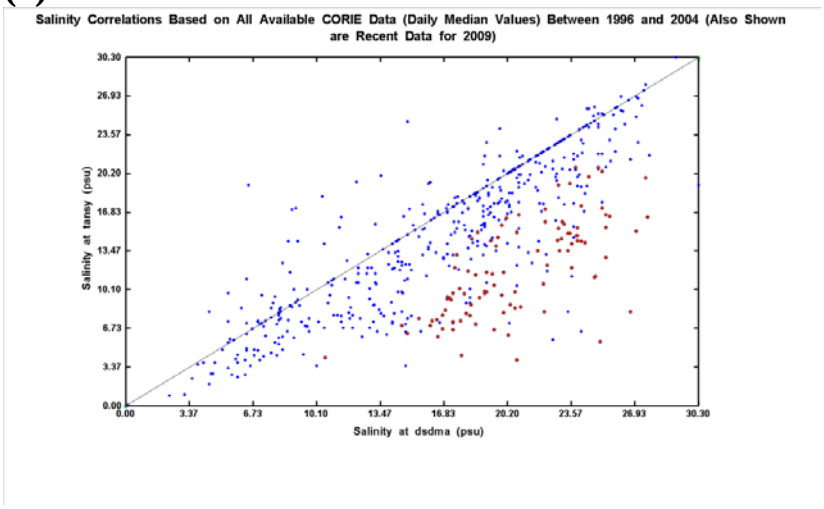
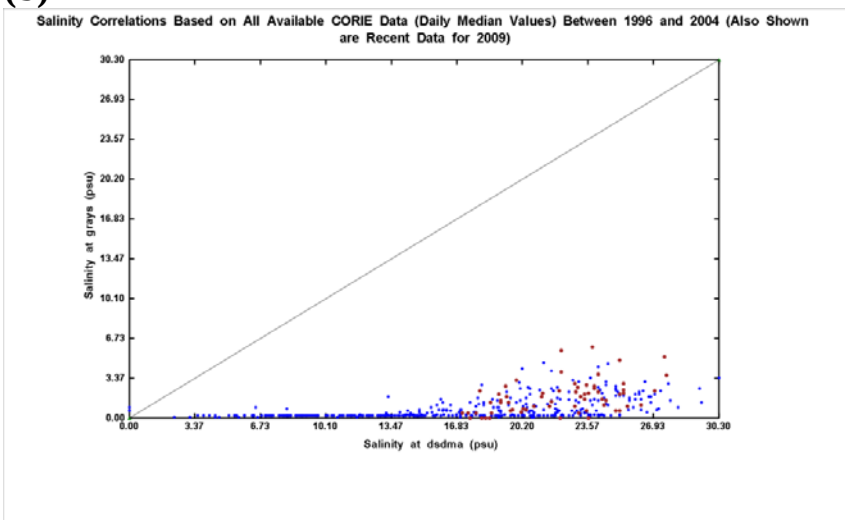


Figure 2-3.1. Daily median values of salinity for (a) tansy, (b) grays, and (c) cbnc3 sampling stations for 2009 plotted in relation to the CRCIP AEM decision criteria.

(a)



(b)



(c)

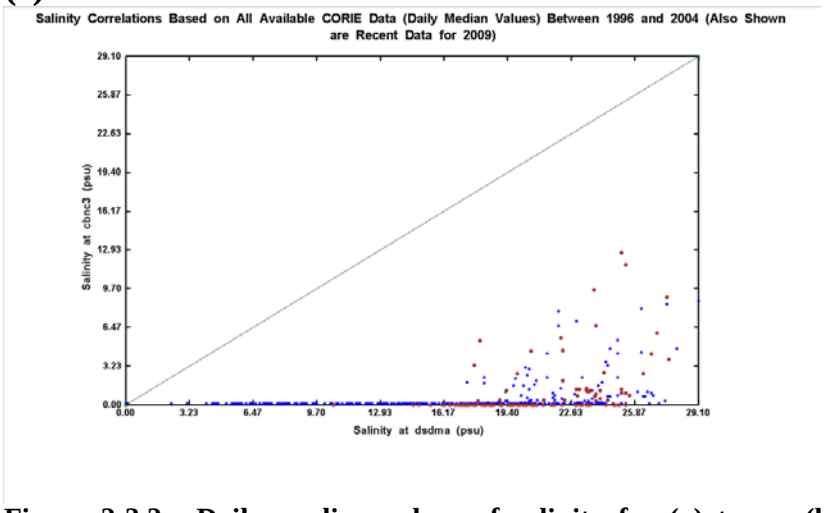


Figure 2-3.2. Daily median values of salinity for (a) tansy, (b) grays, and (c) cbnc3 sampling stations for 2009 plotted in relation to values for the dsdma station.

Table 2-3.1. Summary of 2009 Monthly Median Salinity Values (bold numbers) for tansy Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Salinity (psu)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
5	1.2	0.9	0.7	0.7	0.9	0.4	1.6	3.5	4.8	5.9	3.3	2.4
20	4.2	3.7	3.4	3.0	2.7	1.7	3.8	8.7	10.4	10.7	6.8	5.9
	No data	**19.5**	**13.4**	**5.9**	**4.8**	**6.7**	**15.8**	**17.8**	**18.6**	**15.2**	**9.9**	**8.3**
80	23.9	23.4	21.5	23.0	22.9	22.9	24.1	26.3	26.0	26.0	23.9	24.6
95	27.3	26.7	25.5	26.6	26.5	27.2	28.4	28.9	28.6	28.0	26.9	27.6

Table 2-3.2. Summary of 2009 Monthly Median Salinity Values (bold numbers) for grays Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Salinity (psu)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
	0.0			**0.0**	**0.0**	**0.0**						
5	0.2	0.2	0.2	0.2	0.0	0.2	0.3	0.3	0.5	0.4	0.3	0.3
20	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.5	0.8	0.7	0.5	0.3
			0.4				**0.7**	**2.3**	**3.5**	**3.1**	**1.8**	**No data**
80	1.2	0.8	0.8	0.7	0.7	0.7	2.4	2.4	4.4	3.7	2.7	0.8
		1.3										
95	3.1	2.7	2.0	1.4	0.8	1.3	5.5	4.4	6.9	6.2	4.8	2.2

Table 2-3.3. Summary of 2009 Monthly Median Salinity Values (bold numbers) for cbnc3 Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Salinity (psu)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
		0.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**				**0.0**	**0.0**
5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
20	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.2	0.2	0.2
	No data							**1.7**	**2.8**	**2.8**		
80	0.7	0.7	0.7	0.7	0.7	0.7	1.7	2.5	3.5	7.0	2.2	0.7
95	2.3	2.1	3.3	1.7	0.9	1.5	4.5	6.3	9.3	12.3	5.3	2.0

2-4 Columbia River Discharge

The collation and analysis of the Bonneville Dam discharge data continued through 2009 as the data became available (Figure 2-4.1). The seasonal pattern indicates that spring and autumn discharges for 2009 tended towards the lower values defined by the 1996–2004 pre-Project discharges. The late spring and early summer discharges for 2009 were consistent with the approximately average values recorded during the pre-Project years. The year of 2009 appeared overall to be characterized by average (mid-year) to low (spring and autumn) flows compared to the pre-Project baseline.

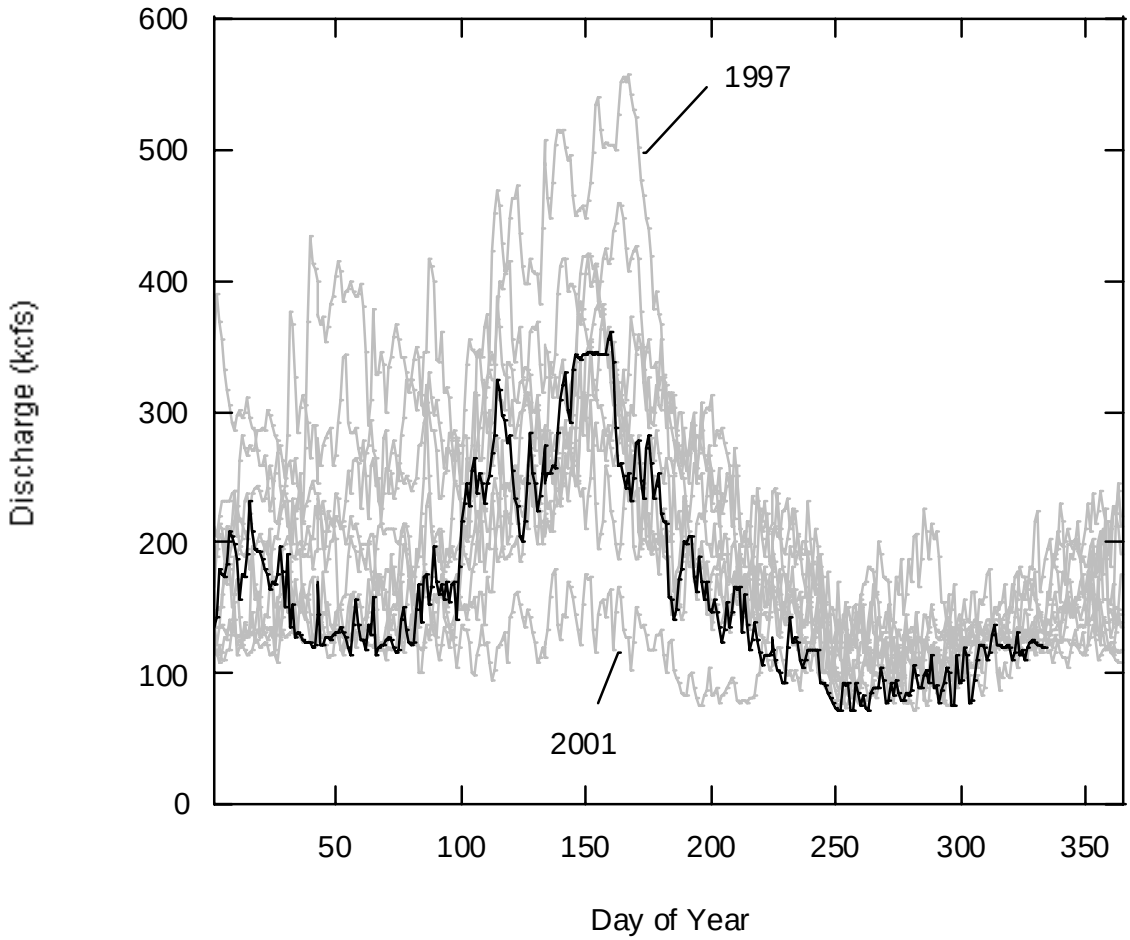


Figure 2-4.1. Daily flow values recorded at Bonneville Dam for calendar year 2009 (solid black line). Light gray lines show pre-Project (baseline) values for 1996–2004.

2-5 AMT Decisions for MA-1

Table 2-5.1 summarizes the key discussions and decisions made by the AMT during the course of the quarterly meetings in relation to MA-1 monitoring and MA-1 monitoring results through calendar 2009.

Table 2-5.1. CRCIP AEM Plan Record of AMT MA-1 Decisions.

Date	Issue	MA-1 Decisions	Comments
16 Dec 2004	**MA-1**	Compare with different monthly confidence intervals (CI) (e.g., 70, 80, 90 percentiles).	
16 Dec 2004	**MA-1**	Develop plots of daily mean values against the CI.	
16 Dec 2004	**MA-1**	Add state water quality standards (e.g., temperature for Washington and Oregon).	
16 Dec 2004	**MA-1**	Produce plots in "real time" as data quality assurance/quality control process permits.	
16 Dec 2004	**MA-1**	Make plots (analyses) available to AMT via file transfer protocol (FTP) site-daily values posted every 1–5 days.	
16 Dec 2004	**MA-1**	At the end of each month, calculate monthly average and compare to the monthly CI values	
16 Dec 2004	**MA-1**	Meet monthly during construction phase to evaluate consensus on criteria.	
14 Jun 2005	**MA-1**	The team tentatively agreed to the water elevation decision criteria. The Science Center http://www.nwr.noaa.gov/ should have the opportunity to review the proposed criteria.	
21 Jun 2005	**MA-1**	Concerns were expressed that cbnc3 had incomplete data and that the Marsh station would provide better data. The cbnc3 station was selected because of the location (channel into Cathlamet Bay) and would be a good indicator of changes that could affect the bay. The Marsh station is too far upstream and would likely not show any changes in salinity or temperature from the deepening. The cnbc3 location is also important for connectivity and conductivity. Natinal Marine Fishery Service (NMFS) agreed with the stated rationale for the selection of cbnc3.	
28 Jun 2005	**MA-1**	The team discussed the desire by Washington Department of Ecology (WDOE) and Oregon Department of Environmental Quality (ODEQ) to substitute cbnc3 for one of the other close proximity CORIE stations (e.g., Marsh), because of the limited historical data availability and it's susceptibility to bio-fouling. However, the change was not agreed to by the AMT and as a result the cbnc3 data that were interpolated will be flagged	
28 Jun 2005	**MA-1**	At the last meeting, Cathy was going to talk to the Science Center about the water elevation decision criteria. She stated that she was waiting for an e-mail back from Ed Castillas. She stated that Ed talked with Antonio Baptista who stated that the evaluation criteria were too broad and we would not be able detect change. The Corps agreed to have a conference call between Steve Bartell, Antonio Baptista and Shyam Nair to discuss these concerns.	
28 Jun 2005	**MA-1**	Sample sizes will be added to the WA-1 tables. The numbers in the tables will be revised and presented to the 10th decimal point. Corrections to the salinity calculations (i.e., binning errors) will be included in the revised tables. Any reference to real-time data needs to be taken out of the decision criteria document. WDOE and ODEQ also requested that the depth at which each CORIE station is monitored is included in each data table provided to the AMT.	

Table 2-5.1. CRCIP AEM Plan Record of AMT MA-1 Decisions. (Continued).

Date	Issue	MA-1 Decisions	Comments
22 Aug 2005	**MA-1**	There was discussion of the normalization of daily median water temperature data for selected CORIE stations to daily median water temperature data for the "woody" sampling location. Temperature values at the woody station are largely determined by river flows. These normalizations have been summarized by simply plotting the data from selected stations against the woody data. Deviations from a linear relationship suggest increasing influence of ocean water on temperature. The suggestion is that alterations in circulation within the estuary due to channel modifications might be indicated by changes in the relations summarized in the plots.	
31 Aug 2005	**MA-1 Decision Criteria**	All agencies concurred on the triggers for MA-1: Two trigger tables will be developed showing triggers values set between the 5th–90th percentile and the 20th–80th percentile. Median daily water temperature values for the three MA-1 CORIE stations will also plotted against corresponding values for the woody station. The data will be evaluated quarterly for the first year and/or after each contract for channel modifications starting October 12, 2005. These data will be reviewed and summarized annually.	
31 Aug 2005	**MA-1 Decision Criteria**	The group also agreed that if one of the stations being used breaks down, one of the other stations close to the unavailable station will be used as a surrogate, if possible.	
1 Sep 2005	**MA-1 Data Analysis**	E2 Consulting Engineers, Inc., (Steve Bartell) will be responsible for analyzing and summarizing the MA-1 data.	
12 Oct 2005	**MA-1 Data Analysis**	Based on the results for depth, temperature, and salinity presented at the AMT meeting, the AMT concluded that adaptive management would not be initiated.	
12 Oct 2005	**MA-1 Data Analysis**	The AMT requested that normalized salinity plots be developed by E2 for the three MA-1 monitoring stations.	
11 Jan 2006	**MA-1 Salinity Plots**	E2 developed salinity plots for the three MA-1 stations and several candidate reference stations. After examining the results of these plots, the AMT agreed that the Desdemona station appeared to provide the best relationship between values of median daily salinity. The AMT concluded that these kinds of normalized salinity plots should become part of the adaptive management process (AMP) and used in the same way as the normalized temperature plots.	
12 Apr 2006	**MA-1 Data Analysis**	Based on the results for depth, temperature, and salinity presented at the AMT meeting, the AMT concluded that adaptive management would not be initiated.	
12 Apr 2006	**Columbia River flow data**	The AMT requested that summaries of flow data be provided to assist in the interpretation of depth, temperature, and salinity data.	
12 Apr 2006	**MA-1 Current Velocity Data**	The AMT asked that the availability of current velocity data be reexamined in relation to MA-1 assessments of changes in physical habitat that might be associated with the CRCIP construction.	
11 Oct 2006	**MA-1 Data Analysis**	The AMT requested that the MA-1 analyses be performed in a timely manner. (This is largely determined by the availability of the data provided by CORIE.)	
10 Jan 2007	**MA-1 Data Analysis**	CORIE and the Corps have agreed that the verified MA-1 data will be available for public download and analyses 30 days after the end of a sampled month. This will essentially introduce a one-month time lag in the reporting of the CORIE analyses to the AMT.	
11 Apr 2007	**MA-1 CORIE Analyses**	Several January and February temperature and salinity values will be examined in relation to river flows and local climate data.	

Table 2-5.1. CRCIP AEM Plan Record of AMT MA-1 Decisions. (Continued).

Date	Issue	MA-1 Decisions	Comments
11 Jul 2007	**MA-1 CORIE Analyses**	No management decisions were required for MA-1.	
3 Oct 2007	**MA-1 CORIE Analysis**	Recommendations were made to examine alternative stations for red26, which has been lost from the CORIE network. Data for dsdma and tansy stations will be analyzed.	
9 Jan 2008	**MA-1 CORIE Analyses**	Analysis of salinity data for tansy station suggest that tansy can be substituted for red26 (which is out of service). Salinity outlier values for cbnc3 in January 2008 will be examined in relation to local climate and river flow data.	
29 Apr 2008	**MA-1 CORIE Analyses**	No decisions were made in relation to the CORIE analysis.	
9 Jul 2008	**MA-1 CORIE Analyses**	No decisions were made in relation to the CORIE analysis.	
8 Oct 2008	**MA-1 CORIE Analyses**	E2 will explore possible reasons to explain the variations in temperature observed in late May and early June.	
14 Jan 2009	**MA-1 CORIE Analyses**	No decisions were made concerning the MA-1 results at the January 2009 meeting.	
8 Apr 2009	**MA-1 CORIE Analyses**	The AMT decided to continue using publicly available CORIE data that have been through the CORIE QA/QC process.	
8 Jul 2009	**MA-1 CORIE Analyses**	Monitoring results for depth, temperature, and salinity were within the monthly decision criteria for MA-1.	
18 Nov 2009	**MA-1 CORIE Analyses**	Monitoring results for depth, temperature, and salinity were within the monthly decision criteria for MA-1.	
18 Nov 2009	**MA-1 CORIE Analyses**	The AMT decided by consensus that MA-1 monitoring activities should continue according to the terms and conditions specified in the Biological Opinion.	

2-6 Maintenance of the CORIE Monitoring Stations

Dr. Antonio Baptista (Director of the CORIE monitoring program) discussed the operational challenges in maintaining the monitoring stations that constitute the CORIE network in the LCR and estuary. Several of these stations (e.g., tansy, grays, cbnc3, dsdmna, woody) are used in the MA-1 analyses of depth, water temperature, and salinity. Difficulties in maintaining the stations center mainly on funding, staff availability, and safety considerations. As a result, when a station encounters problems, it might require several weeks or more until resources and conditions permit restoration of service. Some problems are of sufficient magnitude as to preclude restoration, for example, cbnc3 is tangled with fishing line and fixing this problem is not likely due to safety issues. The red26 station was physically lost, although a replacement might be located in the near vicinity.

Dr. Baptista indicated that it might be possible in some cases to retrieve data that are physically logged into the data recorders at several sampling locations. It might also be possible to reconstruct missing data. However, the quality of the reconstructed data might not comparable to data used previously in the MA-1 analyses. Dr. Baptista offered to make raw data available (essentially in real time) for use in the MA-1 analysis. However, these data will not have been processed by CORIE for quality assurance and the AEM Program would have to assume this responsibility. The MA-1 analyses will continue to use the data that are publicly available on the CORIE website. These data have been processed through the CORIE quality assurance procedures.

Dr. Baptista emphasized that CORIE will do all within reason to maintain the operational status of the stations used in the MA-1 monitoring.

3 Monitoring Action 2—Dredging Volumes

MA-2 tracks and reports annual dredging volumes associated with construction and operation of the 48-foot navigation channel.

3-1 Volumes of Dredged Materials

Volumes are reported for each dredging bar (~3-mile reaches). Adaptive management can be triggered if actual construction volumes exceed projected volumes (e.g., Table 3-1.1). In addition, the adaptive component of the proposed AEM Plan might be initiated if the volumes of dredged materials exceed the capacity for disposal. Volumes and disposal of operations and maintenance dredging are also tracked in relation to the Project. These three aspects of Project construction contribute to decision-making concerning adaptive management based on the MA-2 results.

Early Project construction included work at Desdemona, Flavel Bar, Upper Sands, Willow Bar, Morgan Bar, and Lower Vancouver. Construction in 20008 occurred at Tongue Point Crossing, Miller Sands, Pillar Rock, Brookfield Welch, Wauna-Driscoll, Westport Bar, Stella Fisher, Walker Island, Lower Dobelbower, Upper Dobelbower, Kalama Bar, Lower and Upper Martin Bar, St. Helens, Warrior Rock, Henrici Bar, Willow Bar, Morgan Bar, Lower Vancouver, and the Vancouver Turning Basin.

The original construction volume projected above 48 ft was approximately 19 million cubic yards, e.g., 2001 Biological Assessment (USACE 2001). The projected volume of new work (48 – 45 ft) was originally estimated as 14,473,613 cubic yards (Table 3-1.1). The results indicate that more actual new dredging was required than originally forecasted for several locations. The overall Project new (48 – 45 ft) construction of 15,179,514 cubic yards exceeded the total amount of dredging for the CRCIP by approximately 5% (Table 3-1.1). Phase 1 construction removed approximately 2,572,851 cys. Phase 2 Project construction removed approximately 4,308,232 cubic yards (cys). Phase 3 removed 11,462,014 cys.

Table 3-1.1. Comparisons of Projected and Actual CRCIP Construction Volumes through 2009.

Sheet ID	Chart	Bar Name	Bar Stations by River Mile	D/S River Mile	Projected Volume Above 48ft	Projected Volume Above 45ft	Projected New Work (48–45ft) Volume	Actual New Work (48–45ft) Volume	O&M Volume	Location of CRCIP Placed Material
CL-4		**Lower Desdemona**	04+20+00	04+00+00	317,100	222,412	94,688	3,894[a]	78,755	DWS/IW
				05+00+00	550,640	353,916	196,724			
CL-5		**Upper Desdemona**	06+22+00	06+00+00	66,193	0	66,193	22,704	43,457	DWS
	Predicted Bar New Construction Volume =	473,894		07+00+00	1,039	0	1,039			
	Actual Bar New Construction Volume =	26.598		8+00+00	61,140	8,742	52,398			
	Percentage of Prediction =	6%		9+00+00	71,593	8,742	62,851			
CL-9		**Flavel Bar**	10+00+00	10+00+00	379,028	49,732	329,296	337,154	0	DWS/IW
	Predicted Bar New Construction Volume =	1,169,720		11+00+00	833,973	298,900	535,074	241,059	1,157,548	DWS
	Actual Bar New Construction Volume =	642,520		12+00+00	360,900	121,292	239,608	300	0	DWS/IW
	Percentage of Prediction =	55%		13+00+00	138,168	72,425	65,743	64,007	40,000	DWS/IW
CL-14		**Upper Sands**	13+30+00	14+00+00	226,017	54,585	171,432	102,699	70,000	DWS/IW
	Predicted Bar New Construction Volume =	858,622		15+00+00	323,787	51,945	271,842	202,911	694,245	DWS/IW
	Actual Bar New Construction Volume =	458,550		16+00+00	354,274	47,557	306,717	152,940	0	DWS/IW
	Percentage of Prediction =	53%		17+00+00	108,631	0	108,631			
CL-18		**Tongue Point Crossing**	17+28+00	18+00+00	188,889	14,775	174,113	165,325	200,179	IW
	Predicted Bar New Construction Volume =	464,196		19+00+00	169,841	6,976	162,864	207,932	350,238	IW
	Actual Bar New Construction Volume =	657,424		20+00+00	140,502	13,283	127,219	284,167	501,250	IW
	Percentage of Prediction =	142%								
CL-21		**Miller Sands**	21+20+00	21+00+00	220,662	48,572	172,090	233,323	1,521,222	DWS/IW
	Predicted Bar New Construction Volume =	457,860		22+00+00	536,271	397,564	138,706	241,015		DWS
	Actual Bar New Construction Volume =	1,030,823		23+00+00	16,212	2	16,210	116,866		DWS/BN

Table 3-1.1. Comparisons of Projected and Actual CRCIP Construction Volumes through 2009. (Continued).

Sheet ID	Chart	Bar Name	Bar Stations by River Mile	D/S River Mile	Projected Volume Above 48ft	Projected Volume Above 45ft	Projected New Work (48–45ft) Volume	Actual New Work (48–45ft) Volume	O&M Volume	Location of CRCIP Placed Material
	Percentage of Prediction =	225%		24+00+00	168,189	37,335	130,854	439,619		DWS/IW
CL-26		**Piller Rock**	25+10+00	25+00+00	384,769	112,426	272,344	105,985	108,863	DWS/IW
	Predicted Bar New Construction Volume =	449,324		26+00+00	171.408	44,197	127,211	55,796		IW
	Actual Bar New Construction Volume =	161,780		27+00+00	56,322	6,553	49,769	TBD		IW
	Percentage of Prediction =	36%								
CL-28		**Brookfield Welch**	28+40+00	28+00+00	193,261	28,356	164,905	191,091	286,637	UP/IW
	Predicted Bar New Construction Volume =	404,150		29+00+00	224,225	64,782	159,443	197,346		IW
	Actual Bar New Construction Volume =	191,091		30+00+00	89,561	23,615	65,947			
	Percentage of Prediction =	47%		31+00+00	40,513	26,657	13,855			
CL-33		**Skamokawa Bar**	32+30+00	32+00+00	167,896	31,955	135,941	243,063	243,063	UP/IW
	Predicted Bar New Construction Volume =	735,819		33+00+00	651,852	455,132	196,720			
	Actual Bar New Construction Volume =	568,502		34+00+00	90,709	9,367	81,342	325,439	396,694	IW
	Percentage of Prediction =	77%		35+00+00	358,874	37,059	321,816			
CL-36		**Puget Island**	36+31+00	36+00+00	17,288	354	16,934			
	Predicted Bar New Construction Volume =	522,842		37+00+00	162,466	17,838	144,628	610,292	553,455	IW
	Actual Bar New Construction Volume =	610,292		38+00+00	374,599	54,709	319,889			
	Percentage of Prediction =	117%		39+00+00	46,331	4,940	41,391			
CL-40		**Wauna – Driscoll**	40+40+00	40+00+00	164,427	26,349	138,077	258,062	197,455	IW
	Predicted Bar New Construction Volume =	860,535		41+00+00	226,584	40,230	186,354			
	Actual Bar New Construction Volume =	582,067		42+00+00	323,422	64,593	238,829	324,005	75,491	IW
	Percentage of Prediction =	68%		43+00+00	375,149	77,874	297,275	399,496		

Table 3-1.1. Comparisons of Projected and Actual CRCIP Construction Volumes through 2009. (Continued).

Sheet ID	Chart	Bar Name	Bar Stations by River Mile	D/S River Mile	Projected Volume Above 48ft	Projected Volume Above 45ft	Projected New Work (48–45ft) Volume	Actual New Work (48–45ft) Volume	O&M Volume	Location of CRCIP Placed Material
CL-44		**Westport Bar**	44+27+00	44+00+00	251,076	32,800	218,276	927,116	2,271,096	Rehandled UP
	Predicted Bar New Construction Volume =	1,146,351		45+00+00	458,268	67,950	390,318			
	Actual Bar New Construction Volume =	927,116		46+00+00	285,678	26,341	259,337			
	Percentage of Prediction =	81%		47+00+00	338,946	60,526	278,420			
CL-50		**Eureka Bar**	48+10+00	48+00+00	200,332	41,415	158,918			
	Predicted Bar New Construction Volume =	229,554		49+00+00	73,575	4,751	68,824			
	Actual Bar New Construction Volume =	0		50+00+00	1,812	0	1,812			
	Percentage of Prediction =	0%		51+00+00	0	0	0			
CL-54		**Gull Island**	51+45+00	52+00+00	0	0	0			
	Predicted Bar New Construction Volume =	18,623		53+00+00	0	0	0			
	Actual Bar New Construction Volume =	174,379		54+00+00	19,107	485	18,623	174,379	0	IW
	Percentage of Prediction =	936%								
CL-56		**Stella Fisher**	55+30+00	55+00+00	9,824	0	9,824			
	Predicted Bar New Construction Volume =	594,677		56+00+00	181,756	34,201	147,554	TBD		
	Actual Bar New Construction Volume =	996,392		57+00+00	31,463	0	31,463			
	Percentage of Prediction =	168%		58+00+00	543,065	137,229	405,836	996,392	0	IW/UP
CL-59		**Walker Island**	59+22+00	59+00+00	95,243	15,759	79,484			
	Predicted Bar New Construction Volume =	209,676		60+00+00	82,387	3,116	79,270	146,009	114,363	IW
	Actual Bar New Construction Volume =	146,009		61+00+00	20,432	296	20,136			
	Percentage of Prediction =	70%		62+00+00	32,466	1,679	30,787			
CL-64		**Slaughters Bar**	63+10+00	63+00+00	195,190	15,000	180,190	1,015,926	253,982	UP/IW
	Predicted Bar New Construction Volume =	1,179,942		64+00+00	304,956	30,000	274,956			

Table 3-1.1. Comparisons of Projected and Actual CRCIP Construction Volumes through 2009. (Continued).

Sheet ID	Chart	Bar Name	Bar Stations by River Mile	D/S River Mile	Projected Volume Above 48ft	Projected Volume Above 45ft	Projected New Work (48–45ft)	Actual New Work (48–45ft) Volume	O&M Volume	Location of CRCIP Placed Material
CL-64		**Slaughters Bar**	63+10+00	63+00+00	195,190	15,000	180,190			
	Actual Bar New Construction Volume =	1,015,926		65+00+00	338,641	67,058	271,583	TBD		
	Percentage of Prediction =	86%		66+00+00	561,173	107,960	453,213			
CL-67		**Lower Dobelbower**	67+06+00	67+00+00	192,962	54,691	138,271	310,697	274,492	UP/IW
	Predicted Bar New Construction Volume =	187,741		68+00+00	3,116	16	3,100	188,968	156,713	IW/UP
	Actual Bar New Construction Volume =	499,665		69+00+00	46,386	16	46,370			
	Percentage of Prediction =	266%								
CL-67		**Upper Dobelbower**	69+50+00	70+00+00	194,244	34,134	160,110	273,024	166,634	UP
	Predicted Bar New Construction Volume =	187,381		71+00+00	12,900	0	12,900			IW/UP
	Actual Bar New Construction Volume =	401,285		72+00+00	14,371	0	14,371	128,261	37,579	UP/IW
	Percentage of Prediction =	214%								
CL-73		**Kalama Bar**	72+40+00	73+00+00	115,482	0	115,482			
	Predicted Bar New Construction Volume =	307,268		74+00+00	78,329	5,381	72,948	143,777	39,625	IW/UP
	Actual Bar New Construction Volume =	348,638		75+00+00	135,429	16,591	118,838	204,861	0	IW/UP
	Percentage of Prediction =	113%								
CL-78		**Lower Martin Bar**	76+25+00	76+00+00	406,832	125,671	281,161	260,042	111,221	IW/UP
	Predicted Bar New Construction Volume =	654,718		77+00+00	169,712	14,880	154,833	159,112	0	UP
	Actual Bar New Construction Volume =	762,491		78+00+00	5,860	39	5,821	343,337	74,083	IW/UP
	Percentage of Prediction =	116%		79+00+00	281,891	68,988	212,903			IW/UP
CL-78		**Upper Martin Bar**	80+16+50	80+00+00	68,158	18,927	149,231	296,815	166,909	IW/UP
	Predicted Bar New Construction Volume =	409,017		81+00+00	68,884	22,936	45,948	142,936	0	IW/UP
	Actual Bar New Construction Volume =	736,649		82+00+00	226,583	12,745	213,838	296,898	377,844	IW/UP
	Percentage of Prediction =	180%								

Table 3-1.1. Comparisons of Projected and Actual CRCIP Construction Volumes through 2009. (Continued).

Sheet ID	Chart	Bar Name	Bar Stations by River Mile	D/S River Mile	Projected Volume Above 48ft	Projected Volume Above 45ft	Projected New Work (48–45ft)	Actual New Work (48–45ft) Volume	O&M Volume	Location of CRCIP Placed Material
CL-84		**St. Helens**	83+44+00	83+00+00	113,920	8,610	105,311	186,561	51,675	IW/UP
	Predicted Bar New Construction Volume =	451,717		84+00+00	60,424	7,337	53,087	124,405	321,657	IW/UP
	Actual Bar New Construction Volume =	562,567		85+00+00	97,614	3,681	93,933	98,635		IW/UP
	Percentage of Prediction =	125%		86+00+00	268,809	69,223	199,386	152,966		IW/UP
CL-87		**Warrior Rock**	87+15+00	87+00+00	161,482	45,127	116,355	462,416	0	IW/UP
	Predicted Bar New Construction Volume =	354,413		88+00+00	157,476	21,660	135,816	411,942	38,266	IW
	Actual Bar New Construction Volume =	874,358		89+00+00	117,165	14,924	102,241			IW/UP
	Percentage of Prediction =	247%								
CL-90		**Henrici Bar**	90+20+00	90+00+00	481,852	100,142	381,709	306,720	191,060	IW
	Predicted Bar New Construction Volume =	642,166		91+00+00	232,015	51,233	180,781	279,964	0	IW
	Actual Bar New Construction Volume =	785,724		92+00+00	86,909	7,234	79,675	199,040	0	Rehandled UP
	Percentage of Prediction =	122%								
CL-94		**Willow Bar**	93+50+00	93+00+00	261,237	67,579	193,659	278,513	19,052	Rehandled UP
	Predicted Bar New Construction Volume =	537,183		94+00+00	156,838	45,286	111,552	136,003	26,950	Rehandled UP
	Actual Bar New Construction Volume =	468,766		95+00+00	78,237	6,356	71,881	54,250	301,373	Rehandled UP
	Percentage of Prediction =	87%		96+00+00	191,681	31,588	160,093			
CL-97		**Morgan Bar**	97+40+00	97+00+00	167,351	31,430	135,922			
	Predicted Bar New Construction Volume =	191,689		98+00+00	50,416	3,821	46,595	33,637	3,100	Rehandled Material
	Actual Bar New Construction Volume =	33,637		99+00+00	9,172	0	9,172			
	Percentage of Prediction =	18%		100+00+00	0	0	0			

Table 3-1.1. Comparisons of Projected and Actual CRCIP Construction Volumes through 2009. (Continued).

Sheet ID	Chart	Bar Name	Bar Stations by River Mile	D/S River Mile	Projected Volume Above 48ft	Projected Volume Above 45ft	Projected New Work (48–45ft) Volume	Actual New Work (48–45ft) Volume	O&M Volume	Location of CRCIP Placed Material
CL-102		**Lower Vancouver**	101+18+00	101+00+00	87,054	10,311	76,744			
	Predicted Bar New Construction Volume =	556,043		102+00+00	84	0	84	352,718	937	Rehandled UP
	Actual Bar New Construction Volume =	352,718		103+00+00	87,909	1,810	86,099			
	Percentage of Prediction =	63%		104+00+00	393,116	0	393,116			IW/UP
CL-105		**Vancouver Turning Basin**	104+31+25	105+00+00	287,713	69,220	218,493	1,163,547	0	IW/UP-Hickey
	Predicted Bar New Construction Volume =	218,493		105+31+07			0			
	Actual Bar New Construction Volume =	1,163,547								
	Percentage of Prediction =	533%								
				TOTAL=	**19,047,502**	**4,573,889**	**14,473,613**	**15,179,514**	**11,517,073**	

[a]Values in blue denote construction and O&M reported through 2008
[b]Values in green denote construction and O&M reported after 2008

3-2 Disposal of Project Dredged Materials

The Corps also provided a detailed summary of Project construction and disposal of construction materials for Phases 1-3. The Phase 1-3 summaries have been developed as updates to existing Project MA-2 spreadsheets (Tables 3-2.1 – 3-2.3) included in previous annual reports. It is important to understand that two independent methods are used to quantify the construction material removed and the disposed materials. The materials removed are based on bathymetric surveys following construction, while the volumes disposed are based on values reported by the contractors. The construction and disposal values, therefore, do not always match.

In Phase 1, approximately 2,572,851 cys were removed by the Dredge Sugar Island from the river locations indentified in Table 3-2.1. 1,452,418 cys were disposed of in-water or flow lane, while 1,228,584 were disposed in the ocean deep water site (DWS). In addition, the Dredge Oregon rehandled 724,843 cys from the W-101.0 flow lane location and placed these materials at the W-101.0 upland site (Gateway).

Table 3-2.1. Phase 1 Removal and Disposal of CRCIP Dredged Materials through 2009.

Limits		Total Removed	In-Water or Upland Disposal				Ocean Disposal
Downstream	Upstream						
Sugar Island Phase 1 Removal							
			O-9.0-FL	O-17.5-FL	O-18.8-FL	W-101.0-FL	
4+20+00	6+22+20	38,894	2,024				29,612
6+22+00	10+00+00	22,704					17,910
10+00+00	11+10+00	337,154	17,571				325,245
11+10+00	12+40+00	275,367					227,581
12+40+00	13+30+00	300					321
13+30+00	14+45+00	104,007	2,760				95,588
14+45+00	15+27+00	172,699	5,033				167,332
15+27+00	16+10+00	214,174		2,095			206,082
16+10+00	17+30+00	152,940	4,726	35,996			158,913
17+30+00	19+00+00	165,325		177,842	19,752		
19+00+00	20+10+00	207,932		95,459	111,717		
20+10+00	21+10+00	139,377		87,323	75,617		
95+00+00	98+00+00	355,623				371,909	
98+00+00	102+00+00	33,637				44,591	
102+00+00	104+20+00	352,718				398,003	
Oregon Phase 1 Rehandle							
			W-101.1-UD				
W-101.0-FL			724,843				

Approximately 4,308,232 cys were removed in Phase 2 of Project construction by the Dredges Stuyvesant, Essayons, and Oregon (Table 3-2.2). The Deep Water Site received ~1,034,864 cys.. In Phase 2, approximately 1,312,665 cys were disposed/rehandled at an upland site on Brown Island (W-46.3) and another 432,782 cys were placed upland at Gateway (W-101.0). The remainder of the dredged materials was disposed in-water or in the flow lane.

Table 3-2.3 summarizes the removal and disposal activities for Phase 3 of Project construction. This work was performed by the Dredges Terrapin Island, Liberty Island, Oregon, Megan-Renee

and the Sea Horse. The latter two vessels were involved in removal of consolidated rock. Phase 3 removed ~11,462,014 cys. Phase 3 emphasized disposal in-water, flow lane, and upland. No construction materials were disposed in the Deep Water Site in Phase 3. The Terrapin Island and Liberty Island disposed of ~3,421,970 cys in-water or in the flow lane. These dredges also placed ~4,406,341 cys on upland disposal sites. The Oregon placed 2,180,014 cys in-water or flow lane and ~2,232,591 cys at upland locations. The Megan-Renee and Sea Horse removed ~1,163,547 cys of consolidated rock and disposed 1,530, 230 cys at upland locations (O-102.2-CM and Hickey).

Table 3-2.2. Phase 2 Removal and Disposal of CRCIP Dredged Materials through 2009.

Limits		Total	In-Water or Upland Disposal							Ocean
Downstream	**Upstream**	**Removed**	**O-18.2-FL**	**W-24.0-FL**	**W-26.0FL**	**W-30.2-FL**				**Disposal**
Stuyvesant Removal										
21+10+00	22+20+00	238,248								359,675
22+20+00	23+20+00	140,387								173,424
23+20+00	24+17+00	57,427								66,298
24+17+00	25+20+00	439,619		7,311	66,028					384,065
25+20+00	26+20+00	214,847	104,937		29,706	29,991				51,402
26+20+00	27+20+00	55,796				70,524				
Essayons Removal										
			W-97.0-FL	**W-101.0-FL**						
91+00+00	92+00+00	279,964	297,947							
92+00+00	93+00+00	199,040		227,114						
93+00+00	94+00+00	297,565	215,498	169,887						
94+00+00	95+00+00	162,953	8,085	35,791						
Oregon Removal										
			O-40.1-IW	**W-40.1-IW**	**W-40.6-IW**	**O-42.2-IW**	**W-43.5-IW**	**O-43.7-IW**	**W-43.7-IW**	
40+30+00	41+30+00	342,608	143,892	48,816	190,038					
41+30+00	44+00+00	399,496				278,125	147,848	40,581	46,824	
Oregon Rehandle										
			W-101.0-UP							
W-101.0-FL		-	432,792							
Essayons/Oregon Removal/Rehandle										
			O-46.2-IW	**W-46.3-UP**						
44+05+00	48+10+00	1,480,283	167,618	1,312,665						

Table 3-2.3. Phase 3 Removal and Disposal of CRCIP Dredged Materials through 2009.

Limits			In-Water or Upland Disposal									
Terrapin Island/Liberty Island Removal												
Downstream	**Upstream**	**Total Removed**	**W-36.3-IW**	**W-55.3-IW**	**W-61.1-IW**	**W-67.7-IW**	**W-72.6-IW**	**W-77.9-IW**	**W-78.6-IW**	**W-81.9-IW**	**W-86.8-IW**	**W-97.0-FL**
37+25+00	39+10+00	839,130	993,292									
58+00+00	59+40+00	996,392		418,720								
59+40+00	62+00+00	203,689		85,932	161,185							
67+05+00	68+25+00	458,680				28,744	49,424					
68+25+00	70+25+00	345,681				52,624						
70+25+00	72+20+00	340,087										
72+20+00	74+00+00	128,261				9,830	52,786					
74+00+00	75+00+00	183,402				4,928						
75+00+00	76+10+00	204,861					77,909					
76+10+00	77+00+00	371,263					32,886					
77+00+00	78+10+00	159,112										
78+10+00	80+00+00	417,420					45,779					
80+00+00	81+00+00	463,724						49,439				
81+00+00	82+00+00	142,936						44,985				
82+00+00	83+00+00	463,884						3,406	197,851			
83+00+00	84+00+00	238,236								250		
84+00+00	85+00+00	124,405								43,464	10,013	
85+00+00	86+00+00	98,635								5,144	32,915	
86+00+00	87+25+00	152,966									46,980	
88+25+00	90+00+00	450,208										498,259
90+00+00	91+00+00	456,476										475,225
28+40+00	31+00+00	477,728	375,349	220,950	120,906							
32+30+00	34+35+00	486,126				149,738	147,247					
34+35+00	36+10+00	650,878						238,453	585,561			
54+15+00	55+20+00	174,379								228,833		
62+00+00	65+00+00	1,269,908									55,156	57,821
Oregon Removal												
			O-34.0-UP	**O-63.5-UP**	**O-64.8-UP**							
28+40+00	31+00+00	477,728										
32+30+00	34+35+00	486,126	413,158									
34+35+00	36+10+00	650,878										
54+15+00	55+20+00	174,379										
62+00+00	65+00+00	1,269,908		196,252	1,623,181							
Megan-Renee/Sea Horse Consolidated Rock Removal												
			O-102.2-CM	**Hickey-UP**								
104+20+00	105+25+00	1,163,547	1,124,335	405,895								

Table 3-2.4 lists in detail the potential disposal sites, their associated capacities and amounts of dredged materials disposed of to date. Upland disposal has not exceeded capacity for any of the disposal locations used thus far. The Northport site appeared as one possible exception. However, further analysis indicated that the Northport location in the summary table was actually two separate disposal sites. Accounting for the total capacity of these locations, it is not likely that this total capacity has been exceeded.

Table 3-2.4. Disposal of CRCIP Dredged Materials through 2009.

Disposal Site	Site Location/Name	CRCIP Construction		Projected O&M Volume	Actual O&M Volume Placed	Percent Full	Total Estimated Capacity
		Projected Volume	Volume Placed				
W-21.0	Rice island	0		5,500,000			5,500,000
O-23.5	Miller Sands	0		7,000,000			NA
O-27.2	Pillar Rock Island	0		1,000,000			2,555,000
W-33.4	Skamokawa	0		varies			250,000
O-34.0	Welch island	0	413,158[b]	400,000		93%	446,000
O-38.3	Tenasillahe Island	0		2,300,000			2,300,000
O-42.9	James River	240,000		830,000			1,280,000
W-44.0	Puget Island (Vik Prop.)	500,000		2,700,000			3,500,000
W-46.3/W-46.0	Brown Island	1,200,000	1,312,665[a]	3,400,000		28%	4,700,000
O-54.0	Port Westward	150,000		1,500,000			1,875,000
O-57.0	Crims Island	30,000	638,954	1,100,000		40%	1,600,000
W-59.7	Hump Island	400,000		900,000			1,500,000
W-62.0	Mt. Solo	300,000		2,100,000			2,500,000
W-63.5	Reynolds Aluminum	180,000		0			500,000
O-63.5	Lord Island Upstream	0	196,252	600,000		16%	1,255,000
O-64.8	Rainier Industrial	270,000	1,623,181	2,400,000		73%	2,235,000
W-67.5	International Paper	140,000		2,700,000			1,000,000
O-67.0	Rainier Beach	450,000		2,400,000			1,095,000
W-68.7	Howard Island	0		600,000			6,400,000
W-70.1	Cottonwood Island	240,000	1,409,554	1,300,000		44%	3,200,000
W-71.9	Northport 1	189,000	561,988	1,800,000		62%	900,000
W-71.9	Northport 2 (Beneficial Use)	750,000	666,963	0		100%	750,000
O-75.8	Sandy Island	120,000		860,000			1,100,000
O-77.0	Lower Deer Island	440,000		700,000			1,498,000
W-80.0	Martin Island Mitigation	370,000		0			550,000
W-82.0	Martin Bar	46,000	554,130	700,000		37%	1,500,000
O-82.6	Reichold	320,000		2,300,000			1,285,000
O-86.2	Sand Island	150,000		860,000			1,250,000
W-86.5	Austin Point	136,000	574,752	1,500,000		35%	1,645,000
O-87.8	Railroad Corridor	300,000		0			540,000
O-91.5	Lonestar	900,000		3,200,000			5,350,000
W-96.9	Adjacent to Fazio	0		varies			475,000

Table 3-2.4. Disposal of CRCIP Dredged Materials through 2009. (Continued).

Disposal Site	Site Location/Name	CRCIP Construction		Projected O&M Volume	Actual O&M Volume Placed	Percent Full	Total Estimated Capacity
		Projected Volume	Volume Placed				
W-97.1	Fazio Sand & Gravel	112,000		1,000,000			650,000
W-101.0	Gateway	587,000	1,157,635	1,600,000		50%	2,300,000
W-102	KTR Furnished Beneficial Use		405,895	0		100%	405,895
O-105.0	West Hayden Island	600,000		3,900,000			5,750,000
Total upland			9,515,127			13%	58,505,858
DWS		6,500,000	2,170,532			1%	225,000,000
IW-FL		2,000,000	5,490,079			275%	2,000,000
Scour Hole	W-40.6-FL/W-43,5-IW		337,886			100%	337,886
Rehandled Material				2,279,575			

[a]Values in blue denote disposal prior to 2008
[b]Values in green denote changes since 2008.

Note that the 275% value for total estimated capacity for IW-FL simply means that the volume placed by O&M exceeded the original projected construction value, which was used to define the IW-FL disposal site capacity.

Overwidth dredging was performed by the Dredge Oregon (Table 3-2.5) and the Dredge Terrapin Island (Table 3-2.6). These dredged materials were disposed mainly in-water or at the Deep Water Site, although 121,201 cys from the Oregon were used for beach nourishment.

Table 3-2.5. CRCIP Phase 1 and 2 Overwidth Dredging Summary for the Dredge Oregon.

Station Limits		Total Removed	In-water disposal				Beach nourishment	
Downstream	Upstream		HPS	O-21.4	W-43.5	W-43.7	O-25.5	W-43.8
21+25+00	21+45+00	18,367		18,367				
22+07+00	23+05+00	138,827	138,827					
23+30+00	24+03+00	67,389					67,389	
44+05+00	45+20+00	89,686			11,958	23,916		53,812

Table 3-2.6. CRCIP Phase 1 and 2 Overwidth Dredging Summary for the Dredge Terrapin Island.

Station Limits		Total Removed	In-water disposal		Ocean
Downstream	Upstream		W-13.9	O-49.9	DWS
11+00+00	21+45+00	75,692			75,692
15+35+00	23+05+00	78,737	78,737		
18+30+00	24+03+00	144,790			144,790
47+35+00	45+20+00	53,439		53,439	

3-3 AMT Decisions for MA-2

Table 3-3.1 lists the decisions made by the AMT in relation to project construction, dredging volumes, and dredged material disposal during the course of the quarterly meetings of the CRCIP AEM Program.

Table 3-3.1. CRCIP AEM Plan Record of AMT MA-2 Decisions.

Date	Issue	MA-2 Decisions	Comments
16 Dec 2004	**MA-2 Decision Criterion**	Compare actual dredging volumes with predicted volumes.	
16 Dec 2004	**MA-2 Decision Criterion**	Annual O&M dredging volumes plus construction volumes.	
16 Dec 2004	**MA-2 Decision Criterion**	Develop plots of predicted vs. actual dredged volumes for the contracted river mile segments; show percentages (e.g., 5, 10, 15, etc.) of possible exceedance.	
16 Dec 2004	**MA-2 Decision Criterion**	Develop similar summaries for dredge disposal.	
16 Dec 2004	**MA-2 Decision Criterion**	Communicate summaries, plots, etc., to the AMT within two months after each contract is completed.	
16 Dec 2004	**MA-2 Decision Criterion**	Trigger for other disposal options (e.g., in-water vs. upland), if larger than predicted volumes are dredged.	
5 Jul 2005	**MA-2 Decision Criterion**	Initial consensus was for reporting the results of dredging on a contract basis, although Washington expressed continued interest in a bar-by-bar summary as well as a summary by contract.	
5 Jul 2005	**MA-2 Decision Criterion**	The AMT achieved consensus that the decision criteria for MA-2 would derive from comparisons between estimated and actual dredging volumes, as summarized and presented in the March annual AMT meeting.	
1 Sept 2005	**MA-2 Decision Criterion**	All agencies concurred that if the dredging volumes exceed the projected amounts in the CRCIP Final Supplemental Environmental Impact Statement (FSEIS) by 15 percent or more that the AMT team members would be notified. Agreement was also reached, that at the quarterly meetings, the Corps would provide: dredging volumes updates for CRCIP construction and O&M, estimated amounts would be compared with actual amounts placed at individual upland sites and that volumes would be provide by bar and river mile.	
12 Oct 2005	**MA-2 Decision Criterion**	The AMT decision criteria refer to bar-by-bar summary of projected and actual dredging volumes. The spreadsheet currently provides a summary based on river miles. The spreadsheet will be modified to include additional rows that provide the bar-by-bar summaries. The location of disposal sites for Project dredging should also be included in the reporting for MA-2.	
11 Jan 2005	**MA-2 Decision Criterion**	It has proved difficult to determine the original source or relevance of the 15 percent proposed exceedance value. Therefore, following discussion, the AMT reached consensus to abandon the 15 percent decision criterion and simply compare projected dredging volumes to actual volumes.	
12 Apr 2006	**MA-2 Reporting**	The AMT made recommendations concerning the format of reporting dredging and disposal of dredged materials. A revised reporting template will be presented to the AMT at the next quarterly meeting.	

Table 3-3.1. CRCIP AEM Plan Record of AMT MA-2 Decisions. (Continued).

Date	Issue	MA-2 Decisions	Comments
10 Jan 2007	**MA-2 Project Construction**	The form and content of the MA-2 spreadsheet summary for the AEM Workbook were accepted by the AMT.	
11 Apr 2007	**MA-2 Dredging Summary**	The spreadsheet summary of disposal will be updated to address concerns regarding disposal capacity.	
11 Jul 2007	**MA-2 Dredging Summary**	MA-2 spreadsheets were updated to address capacity for disposal, especially in the deep ocean areas and Gateway.	
3 Oct 2007	**MA-2 Dredging Summary**	The MA-2 dredging summary tables in the AEM Project Workbook will be updated to include recent construction and disposal of dredged materials.	
9 Jan 2008	**MA-2 Dredging Summary**	Spreadsheet summaries of dredging volumes and disposal locations will be updated upon completion of the year's dredging.	
29 Apr 2008	**MA-2 Dredging Summary**	No decisions were made concerning Project dredging for MA-2.	
9 Jul 2008	**MA-2 Dredging Summary**	Disposal of Project dredged materials will be updated and summarized for the October AMT meeting.	
8 Oct 2008	**MA-2 Dredging Summary**	The summary for disposal at Northport will be revised to reflect that it is actually two disposal sites. Disposal capacity has not been exceeded.	
14 Jan 2009	**MA-2 Dredging Summary**	The upland disposal summary table was modified to show that the Northport site includes two disposal locations.	
8 Apr 2009	**MA-2 Dredging Summary**	Upland disposal has not exceeded capacity for any of the disposal locations used thus far in the CRCIP construction.	
8 Jul 2009	**MA-2 Dredging Summary**	No new information was presented for MA-2. However, the AMT will continue to be informed concerning monitoring plans being developed for rock removal as part of the CRCIP construction.	
18 Nov 2009	**MA-2 Dredging Summary**	No new information was presented for MA-2.	

4 Monitoring Action 3—Crossline Surveys

MA-3 examines accretion/erosion and changes in bathymetry of the main channel in relation to the channel deepening. Crossline surveys will be performed annually for two years prior to construction, during construction, and three years after construction. Annual surveys are performed at CRM 42, 46, 72, 75, 86, and 99. These river mile locations were identified through previous Corps analysis of locations that appeared potentially sensitive to accretion and erosion. Additional surveys will be performed at 0.5 miles up-river and 0.5 miles down-river from each of the selected CRM locations. Comparisons of survey results obtained during and after construction (year 2005+) with the MA-3 decision criteria will determine any need for adaptive management.

4.1 MA-3 Decision Criteria

In 2006, the results of pre-construction surveys (1996–2004) were used to develop consensus decision criteria to evaluate surveys performed in relation to Project construction (Table 4-1.1). The resulting depth "envelopes" define upper and lower depths that should not be exceeded as the result of construction dredging at these locations. The envelopes were calculated by subtracting the value of one standard deviation (SD) (sigma) from the minimum reported depth and adding one SD (sigma) to the maximum reported depth. The standard deviations are based on analysis of the 1996–2004 pre-construction data reported for each location

The first post-construction survey was completed in 2008. The results of the 2008 MA-3 crossline surveys were compiled and presented in relation to the previously developed decision criteria (i.e., depth "envelopes"). The results of the 2008 surveys suggested two possible outlier values: one at CRM 75 (Kalama Bar) on the Washington side and the other at CRM 42.5 (Wauna/Driscoll Bar) also on the Washington side. The 2008 surveys also showed that channel alterations suggested by the 2007 outlier value observed at CRM 45.5 (Westport Bar) had returned to conditions that were within the decision envelopes.

The revised analysis was posted to the MA-3 folder in the AEM Workbook at the E2 CRCIP website.

A survey was not performed in calendar year 2009. The next post-construction survey is scheduled for calendar 2010. The results will be presented at one of the scheduled 2010 AMT quarterly meetings and summarized in the CRCIP AEM annual report for 2010.

Table 4-1.1. Adaptive Management Depth Envelopes for MA-3 Crossline Surveys.

	Pre-construction Depth Values (ft)			AEM Envelope Depth (ft)	
CRM	**Minimum**	**Maximum**	**Sigma[1]**	**Upper**	**Lower**
41.5 South	47.94	50.48	0.69	47.25	51.17
North	46.17	52.02	1.48	44.69	53.50
42.0	51.38	55.60	1.48	49.90	57.08
	43.58	48.74	1.64	41.94	50.38
42.5	47.17	54.54	2.71	44.46	57.25
	41.90	44.95	1.07	40.83	46.02
45.5	44.98	47.13	0.71	44.27	47.84
	40.71	44.31	1.20	39.51	45.51
46.0	46.53	52.64	1.67	44.86	54.31
	40.46	46.72	1.93	38.53	48.65
46.5	42.41	47.83	1.55	40.86	49.38
	41.43	46.83	1.45	39.98	48.28
71.5	40.75	46.79	1.61	39.14	48.40
	45.10	50.98	1.73	43.37	52.71
72.0	47.30	53.48	1.93	45.37	55.41
	44.37	50.44	2.13	42.24	52.57
72.5	61.39	77.15	4.40	56.99	81.55
	60.71	69.81	2.46	58.25	72.27
74.5	43.32	46.25	0.95	42.37	47.20
	52.33	59.04	1.85	50.48	60.89
75.0	42.17	47.14	1.60	40.57	48.74
	42.44	47.90	1.49	40.95	49.39
75.5	41.92	46.86	1.51	40.41	48.37
	45.84	49.54	1.29	44.55	50.83
85.5	42.18	46.55	1.46	40.72	48.01
	43.92	49.88	1.69	42.23	51.57
86.0	41.11	46.70	1.63	39.48	48.33
	46.78	55.77	2.68	44.10	58.45
86.5	39.64	44.42	1.50	38.14	45.92
	45.35	49.66	1.65	43.70	51.31
98.5	49.43	52.69	1.21	48.22	53.90
	43.15	46.94	1.26	41.89	48.20
99.0	50.35	54.55	1.25	49.10	55.80
	43.76	48.81	1.65	42.11	50.46
99.5	48.65	49.92	0.46	48.19	50.38
	45.13	47.36	0.77	44.36	48.13

[1]One SD of mean depth based on analysis of pre-Project surveys.

Table 4-1.2 lists the locations and dates of the crossline survey data used in developing the MA-3 decision criteria and the dates of the post construction surveys conducted through 2008. The dates for the 2010 survey will be included in the 2010 annual report.

Table 4-1.2. Columbia River Cross-Line Hydrosurvey Dates.

	Morgan Bar	St. Helens Bar	Kalama Bar	Upper Dobelbower	Westport Bar	Wanna/Driscoll
Year	CRM 98-101	CRM 84-87	CRM 73-76	CRM 70-73	CRM 45-48	CRM 41-44
1996	24-Feb	21-Feb	20-Feb	20-Feb	20-Feb	20-Feb
1997	-	24-Feb	12-Feb	12-Feb	10-Feb	6-Feb
1998	5-Jan	-	21-Jan	21-Jan	28-Jan	28-Jan
1999	12-Jan	19-Jan	26-Jan	26-Jan	1-Feb	27-Jan
2000	20-Jan	11-Jan	10-Jan	6-Jan	26-Jan	25-Jan
2001	13-Feb	5-Feb	31-Jan	30-Jan	30-Jan	29-Jan
2002	13-Feb	12-Feb	7-Feb	6-Feb	24-Jan	24-Jan
2003	7-Jan	14-Jan	23-Jan	28-Jan	5-Feb	5-Feb
2004	22-Jan	31-Mar	28-Apr	29-Apr	17-May	13-May
2005	4-Apr	10-May	24-May	25-May	22-Jun	18-May
2006	12-Jan	25-Jan	7-Feb	7-Feb	31-Jan	24-Jan
2007	12-Feb	14-Feb	21-Feb	22-Mar	27-Mar[a]	26-Mar
2008	27-Mar	10-Apr	8-Apr	8-Apr	1-May	2-Apr

[a]Dates in blue indicate post-construction surveys.

4.2 AMT Decisions for MA-3

Table 4-2.1 briefly summarizes the key AMT discussion points and decisions concerning potential effects of Project construction on channel bathymetry through calendar 2009.

Table 4-2.1. CRCIP AEM Plan Record of AMT MA-3 Decisions.

Date	Issue	MA-3 Decisions	Comments
16 Dec 2004	**MA-3 Decision Criterion**	Develop plots that compare pre-construction variations in side slopes with post-construction slopes using results of crossline surveys; show percentages (e.g., 5, 10, 15, etc.) of measured changes in side slopes.	
16 Dec 2004	**MA-3 Decision Criterion**	Focus on six locations identified in the Environmental Impact Statement (EIS).	
16 Dec 2004	**MA-3 Decision Criterion**	Use recorded dredging volumes to identify other possible locations for impacts on slopes. O&M dredging volumes that substantially exceed predicted values might indicate locations of increased side slope adjustments.	
16 Dec 2004	**MA-3 Decision Criterion**	Communicate summaries, plots, etc., to the AMT 2 years prior, 2 years during, and 3 years after construction is completed.	
16 Dec 2004	**MA-3 Decision Criterion**	Trigger for adaptive management if larger than predicted changes in side slope adjustment are observed.	
9 Aug 2005	**MA-3 Decision Criterion**	Crossline data are available at approximately 500-foot intervals throughout the navigable river. The results also summarized the minimum, maximum, and SD for surveyed depths at the southern and northern edges of the navigation channel. An envelope defined by the minimum + 1 SD and the maximum +1 SD was also plotted for each of the cross sections.	
9 Aug 2005	**MA-3 Decision Criterion**	Concerns were expressed that the selected few locations did not provide a sufficient description of potential impacts of channel dredging on slide slope adjustments and corresponding potential impacts on shallow water habitats. Requests were made to include two additional cross sections, upriver and downriver, to the locations currently included in the MA-3 design. Inclusion of more cross sections at other selected river miles into the MA-3 effort was also desired by several AMT members.	
9 Aug 2005	**MA-3 Decision Criterion**	Concerns were raised about the number of years included in the analysis. The years represent different flow conditions, for example, with 1996-97 being years with comparatively higher flows, and 2001 being an example of a low flow year. The surveys are part of an ongoing activity in support of navigation the CRCIP was funding several surveys in relation to the time periods outlined in the terms and conditions of the Biological Opinion - i.e., 2 years before, 2 years during, and 2 years after project construction.	
1 Sept 2005	**MA-3 Decision Criterion**	The consensus AMT decision criteria for MA-3 are defined as an "envelope" calculated as the minimum surveyed depth + 1 SD and the maximum depth + 1 SD. The envelope is defined across the channel for each survey with particular emphasis on the northern and southern boundaries of the navigation channel.	

Table 4-2.1. CRCIP AEM Plan Record of AMT MA-3 Decisions. (Continued).

Date	Issue	MA-3 Decisions	Comments
1 Sept 2005	**MA-3 Decision Criterion**	All agencies concurred that the crossline survey results will be reviewed for exceedances and will reported yearly after the cross line surveys are completed. The MA-3 will examine accretion/erosion and changes in bathymetry of the main channel in relation to the channel deepening. Surveys will be conducted annually for two years prior to construction (by individual contract), two years during construction, and three years after construction. Crossline surveys will be conducted within a December-February time period to coincide with the end of the dredging season. Surveys will be conducted along the navigation channel from CRM 3 to CRM 106. Statistical analyses will produce estimates of mean and median depth at each sampled location across the channel; minimum and maximum values as well as SD and coefficients of variation will also be determined.	
11 Jan 2006	**MA-3 Decision Criterion**	The AMT agreed that the "envelope" calculations for side slope adjustments would serve as initial decision criteria for MA-3. The AMT requested that the O'Brien-Michalsen' plots be incorporated as part of the AEM Plan implementation.	
10 Jan 2007	**MA-3 Crossline Surveys**	Additional pre-construction crossline survey data were used to revise the decision "envelopes" for MA-3.	
11 Apr 2007	**MA-3 Crossline Surveys**	An outlier value in reference to the decision "envelopes" at CRM 45.5 will be examined.	
11 Jul 2007	**MA-3 Crossline Surveys**	No new information was reported for MA-3.	
3 Oct 2007	**MA-3 Crossline Surveys**	No new information was available for MA-3.	
9 Jan 2008	**MA-3 Crossline Surveys**	No new information was available for MA-3.	
29 Apr 2008	**MA-3 Crossline Surveys**	No new information was available for MA-3.	
9 Jul 2008	**MA-3 Crossline Surveys**	Available 2008 survey results will be summarized and presented at the October AMT meeting.	
8 Oct 2008	**MA-3 Crossline Surveys**	The 2008 surveys suggest two possible values that lie outside the decision envelopes on the Washington side at CRM 75 and 42.5. The 2008 survey also shows that an outlier observed in 2007 at CRM 45.5 had returned to conditions within the enveloped decision criteria. The AMT will continue to review future crossline survey results for these locations.	

Table 4-2.1. CRCIP AEM Plan Record of AMT MA-3 Decisions. (Continued).

Date	Issue	MA-3 Decisions	Comments
14 Jan 2009	**MA-3 Decision Criterion**	No new information was presented regarding MA-3.	
8 Apr 2009	**MA-3 Decision Criterion**	No new information was presented for MA-3 at the April 2009 meeting.	
8 Jul 2009	**MA-3 Crossline Surveys**	No new information was presented for MA-3 at the July 2009 meeting.	
18 Nov 2009	**MA-3 Crossline Surveys**	No new information was presented for MA-3 at the November 2009 meeting.	

5 Monitoring Action 4—Habitat Opportunity

Following the completion of Project construction, MA-4 will augment the estuary habitat surveys currently being conducted by NMFS as part of the Anadromous Fish Evaluation Program (AFEP) (Bottom and Gore 2001). The objective is to determine if changes in habitat opportunity and habitat capacity result from modifications to the channel. Habitat opportunity is defined as the number of hours within a 30-day (720-hour) month, wherein values of physical habitat criteria are consistent with criteria developed for juvenile salmonids (Bottom et al. 2001). Pre-construction characterizations of habitat opportunity have been provided for juvenile chinook and chum in terms of suitable water depths and current velocity. These estimates can serve as a basis for comparing post-Project estimates of habitat opportunity to determine any impacts of channel modifications on physical habitat for juvenile salmonids.

The MA-4 activity will not occur until three years after the Project construction is completed. As a result, the AMT did not address this monitoring action during 2009. The following sections are identical to the 2008 annual report and are presented in order that the 2009 annual report can stand as a separate document without having to refer to previous annual reports of the AEM Program for the CRCIP.

5-1 MA-4 Decision Criteria

Estimates of habitat opportunity will be calculated using the post-Project bathymetry of the LCR. Pre- and post-Project comparisons may require re-calculation of pre-Project opportunity values given the availability of more recent pre-Project bathymetry than that used in the original Bottom et al. (2005) analyses. The post-construction MA-3 survey data can contribute to the calculations of habitat opportunity.

The CRCIP will fund one habitat survey conducted under the AFEP. The survey will be conducted three years following Project construction. As a result of the AFEP, there will be approximately 10-years of pre-Project habitat survey data. The results of the pre- and post-Project habitat comparisons will be evaluated in the AEM process.

Threshold values of change (i.e., decision criteria) will be defined for each habitat type as a result of the pre-Project survey data. Measures that exceed any of the decision criteria may result in adaptation to current management actions. Table 5-1.1 illustrates a template for future use in evaluating results of MA-4 habitat surveys.

Table 5-1.1. Template for Evaluating Changes in Habitat Opportunity (Velocity, Depth) using Results from MA-4 Habitat Surveys.

	Habitat Opportunity (h/month)[2]											
LCR	Pre-construction[3]			Post-construction[5]			Percent change			Decision criteria (%-change)[6]		
Region[1]	Velocity	Depth	Combined	Velocity	Depth	Combined	Velocity	Depth	Combined	Velocity	Depth	Combined
1	580 - 620[4]	125 - 160										
2	275 - 310	~50										
3	590 - 610	210 - 240										
4	350 - 550	190 - 210	140 - 180									
5	390 - 500	155 - 180										
6	50 - 490	10 - 90										

[1] Regions defined by Bottom et al. (2005)

Region 1	Baker Bay
Region 2	Lower mainstem
Region 3	Youngs Bay
Region 4	Cathlamet Bay
Region 5	Grays Bay
Region 6	Upper estuary

[2] Calculated for 30-d (720 h) month

[3] Results reported in Bottom et al. (2005)

[4] Ranges reflect seasonal variations in river discharge

[5] Post-Project values of habitat opportunity will be estimated using the same methodology as Bottom et al. (2005) and bathymetry data revised in relation to channel deepening

[6] MA-4 decision criteria have yet to be defined by the Adaptive Management Team

5-2 AMT Decisions for MA-4

Table 5-2.1 outlines the key discussion and decisions regarding potential CRCIP impacts on habitat through calendar 2009 of the AEM Program.

Table 5-2.1. CRCIP AEM Plan Record of AMT MA-4 Decisions.

Date	Issue	MA-4 Decisions	Comments
16 Dec 2004	**MA-4 Decision Criterion**	Re-evaluation of Bottom et al.(in prep.) calculations of habitat opportunity.	
16 Dec 2004	**MA-4 Decision Criterion**	Detailed survey to be conducted 3 years after project construction.	
16 Dec 2004	**MA-4 Decision Criterion**	Presentation of ongoing studies (Science Center) that are further elaborating salmonid utilization of the lower river and estuary.	
5 Jul 2005	**MA-4 Decision Criterion**	The Channel Improvement Project will fund one of the 10 years and include support for in-depth analysis of the data obtained during this study. Discussion continues concerning which one of the 10 years will be funded by the CRCIP. It was proposed to select the year corresponding to 3 years after Project completion.	
5 Jul 2005	**MA-4 Decision Criterion**	NOAA Fisheries (C. Tortorici) expressed an interest in selecting the year of Project funding for the more intensive studies to be supported by MA-4. The NOAA emphasis resides in ensuring that the intensive study is performed. NOAA was silent concerning the Corps proposed target year designated as three years post-construction.	
5 Jul 2005	**MA-4 Decision Criterion**	The Corps noted that additional discussion is needed to come to an agreement on identifying the post-construction year selected for MA-4. This should be a topic of future AMT meetings until resolved.	
1 Sep 2005	**MA-4 Decision Criterion**	The agencies concurred that setting triggers at this time would be premature and that this MA would be reviewed quarterly. It was also agreed that either NOAA or the Corps would report the study findings at the yearly AFEP meeting.	
10 Jan 2007	**MA-4 Habitat Surveys**	The AMT made no new decisions concerning MA-4.	
11 Apr 2007	**MA-4 Habitat Surveys**	No decisions were required for MA-4.	
11 Jul 2007	**MA-4 Habitat Surveys**	No new information was reported for MA-4.	
3 Oct 2007	**MA-4 Habitat Surveys**	No new information was reported for MA-4.	
9 Jan 2008	**MA-4 Habitat Surveys**	No new information was available for MA-4.	
29 Apr 2008	**MA-4 Habitat Surveys**	No new information was available for MA-4.	
9 Jul 2008	**MA-4 Habitat Surveys**	No new information was available for MA-4.	

Table 5-2.1. CRCIP AEM Plan Record of AMT MA-4 Decisions. (Continued).

8 Oct 2008	**MA-4 Habitat Surveys**	No decisions were made for MA-4 at the October 2008 meeting.	
14 Jan 2009	**MA-4 Habitat Surveys**	No new information was available for MA-4.	
8 Apr 2009	**MA-4 Habitat Surveys**	No new information was presented for MA-4 at the April 2009 meeting.	
8 Jul 2009	**MA-4 Habitat Surveys**	No new information was presented for MA-4 at the July 2009 meeting.	
18 Nov 2009	**MA-4 Habitat Surveys**	No new information was presented for MA-4 at the November 2009 meeting.	

6 Monitoring Action 5—Sediment Contaminants

MA-5 addresses the potential for existing sediment contaminants to be suspended by dredging activities. This action includes the collation and evaluation of existing data that describe sediment contaminants in the LCR and estuary. Given limitations in available data, MA-5 has initially focused on samples that were collected well before the onset of the CRCIP. More recent data will be included as they are identified and become available to the AMT.

6-1 Sediment Contaminants

During 2008, sediment samples were obtained for chemical analysis from CRM 3–106.5 by the USACE. However, the results of the chemical analysis were not available at the end of calendar 2008. The 2008 USACE sediment quality sampling results were presented at the April 2009 AMT meeting (Tim Sherman, USACE).

Maps were presented that showed the locations of the separate sampling efforts subsequently described. Characterization of 12 surface sediment samples collected on March 25, 2008 in locations relevant to overwidth areas demonstrated that the sediment quality was consistent with sediments in the Federal Channel. Ten surface sediment grab samples obtained in June 2008 by the USEPA research vessel OSV Bold were determined to be of acceptable quality for in-water placement or beach nourishment. As part of the Columbia River Federal Navigation Channel Characterization, 96 box core samples were obtained in August 2008. Physical analyses were performed for samples obtained from all locations.

Chemical analyses were performed for samples from 23 locations (Table 6.1-1). Analytes included metals, TOC, pesticides, PCBs, chlorinated hydrocarbons, phthalates, PAHs, phenols, miscellaneous extractables, and petroleum. Initial evaluation of the results of the chemical analysis indicated suggested that the materials obtained within the Channel were suitable for in-water placement. Based on this evaluation further characterization of sediment contaminants might not be necessary for another ten years (i.e., 2018).

Table 6-1.1. Locations of 23 Columbia River sediment samples collected in August 2008 and analyzed for metals.

Sample Location (CRM)	Sample Identification Number
9+00-WA	082608CRWA- 9+00BC-04
9+30-OR	082608CROR - 9+30BC-04A
12+45-OR	082608CROR-12+45BC-12
13+05-OR	082608CROR-13+05BC-14
20+30-OR	082608CROR-20+30BC-22
33+10-OR	082608CROR-33+10BC-30
33+20-OR	082608CROR-33+20BC-31
35+15-OR	082608CROR-35+15BC-33
41+00-OR	082608CROR-41+00BC-38
56+25-OR	082608CROR-56+25BC-47
67+00-WA	082708CRWA-67+00BC-57
80+40-CL	082708CRCL -80+40BC-65
84+40-OR	082708CROR-84+40BC-68
86+00-OR	082708CROR-86+00BC-70
86+20-OR	082708CROR-86+20BC-71
86+50-OR	082708CROR-86+50BC-72
97+00-OR	082708CROR-97+00BC-83
97+00-WA	082708CRWA-97+00BC-85
99+30-WA	082708CRWA-99+30BC-88
100+25-WA	082708CRWA-100+25BC-90
100+40-OR	082708CROR -100+40BC-91
102+20-WA	082708CRWA-102+20BC-93
102+40-WA	082708CRWA-102+40BC-94

Twelve samples were collected from six locations within the Chinook Channel on October 21, 2008. Physical analyses showed that sediments from the outer channel were 19.4% sand and 81% fine-grained material. Samples from the inner channel were 1.5% sand and 98.1% fine-grained material. The sediments were chemically analyzed for metals, TOC, pesticides, PCBs, chlorinated hydrocarbons, phthalates, PAHs, phenols, miscellaneous extractables, petroleum, and TBT (only samples from inside the breakwater). Results of the analyses and weight-of-evidence determined that the sediments collected on October 21, 2008, to be of sufficient quality for in-water placement.

The sediment quality presentation was posted to the E2 CRCIP website and placed in the AEM Workbook folder for MA-5 Reporting – Sediment Quality.

6.2 AMT Decisions for MA-5

Table 6-2.1 summarizes the important AMT discussion points and decisions concerning the possible impacts of Project construction on redistribution of sediment contaminants through calendar 2009.

Table 6-2.1. CRCIP AEM Plan Record of AMT MA-5 Decisions.

Date	Issue	MA-5 Decisions	Comments
16 Dec 2004	**MA-5 Decision Criterion**	AMT will solicit summaries of sediment contamination data from technical group already performing this work.	
16 Dec 2004	**MA-5 Decision Criterion**	The AMT will interact with the LCREP to acquire additional data and information concerning chemical contaminants in the lower river and estuary.	
1 Sep 2005	**MA-5 Decision Criterion**	WDOE agreed to verify whether they would be housing the system. (Update: WDOE e-mailed the Corps on September 6, stating that WDOE "…will always maintain the SEDQUAL system as for their purposes so it will always be available to use of the AMT.)	
1 Sep 2005	**MA-5 Decision Criterion**	As for the triggers, the team discussed using the new SEF as triggers for sediment quality upon approval and adoption of the SEF.	
12 Oct 2005	**MA-5 Decision Criterion**	While there are some gaps, the SEF largely addresses the sediment contaminants of interest to Washington, Oregon, and Idaho. The AMT agrees that decision criteria for MA-5 should be made on the basis of the final SEF.	
12 Apr 2006	**MA-5 Reporting**	The AMT agreed that the SEDQUAL input template was adequate to describe newly obtained sediment contaminants data.	
10 Jan 2007	**MA-5 Sediment Contaminants**	The Corps will convene a meeting to review available sediment contaminant data.	
11 Apr 2007	**MA-5 Sediment Contaminants**	No decisions were required for MA-5.	
11 Jul 2007	**MA-5 Sediment Contaminants**	No new information was reported for MA-5.	
3 Oct 2007	**MA-5 Sediment Contaminants**	The Corps (Mark Sippola) will be contacting ODEQ to provide sediment toxic chemical information for the base period and optional work that was awarded to the Great Lakes. The AMT also discussed tracking in the decision summary the areas that ODEQ has approved for dredging.	
9 Jan 2008	**MA-5 Sediment Contaminants**	ODEQ has provided a summary of river miles that have been approved for dredging. This information will be summarized in a spreadsheet and posted at the E2 CRCIP website (Folder: MA-5 Sediment Quality).	
29 Apr 2008	**MA-5 Sediment Contaminants**	No decisions were made concerning MA-5.	
9 Jul 2008	**MA-5 Sediment Contaminants**	No new information was available concerning MA-5.	
8 Oct 2008	**MA-5 Sediment Contaminants**	Results of sediment testing from CRM 3-106.5 will be presented at the January 2009 AMT meeting.	

Table 6-2.2. CRCIP AEM Plan Record of AMT MA-5 Decisions. (Continued).

Date	Issue	MA-5 Decisions	Comments
14 Jan 2009	**MA-5 Decision Criterion**	No decisions were made regarding MA-5 monitoring activities.	
8 Apr 2009	**MA-5 Decision Criterion**	Based on chemical analysis of 23 samples from the Columbia River navigation channel, dredged sediments were judged as suitable for in-water placement.	
8 Apr 2009	**MA-5 Decision Criterion**	No new information was presented for MA-5 at the July 2009 meeting.	
18 Nov 2009	**MA-5 Decision Criterion**	No new information was presented for MA-5 at the November 2009 meeting.	

7 Monitoring Action 6—Fish Stranding

Similar to MA-4, the monitoring of fish stranding in relation to Project construction will be based on a before-and-after comparison. Project construction is not anticipated to be completed until December 2010. The November 2009 AMT meeting included some discussion concerning the post-construction fish stranding studies. At issue were the noted minimal changes in commercial navigation during the construction period and the possible use of one of the three pre-construction stranding study locations for beach nourishment. The consensus agreement of the AMT was to pursue the post-construction fish stranding studies as originally planned.

7-1 Frequency of Stranding

The proposed decision criteria for fish stranding are based on a comparison of pre- and post-Project numbers of stranded fish. An increase in the number of stranded fish following channel improvements could initiate the adaptive components of the AEM Program for the CRCIP. Table 7-1.1 summarizes the results of intensive field studies aimed at understanding the potential for fish stranding by commercial navigation in the Columbia River and estuary (Pearson et al. 2005a). On average across all three locations, approximately 26 percent of the vessel passages were associated with stranding events. This frequency ranged from ~18 to 30 percent for these 3 locations. If corresponding post-Project stranding frequencies are statistically greater than the values summarized in Table 7-1.1, the adaptive components of the AEM Plan could be invoked to determine the likely cause for the measured increase.

Table 7-1.1. Frequency of Fish Stranding Events at Study Sites (Pearson et al. 2005a).

Sites	Stranding events	Total passages	Frequency (%)
County Line Park (RM 51)	3	17	17.6
Barlow Point (RM 62)	7	23	30.4
Sauvie Island (RM 97)	4	14	28.6
Overall frequency: 25.9% Chi square: p=0.64			

7-2 Susceptibility to Stranding

In addition to potentially changing the frequency of fish stranding events, channel modifications in the Columbia River and estuary might alter the susceptibility of different fish species to stranding. Pearson et al. (2005a) estimated the relative percentage of 11 species commonly collected in the locations of the stranding studies (Table 7-2.1). The results of seining indicated that the relative abundance of fish subject to stranding was dominated by the three-spine stickleback, peamouth, American shad, and age 0+ chinook salmon. The relative abundances of these species among the stranded fish were also calculated. Dividing the relative frequency of stranding by the relative abundance produced a ratio that defines the susceptibility for each of the 11 species (Table 7-2.1). Ratios greater than 1.0 indicate greater susceptibility to stranding.

That is, the species is proportionally over-represented among the stranded fish compared to its relative availability. In contrast, susceptibility ratios less than 1.0 indicate some ability of the species to reduce its likelihood of stranding.

Bass (fry) were the most susceptible of the 11 species to stranding by commercial vessel passage. Sunfish (bluegill), crappie, and age 0+ chinook were also susceptible. The remaining species demonstrated some capability to avoid stranding. The susceptibility ratios can also serve as decision criteria for fish stranding in the AEM Plan. Potential modifications in fish habitat and changes in fish behavior associated with channel modifications could increase the local availability or susceptibility of these (or other) species. If post-Project susceptibility ratios increase significantly compared to those reported in Table 7-2.1, the adaptive components of the AEM Plan should be followed to determine the likely reason for the increases.

Table 7-2.1. Relative Susceptibility of Different Fish Species to Stranding (Pearson et al. 2005a).

Species	Percent Stranded	Percent Seined	Susceptibility Ratio
Chinook salmon (0+)	30.1	12.5	2.4
Three-spin stickleback	25.9	28.7	0.9
Peamouth	5.7	22.3	0.3
Banded killifish	10.6	12.3	0.9
Bass (fry)	16.0	0.2	80.0
American shad	8.2	20.1	0.4
Yellow perch	0.8	1.7	0.5
Mountain whitefish	0.6	0	0
Starry flounder	0.8	2.0	0.4
Crappie	0.4	0.1	4.0
Sunfish/bluegill	0.8	0.1	8.0

The pre-construction evaluation of fish stranding was completed in 2007 and the final report has been posted to the E2 Project website (www.e2tm.com/CRCIP). The form and content of these tables of decision criteria have been accepted by the AMT. The above decision criteria have been included in the AEM Workbook.

7-3 AMT Decisions for MA-6

Table 7-3.1 summarizes the key discussion points and decisions concerning the possible impacts of CRCIP construction on fish stranding through calendar 2009 for the AEM Program.

Table 7-3.1. CRCIP AEM Plan Record of AMT MA-6 Decisions.

Date	Issue	MA-6 Decisions	Comments
16 Dec 2004	**MA-6 Decision Criterion**	Studies of fish stranding will continue in 2005.	
16 Dec 2004	**MA-6 Decision Criterion**	Need to examine the statistical model to identify the factors and interaction terms that can be effectively incorporated into the AEM process.	
16 Dec 2004	**MA-6 Decision Criterion**	Revisit decision criteria after studies are completed (approx. November–December 2005).	
1 Sep 2005	**MA-6 Decision Criterion**	Post-construction studies of stranding will be performed and the results will be compared to pre-construction stranding study results.	
12 Oct 2005	**MA-6 Decision Criterion**	No decisions were made concerning fish stranding at the October 2005 AMT meeting.	

Table 7-3.1. CRCIP AEM Plan Record of AMT MA-6 Decisions. (Continued).

12 Apr 2006	**MA-6 Reporting**	The AMT suggested that tables describing fish stranding be modified to focus on species of concern (i.e., salmonids).	
10 Jan 2007	**MA-6 Fish Stranding**	The final report of the pre-construction evaluation of fish stranding has been completed and will be posted to the E2 FTP site.	
11 Jul 2007	**MA-6 Fish Stranding**	No new information was provided for MA-6.	
3 Oct 2007	**MA-6 Fish Stranding**	No new information was provided for MA-6.	
9 Jan 2008	**MA-6 Fish Stranding**	No new information was provided for MA-6.	
29 Apr 2008	**MA-6 Fish Stranding**	No new information was provided for MA-6.	
9 Jul 2008	**MA-6 Fish Stranding**	No new information was provided for MA-6.	
8 Oct 2008	**MA-6 Fish Stranding**	No decisions were made for MA-6 at the October 2008 meeting.	
14 Jan 2009	**MA-6 Fish Stranding**	No new information was presented regarding MA-6.	
8 Apr 2009	**MA-6 Fish Stranding**	No new information was presented for MA-6 at the April 2009 meeting.	
8 Jul 2009	**MA-6 Fish Stranding**	No new information was presented for MA-6 at the July 2009 meeting.	
18 Nov 2009	**MA-6 Fish Stranding**	The AMT requested that the post-construction (Phase 2) fish stranding studies be performed as originally specified in the Biological Opinion.	

8 Sturgeon

Criteria to protect sturgeon as part of the AEM process will address the possible CRCIP impacts on the mortality, survival, growth, movements, feeding behavior, and habitat utilization of these fish in relation to the dredging process and the disposal of dredged materials. These actions emphasize the selection of alternative sites for disposing of dredged materials if significant impacts are observed. Alternatively, the dredging schedule can be modified to minimize impacts on sturgeon.

8-1 Decision Criteria for Sturgeon

AMT discussions during 2009 focused on status of the reports that summarized the results of the previous studies of the impacts of dredging on sturgeon and sturgeon habitat.

The two reports that summarize the studies of dredging activities have been essentially finalized during 2009. The first study describes the behavioral response of tagged white sturgeon to dredging activities. The second study developed a model that predicts sturgeon habitat quality based on physical descriptions of channel physical characteristics. The resulting reports were posted on the E2 website. The investigators are in the process of publishing the results of these studies in the open technical literature.

8-2 AMT Decisions regarding Sturgeon

Table 8-2.1 summarizes the key discussion points and decisions concerning the possible impacts of Project construction on sturgeon through calendar year 2009 for the AEM Program.

Table 8-2.1. CRCIP AEM Plan Record of AMT Decisions for Sturgeon.

Date	Issue	Sturgeon Decisions	Comments
16 Dec 2004	**Sturgeon**	Slope characteristics will be further analyzed to identify categories of slope and bed form using existing data. Results will be used to guide dredging and dredge disposal.	
16 Dec 2004	**Sturgeon**	Awaiting completion of report (due mid-January 2005).	
16 Dec 2004	**Sturgeon**	Mitigation strategy to be developed during January.	
16 Dec 2004	**Sturgeon**	Ongoing studies will look at disposal impacts.	

Table 8-2.1. CRCIP AEM Plan Record of AMT Decisions for Sturgeon. (Continued).

5 Jul 2005	**Sturgeon**	Previous monitoring studies of tagged sturgeon suggest minimal or no impacts of dredging or disposal of dredged materials on these fish. Additional analyses of the data are awaited to determine the nature of bottom type (flat or presence of structure) that seem important to sturgeon in the lower river and estuary. With the exception of a desire for additional studies by Washington (L. Randall), there is general consensus among the AMT that sturgeon can be removed from further consideration in relation to implementing the Project AEM Plan.	
1 Sep 2005	**Sturgeon**	At the July 5, 2005 weekly AMT meeting, the AMT agreed that previous monitoring studies of tagged sturgeon suggested minimal or no impacts due to dredging or disposal of dredged materials and that adaptive management will be required only if dredging activities alter habitat. The Corps had previously indicated that additional work would be done on correlating sturgeon abundance with habitat using the existing data.	
1 Sep 2005	**Sturgeon**	The Corps at the current meeting had concerns with funding stating that the work plan for this study was stopped and the study plan was not finalized. The agencies also requested that any study plans for this work be reviewed by all agencies.	
10 Jan 2007	**Sturgeon**	The Corps will check the status of the sturgeon habitat analysis.	
11 Apr 2007	**Sturgeon**	No decisions were required for sturgeon.	
11 Jul 2007	**Sturgeon**	The habitat analysis report for sturgeon has not yet been completed.	
3 Oct 2007	**Sturgeon**	It is anticipated that the USGS will finalize the sturgeon report in time for the January 2008 AMT meeting. If the report is available in time, the results will be discussed at the meeting.	
9 Jan 2008	**Sturgeon**	The report describing habitat analysis for sturgeon should be available for the April 2998 AMT meeting.	
29 Apr 2008	**Sturgeon**	Oregon Department of Fish and Wildlife (ODFW) had some remaining issues and requested time at a future meeting to discuss them with the original investigators, who will be contacted concerning availability.	
9 Jul 2008	**Sturgeon**	The sturgeon habitat analysis and model developed by Parsley and Hatten will be posted to the E2 CRCIP website.	
8 Oct 2008	**Sturgeon**	No decisions were made for sturgeon at the October 2008 meeting.	
14 Jan 2009	**Sturgeon**	No new information was available for sturgeon at the January 2009 meeting.	
8 Apr 2009	**Sturgeon**	Finalization of the sturgeon report was re-scheduled for the July 2009 AMT meeting.	
8 Jul 2009	**Sturgeon**	The two reports that summarize the responses of sturgeon to dredging have been finalized.	
18 Nov 2009	**Sturgeon**	No new information was available concerning sturgeon for the November 2009 meeting.	

9 Smelt

Criteria to protect smelt (Eulachon) as part of the AEM process address the possible CRCIP impacts on the survival, movements, and habitat utilization of these fish in relation to the dredging process. Decision criteria to minimize channel improvement impacts on smelt take the form of depth constraints (43 ft.) on flow lane disposal between CRM 35 and CRM 75. In-water disposal is not permitted between the eighth and 20th weeks of the year (out migration).

9-1 Decision Criteria for Smelt

Decision criteria concerning disposal of dredged materials on smelt were provided in the 2006 annual report for the channel deepening AEM Plan (Table 9-1.1). The criteria are essentially compliance or non-compliance with state requirements for disposal of dredged materials during smelt migration. The AMT concurred that no variances with the decision criteria for smelt were reported for 2009.

Table 9-1.1. Compliance Measures Offered as Decision Criteria for Smelt in Implementation of the CRCIP AEM Plan.
Washington
In-water disposal of dredged material will not occur in areas shallower than 43-feet between CRM 35 and CRM 75 along the Washington shoreline. These areas are defined by depths determined in the pre-construction bank-to-bank bathymetry supplemented by additional channel bathymetry.
Washington, Oregon
In-water disposal will not occur during the period of peak Eulachon out migration (between the 8th and 20th weeks of the year) from the identified spawning areas (CRM 35–CRM 75). If in-water disposal is essential during the period of peak out migration, then the Corps shall further study the potential for Eulachon losses as a result of dredged material disposal impacts. Appropriate mitigation measures shall be developed based on the study outcomes, as determined through an AMP.

9-2 AMT Decisions regarding Smelt

The information summarized from the quarterly AMT meetings indicated that no decisions were required concerning project impacts on smelt during 2009 (Table 9-2.1).

Table 9-2.1. CRCIP AEM Plan Record of AMT Decisions for Smelt.

Date	Issue	Smelt Decisions	Comments
16 Dec 2004	**Smelt**	Regularly report compliance with state issues concerning flow-lane disposal.	
16 Dec 2004	**Smelt**	If flow-lane disposal becomes necessary, the abundance of smelt and time of peak out-migration will be documented by the Corps and provided to the AMT to determine timing and guidance for dredge disposal.	
28 Jun 2005	**Smelt**	The team agreed that dredging will occur between RM 35-75 between August 1 and September 30.	
10 Jan 2007	**Smelt**	No issues or decisions concerning smelt were raised at the January 10, 2007, AMT meeting.	
11 Apr 2007	**Smelt**	No decisions were required for smelt.	
11 Jul 2007	**Smelt**	No decisions were required for smelt.	
3 Oct 2007	**Smelt**	No decisions were required for smelt.	
9 Jan 2008	**Smelt**	No new information was provided for smelt, although there was some discussion and recognition concerning smelt in the diet of sturgeon.	

Table 9-2.1. CRCIP AEM Plan Record of AMT Decisions for Smelt. (Continued).

Date	Issue	Smelt Decisions	Comments
29 Apr 2008	**Smelt**	No new information was available regarding smelt.	
9 Jul 2008	**Smelt**	No new information was available regarding smelt.	
8 Oct 2008	**Smelt**	No decisions were made for smelt at the October 2008 meeting.	
14 Jan 2009	**Smelt**	The AMT was informed that smelt might be listed as an endangered species during the spring of 2009.	
8 Apr 2009	**Smelt**	NMFS indicated that smelt would not likely be listed prior to the Project rock removal planned for the November - December 2009 and January – February 2010 in-water work window.	
8 Jul 2009	**Smelt**	It seems unlikely that smelt will be listed before completion of Project construction.	
18 Nov 2009	**Smelt**	No new information was available regarding smelt.	

No new Project-related information concerning adaptive management and smelt was presented during the 2009 AEM Program. However, the NMFS noted that smelt were under review for possible Endangered Species Act listing. The proposal for listing will appear in the Federal Register and NMFS will notify the AMT upon publication. The USACE will have approximately one year (+60 days) to make any necessary modifications to its construction and potentially, maintenance practices for the CRCIP. The USACE was in contact with the NMFS regarding the listing of smelt during the 2009 Project construction period. Smelt were listed as a threatened species on March 16, 2010. The effective date of listing was May 17, 2010.

10 Dungeness Crab

The objectives of the AEM Plan concerning Dungeness crab are to avoid or minimize (1) entrainment mortality during dredging and (2) crab burial by disposal of dredged materials. The underlying intent is "no net loss" of these organisms as a result of channel improvement. Two studies were performed prior to Project construction to assess the potential impacts on crabs. Phase I studies addressed the physical forces associated with dredging on crabs. Phase II studies focused on the response of crabs to burial in experimental tanks. Phase III studies were proposed to examine crab burial under field conditions. However, it is logistically very difficult to perform the necessary experiments under field conditions and Phase III studies will not likely be conducted in relation to the AEM Program for the CRCIP.

10-1 Decision Criteria for Dungeness Crab

As indicated in previous CRCIP AEM annual reports, entrainment studies were performed at several locations within the estuary, including the mouth of the Columbia River, Desdemona Shoals, Upper Sands, Miller Sands, and Flavel Bar (Pearson et al. 2005b). Estimated crab entrainment rates varied by location, age class, and year. Entrainment rates decreased progressively upriver from the mouth of the estuary, presumably in relation to the reduced abundance of crabs (Table 10-1.1).

Table 10-1.1. Crab Entrainment Rates (crabs/cy) Estimated for 2004 (Pearson et al. 2005b).

Location	Age 0+	Age 1+	Age 2+	Age 3+	All
MCR All	0.0572	0.0028	0.0210	0.0128	0.0937
MCR-1	0.0535	0.0023	0.0147	0.0179	0.0883
MCR-2	0.0445	0.0022	0.0341	0.0126	0.0934
MCR-3	0.0760	0.0042	0.0137	0.0067	0.1007
Desdemona	0.0139	0	0.0035	0.0065	0.0239
Flavel Bar	0	0.0031	0.0035	0.0046	0.0112

Pearson et al. (2005b) recommended actions to mitigate the potential impacts of Project dredging on Dungeness crabs. One, understanding of seasonal patterns of salinity values throughout the lower river and estuary could be used to schedule dredging operations when salinity values are low (<16 psu) and crabs are correspondingly less abundant. Additionally, disposal of dredged materials should be avoided at the North Jetty Site thus reducing potential impacts on 1+ crabs that migrate through this area during the October–November time frame.

The AMT had previously agreed that the results of the crab entrainment studies provided useful information for evaluating the effects of Project-related dredging on crab mortality and distribution. However, during 2008, the AMT was informed that several issues of potential concern to the ODFW remained with regard to crab entrainment and burial. ODFW raised the need for additional information concerning dredging impacts on YOY and age 1+ crabs.

The remaining issues concerning crab were further pointed out by the ODFW during 2009. These issues concerned the potential impacts of dredging and disposal of dredged materials on crabs. While the ODFW recognizes the value of the Phase I and Phase II studies of crab

entrainment and burial, the agency remains concerned about the comparative lack of information for young-of-year and smaller sized individuals. Previously proposed Phase III studies were to extend the laboratory entrainment and burial studies to field conditions. However, the logistical challenges posed by field conditions in further studying potential impacts on crabs have thus far precluded the Phase III studies. ODFW would like to see additional studies that describe the spatial-temporal variability in the distribution and abundance of crabs in areas potentially impacted by dredging or the in-water disposal of dredged materials.

The USACE underscored the difficulties of studying crab burial under field conditions and indicated that, as a result, Phase III studies will not likely be performed. In addition, the recent commercial harvests do not indicate that the crab populations are declining. Surveys of crabs following dredging and disposal indicate that crabs inhabit and utilize the newly deposited dredged materials. Despite the remaining issues and data gaps, ODFW indicated that no additional actions seemed necessary on the part of the AMT at this time.

Nevertheless, ODFW asked for confirmation that the OCMP crab conditions (II.a.(i) – (iv)) would apply to operations and maintenance following the completion of the Channel Improvement Project construction. These conditions primarily address activities to minimize crab entrainment and burial (e.g., use of the crab distribution model to schedule dredging and disposal), restrictions on dredging and flow lane disposal below CRM 17 during periods of high crab abundance, and a crab mitigation strategy. The opinion of the ODFW was that the conditions have been satisfied in relation to Project construction, but indicated that the final OCMP provisions apply to maintenance activities, as well as construction.

ODFW cautioned that although there is an ongoing and continuing adaptive management process, state decisions (i.e., 401 and CZMA) are requirements that must be met by the USACE. This caution refers not only to crabs, but also to the sediment issues referred to previously (i.e., MA-3 and MA-4 above). It was noted, however, that the new 401 water quality certification does not identify crabs, although the sediment monitoring requirements are retained in the current CZMA.

10-2 AMT Decisions regarding Dungeness Crab

Table 10-2.1 summarizes the accumulated decision and key discussion points through calendar year 2009 concerning the CRCIP and potential impacts on Dungeness crab in the LCR and estuary.

Table 10-2.1. CRCIP AEM Plan Record of AMT Decisions for Crab.

Date	Issue	Crab Decisions	Comments
1 Sep 2004	**Crab**	The draft crab mitigation strategy document was sent out for review by the AMT on June 21, 2005. The agencies had no feedback on the document but considered it to be a living document that could potentially change as new information on crabs was obtained. They also indicated that additional information should be obtained on the distribution and abundance of 1+ crab at Desdemona shoal.	
12 Apr 2006	**Crab**	The AMT agreed that reporting on crab entrainment would mainly take the form of including new data that became available during the course of the Project.	
12 Apr 2006	**Crab**	The Washington Department of Ecology accepted the Corps crab mitigation plan subject to the collection of additional data in 2007 at the Desdemona sampling location.	
11 Oct 2006	**Crab**	The final version of the Pearson et al. (2005b) report on crab entrainment will be posted at the E2 Project website.	
10 Jan 2007	**Crab**	DLCD and ODFW indicated some remaining issues concerning project impacts on Dungeness crab. Conversations will occur separately outside the context of the AMT.	
11 Apr 2007	**Crab**	Final crab entrainment and burial report was posted to the E2 website.	
11 Jul 2007	**Crab**	The final report was posted for review on the E2 FTP site.	
3 Oct 2007	**Crab**	Awaiting possible comments from ODFW on crab report.	
9 Jan 2008	**Crab**	Dale Blanton will check to see if ODFW has any remaining issues regarding the crab study report. He will report at the July 2008 AMT Meeting.	
29 Apr 2008	**Crab**	No decisions were made concerning crab.	
9 Jul 2008	**Crab**	ODFW indicated that there were some unresolved issues to be discussed concerning potential dredging impacts on crab. ODFW will summarize these issues at the October AMT meeting. There was also recognition of possible dredging conflicts between the time period for outmigration of juvenile salmonids and movement of Age 1+ crab.	
8 Oct 2008	**Crab**	No decisions were made for crab at the October 2008 meeting.	

Table 10-2.2. CRCIP AEM Plan Record of AMT Decisions for Crab - Continued.

Date	Issue	Crab Decisions	Comments
14 Jan 2009	**Crab**	ODFW indicated that there were some remaining concerns regarding dredging and disposal for crabs, but no actions of the AMT were required.	
8 Apr 2009	**Crab**	ODFW requested confirmation that OCMP crab conditions (II.a(i)-(iv)) would apply to operations and maintenance following completion of the CRCIP construction.	
8 Jul 2009	**Crab**	No new information was presented concerning crab at the July 2009 meeting.	
18 Nov 2009	**Crab**	No new information was presented concerning crab at the November 2009 meeting.	

11 Sediments

AMT discussions continued during 2009 concerning the contributions of the AEM Program for the CRCIP towards the development of a regional sediment management plan for the Lower Columbia River and estuary.

11-1 Decision Criteria for Sediments

Discussions continued among the AMT participants in 2009 about the relationship between the CRCIP and recognized needs for regional sediment management for the LCR and estuary. Concerns were expressed among the AMT that opportunities for beneficial uses of Project dredged materials might have been or were being missed. Throughout 2009, USACE reinforced its intentions of looking for beneficial uses of Project post-construction dredged materials. With a transition of the Project from construction to operations and maintenance (O&M), the USACE will continue its interest in contributing to regional sediment management activities.

Doris McKillip (USACE) briefly described regional sediment management activities. An omnibus bill was pending that will provide funds for regional sediment management. The WRDA has been amended to specifically address sediment management. The south jetty project includes sites in the MCR proposal for littoral zone restoration. The sites are located mainly along the Oregon coast. Approximately $450K has been added to the south jetty regional sediment management budget. Other stakeholders interested in regional sediment management include the Lower Columbia Solutions Group (LCSG). The LCSG has been examining potential restoration and replacement sites on the Washington side of the river. There might be as much as $1.7 million in Corps matching funds for beneficial uses of sediments intended for upland disposal.

The USEPA has been interested in a regional sediment management plan through its Lower Columbia River and Estuary Program (LCREP) to apply from Bonneville Dam to the MCR. The AMT wants to ensure that the CRCIP Sediment Management Plan is also noted and considered in the development of the regional framework.

11-2 Summary of Decisions

Table 11-2.1 summarizes the decisions made during 2009 regarding the relevance of Project disposal of dredged materials to regional sediment management.

Table 11-2.1. CRCIP AEM Plan Record of AMT Decisions for Sediments.

Date	Issue	Sediments Decisions	Comments
11 Jan 2006	**Sediment Management**	The Corps and E2 agreed to collaborate with WDOE in the development of language concerning sediments (i.e., management of disposal of dredged materials) for incorporation into the Project of the AEM Plan.	
12 Apr 2006	**Sediment Management**	The Corps agreed to further consultation with WDOE concerning the incorporation of sediment management language into the AEM Plan.	
10 Jan 2007	**Sediment Management**	The AMT requested that the exact state language be incorporated into documentation of the sediment management component of the AEM. The Corps will continue to work with the AMT on achieving consensus regarding sediment management in relation to the Project.	
11 Apr 2007	**Sediment Management**	No decisions were required for sediment management. Discussion was deferred to the July AMT meeting.	
11 Jul 2007	**Sediment Management**	Discussions of sediment management were rescheduled for the October AMT meeting.	
3 Oct 2007	**Sediment Management**	Discussions of sediment management will continue at the January 2008 AMT meeting.	
9 Jan 2008	**Sediment Management**	The April 2008 AMT Meeting will focus on conceptual models and approaches to regional sediment management. E2 will propose a "strawman" conceptual model in advance of the April meeting.	
29 Apr 2008	**Sediment Management**	The April AMT Meeting developed an initial process for sediment management in relation to Project construction. The process has been summarized in a draft sediment management workshop report.	
9 Jul 2008	**Sediment Management**	Sediment management will likely occur under LCR channel operation and maintenance. The AMT agreed to look more broadly across Corps projects for opportunities in regional sediment management. The future of sediment management in relation to CRCIP AEM Program will be addressed at the October AMT meeting.	
8 Oct 2008	**Sediment Management**	The 2008 AMT sediment management workshop report was approved as final.	
14 Jan 2009	**Sediment Management**	The AMT expressed a desire that the CRCIP Sediment Management Plan be communicated to regional sediment management activities underway.	
8 Apr 2009	**Sediment Management**	Mike Ott (COE) will replace Doris McKillip (COE) with regard to future AMT discussions of regional sediment management.	
8 Jul 2009	**Sediment Management**	The Corps reinforced its intentions of looking for beneficial uses of Project construction dredged materials. This interest will continue into the operations and maintenance activities.	
18 Nov 2009	**Sediment Management**	Sediment management (i.e., beach nourishment) was discussed in relation to post-construction fish stranding studies. A decision was made to go forward with the Phase 2 fish stranding studies.	

12 Integration with 2008 AEM Results

Each annual report refers to AEM activities and conclusions in the prior year to provide continuity during the AEM Program for the CRCIP. The following sections briefly review the 2008 AMT activities and summarize AEM monitoring results. Additional detail can be found in the notes from the quarterly AMT meetings and the AEM program workbook that are available through the project website hosted by E2 (www.e2tm.com/CRCIP).

12-1 Results for Analyses of 2008 Data for MA-1

The primary MA-1 decision criteria are the monthly percentile values for depth, temperature, and salinity. Monthly median values calculated from the CORIE data for tansy, grays, and cbnc3 are compared against these criteria. Tables 12-1.1–12-1.7 list these decision criteria and corresponding MA-1 monthly results for 2008. Detailed plots of daily median values and normalized values of temperature and salinity can be examined by downloading the corresponding files at the E2 website.

Depth

Table 12-1.1 lists the 2008 monthly median depths for the grays station. All 12 monthly values are within the 20–80th percentile decision criteria.

Temperature

With only three exceptions (January, April, and November), the 2008 monthly median values of water temperature are all within the 20–80th percentile ranges for tansy (Table 12-1.2). All but two of the 2008 grays monthly median values of water temperature are within the 20–80th percentile ranges (Table 12-1.3). Similarly, all but two of the 2008 cbnc3 monthly median values of water temperature are within the 20–80th percentile ranges (Table 12-1.4). Only one of the monthly median values calculated for 2008 was outside of the 5–95th percentile ranges.

Salinity

Tables 12-1.5–12-1.7 present the monthly median salinity values for tansy, grays, and cbnc3. The 2008 results are quite similar to those observed in 2009. The available 2008 data for tansy are all within the 20–80th percentile decision criteria. The 2008 monthly median values for grays are more variable in relation to the decision criteria. The monthly median salinity values for January through June were effectively zero at grays. Values for July through November were within the 20–80th percentile decision criteria. The December value was within the 80–95th percentile range.

Salinity data were not available for cbnc3 during 2008.

Table 12-1.1. Summary of 2008 Monthly Median Depth Values (bold numbers) for Grays Station in Relation to AEM Percentile Decision Criteria.

	Monthly median depth (m)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
5	0.6	0.5	0.5	0.5	0.4	0.3	0.2	0.2	0.3	0.3	0.4	0.5
20	1.3	1.2	1.1	1.1	1.0	1.0	0.9	0.9	0.9	0.9	1.1	1.2
	2.1	**2.1**	**2.0**	**1.9**	**1.9**	**1.9**	**2.0**	**1.8**	**1.8**	**1.8**	**2.0**	**2.0**
80	2.8	2.8	2.7	2.6	2.6	2.5	2.5	2.5	2.5	2.5	2.7	2.8
95	3.4	3.3	3.2	3.1	3.1	3.1	3.0	3.0	3.0	3.0	3.3	3.3

Table 12-1.2. Summary of 2008 Monthly Median Temperature Values (bold numbers) for tansy Station in Relation to AEM Percentile Decision Criteria.

	Monthly median temperature (C)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
5	4.9	5.3	6.3	8.4	9.2	9.4	9.4	9.3	9.4	9.3	8.3	6.5
	4.8			**8.6**								
20	6.2	6.4	7.4	9.3	10.6	10.9	10.8	11.0	11.0	11.1	9.4	7.6
		6.1	**7.8**		**11.3**	**13.0**	**14.1**	**15.2**	**13.0**	**13.0**		**8.8**
80	9.2	8.9	9.7	11.2	13.4	15.6	16.9	17.4	16.1	13.9	11.6	9.9
											11.9	
95	10.3	9.9	10.8	12.0	14.5	16.8	18.9	19.3	17.7	15.1	12.5	10.8

Table 12-1.3. Summary of 2008 Monthly Median Temperature Values (bold numbers) for Grays Station in Relation to AEM Percentile Decision Criteria.

	Monthly median temperature (C)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
5	4.0	4.1	5.2	8.0	10.5	14.1	16.6	18.3	16.3	11.8	7.4	5.2
						14.3						
20	4.7	4.7	6.0	9.0	11.6	15.2	18.0	19.3	17.3	12.9	9.0	6.2
	4.9	**5.4**	**7.1**	**9.0**	**13.1**		**19.0**	**19.8**	**17.9**	**14.4**	**11.1**	
80	6.6	6.5	8.4	11.4	14.8	17.6	20.6	21.1	19.5	15.9	11.3	8.0
												8.2
95	7.7	7.3	9.4	12.6	15.9	18.8	21.8	21.9	20.5	17.3	12.3	8.8

Table 12-1.4. Summary of 2008 Monthly Median Temperature Values (bold numbers) for cnbc3 Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Temperature (C)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
						14.1						
5	3.2	4.2	5.1	8.1	11.1	14.9	17.4	18.4	16.0	11.9	7.7	5.2
												5.7
20	4.1	4.8	6.0	8.9	12.1	15.6	18.4	19.5	17.1	13.4	9.0	6.1
	5.0	**5.1**	**7.0**	**8.9**	**13.0**		**19.1**	**20.1**	**18.0**	**14.7**		
80	6.4	6.5	8.3	11.2	15.0	17.7	21.1	21.5	19.5	16.7	10.9	7.6
											11.4	
95	7.3	7.2	9.0	12.6	16.0	18.8	22.3	22.3	20.6	17.8	12.0	8.6

Table 12-1.5. Summary of 2008 Monthly Median Salinity Values (bold numbers) for Tansy Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Salinity (psu)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
5	1.2	0.9	0.7	0.7	0.9	0.4	1.6	3.5	4.8	5.9	3.3	2.4
20	4.2	3.7	3.4	3.0	2.7	1.7	3.8	8.7	10.4	10.7	6.8	5.9
	No data	**20.8**	**12.5**	**13.6**	**5.1**	**3.0**	**12.3**	**No data**	**No data**	**20.2**	**21.1**	**22.0**
80	23.9	23.4	21.5	23.0	22.9	22.9	24.1	26.3	26.0	26.0	23.9	24.6
95	27.3	26.7	25.5	26.6	26.5	27.2	28.4	28.9	28.6	28.0	26.9	27.6

Table 12-1.6. Summary of 2007 Monthly Median Salinity Values (bold numbers) for grays Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Salinity (psu)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
	0.0	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**						
5	0.2	0.2	0.2	0.2	0.0	0.2	0.3	0.3	0.5	0.4	0.3	0.3
	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.5	0.8	0.7	0.5	0.3
20							**0.4**	**1.2**	**3.2**	**2.4**	**1.0**	
80	1.2	0.8	0.8	0.7	0.7	0.7	2.4	2.4	4.4	3.7	2.7	0.8
												1.3
95	3.1	2.7	2.0	1.4	0.8	1.3	5.5	4.4	6.9	6.2	4.8	2.2

Table 12-1.7. Summary of 2008 Monthly Median Salinity Values (bold numbers) for cbnc3 Station in Relation to AEM Percentile Decision Criteria.

	Monthly Median Salinity (psu)											
Percentile	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**
5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
20	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.2	0.2	0.2
	No data	**No data**	**No data**	**No data**	**No data**	**No data**	**No data**	**No data**	**No data**	**No data**	**No data**	**No data**
80	0.7	0.7	0.7	0.7	0.7	0.7	1.7	2.5	3.5	7.0	2.2	0.7
95	2.3	2.1	3.3	1.7	0.9	1.5	4.5	6.3	9.3	12.3	5.3	2.0

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