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From: Deborah Woodward [DWoodward@waterboards.ca.gov]

Sent: Monday, March 23, 2009 1:32 PM

To: Halter, Amanda (OC); Garrett, Christopher (SD); Singarella, Paul (OC); Peter MacLaggan; Chiara Clemente; Catherine Hagan (George)

Cc: Pete Raimondi

Subject: Poseidon project - Raimondi Initial Review

Attachments: Initial review of Impingement study and mitigation assessment.doc

Hello,

Dr. Raimondi has provided an initial review - please see attached. We are expecting the final review by the end of the week.

Cheers,
Debbie

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ATTACHMENT

Initial review of Impingement study and mitigation assessment – Carlsbad Seawater Desalinization Project

Pete Raimondi
03-22-09

I have made an initial review and thought that before I go further I should present some concerns. I am doing this early because I want to make sure that both Poseidon and the RWQCB are aware of these concerns and also because I want to make sure that Poseidon has the opportunity to consider my comments. Because this is an initial review only the most problematic of the comments are listed below.

1) The impingement tables that were sent were very helpful. I have questions about some of the data. The most important question is related to the weights that were reported. Are these dry or wet weights (this becomes very important later on). If they are wet they seem low – at least for some species. For example, it was reported that 50 *Myliobatis californica* were in the sample count with a total weight of 20000 grams (20 kg). This means that the average weight was 400 grams. This value is lower than the typical birth weight of a bat ray pup. Indeed the total weight of all the bat rays (20kg) is not much more than the average weight for adults. Obviously the accuracy of the weights is important – especially for the consideration of mitigation and the use of fish production in that assessment.
2) Poseidon discusses the merits of their impingement reduction technologies but nowhere quantifies the effect. This lack of quantification was also noted in Nordby appendix 7 replacement. This is important because the argument that impingement attributable to CDP is negligible or already compensated hence rests on the assessment of benefit conferred by the wetland mitigation for entrainment impacts.
3) Nordby appendix 7 replacement document, argues that CDP impingement will be compensated for by the mitigation required for entrainment impacts (55.4 wetland acres restored or created). This argument rests on a series of terms:
    a. Estimates of fish production from a paper by Larry Allen (1982), extrapolated to an estimate of 151.36 kg (wet weight – WW- per acre).
    b. The multiplication of per acre productivity by the mitigation acreage (151.36 kg per acre x 55.4 acres = 8385 kg per year)
    c. The estimation of the impingement losses resulting from water use of 304 MGD of seawater. The average impingement loss is 4.7 kg per day (based on all data including non flow related events) yielding an annual loss of ~1715 kg per year.
    d. The comparison of annual production resulting from the mitigation wetland (8385 kg per year) and the impingement losses (1715 kg per year)

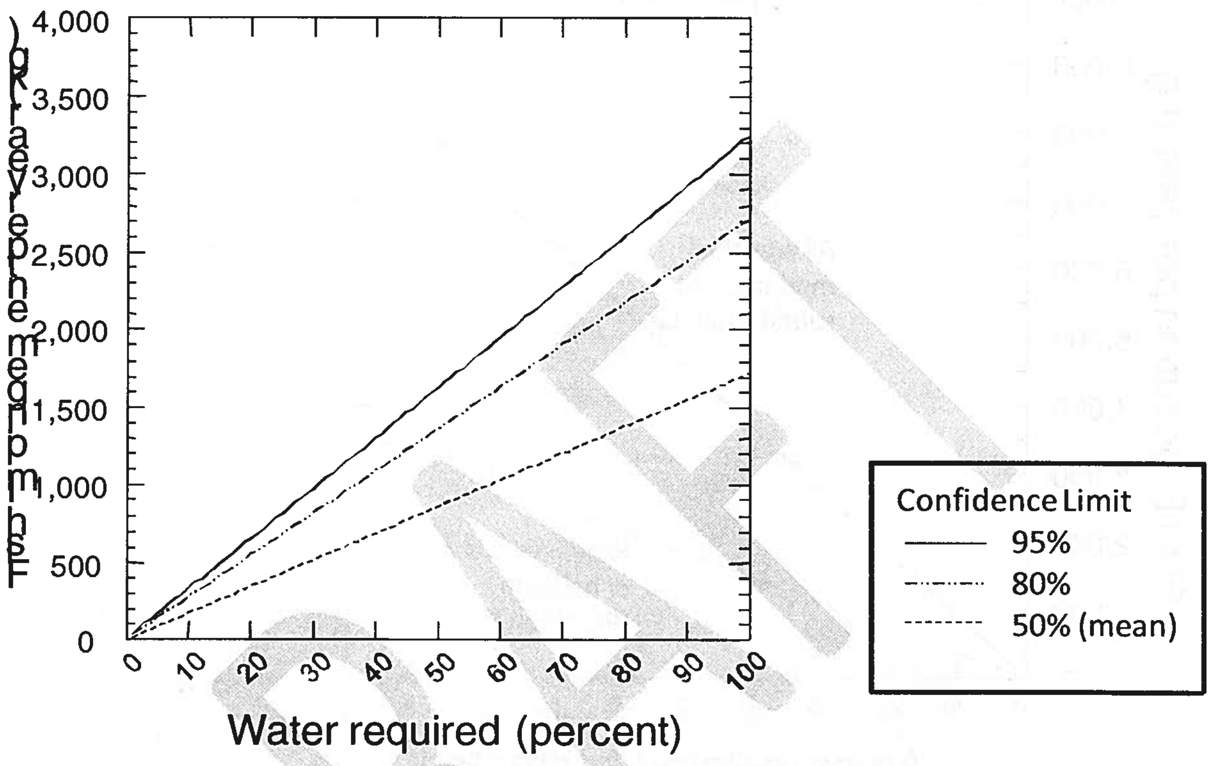
The conclusion of this argument is that the impingement losses are fully offset by the mitigation already required to compensate for entrainment impacts. I disagree with this conclusion for the following reasons.

1) **This conclusion rests on the assumption of compensation.** Compensation is another name for density dependent mortality. As applied here it means that reduction in larval numbers due to entrainment has no effect on adult numbers. An example will be useful. Assume that a 100 acre wetland can naturally support 10000 kg of (non-larval) fish. Now assume that a powerplant is built and that the modeling of entrainments yields an estimate of the loss of 20% of the larval pool in the wetland. If fully compensatory mortality is assumed then there will be no change to the 10000 kg of non-larval fish. Now lets assume that no such compensation occurs (note that the use of compensatory mortality has not been allowed in any recent entrainment assessments (316B or equivalent)) - here the 10000 kg will decrease to 8000kg (assuming only a change in numbers of fish and no change in size structure). If there is impingement of say 1000 kg of fish per year, the overall biomass will decrease to 7000 kg. Okay an assessment is made of entrainment and mitigation is required that will produce the same number of larvae as that lost to entrainment. Assume this is in the form of ~20 new wetland acres. Again we make the mandated assumption of no compensatory mortality and we conclude that the non-larval biomass for the wetland will go up 2000kg yielding 9000kg (7000+2000). What about the missing 1000kg? That amount is still missing due to impingement. Based on the logic and math above another 10 acres of new wetland would be needed to produce the biomass lost to impingement.

   The bottom line is that wetland acreage created or restored based on entrainment impacts cannot be also used to mitigate for impingement impacts unless one invokes compensatory mortality, which is specifically not done in I&E determinations.
2) **The estimates used by Nordby to calculate impingement losses rely on averages.** There is nothing wrong with the use of averages as one estimate of effect, however the use of averages as the only estimate of effect relies on the idea that estimates are made without error, which should not be done. I think that a better approach is one based on degree of confidence (or certainty). Here estimates are expressed as the confidence that one has the real average is no higher that some value X. As an example if the average impingement is 4.7 kg per day, then the equivalent statement using confidence limits is that we are 50% confident that the true average is no greater than 4.7 kg per day. In typical inferential statistics, confidence limits of 95% are generally used (see graphs below).
3) **The estimates of fish production used by Nordby are based on the assumption that the mitigation wetland will be made up entirely of intertidal mudflats.** The estimate of fish production (151.36 kg per acre per year) is based on Larry Allen's work, which specifically is restricted to those areas not including vegetated marsh. The most recent design (presented to the CCC) includes 60% vegetated marsh. Note also that Poseidon did not include vegetated marsh in its estimate of area impacted by intake operations (Flow, entrainment and impingement minimization plan – March 9, 2009 page 6.3)

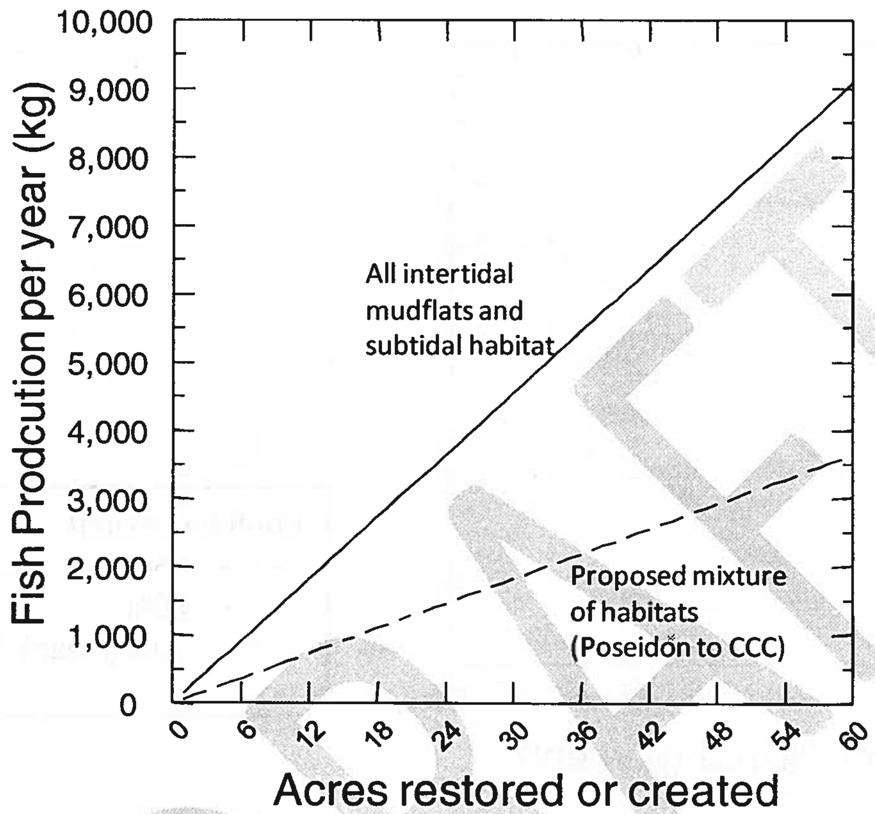
To understand impingement impacts using the logic of the Poseidon approach, I made correction related to the points I made above. I then recalculated the estimates for fish production and impingement and the acres required to offset the losses under differing scenario of the amount of water required (the percent of water required by CDP that is not provided by operations of Power Plant). The results are shown below.

First, impingement losses are shown as a function of the percent of water required (not supplied by the power plant operations).

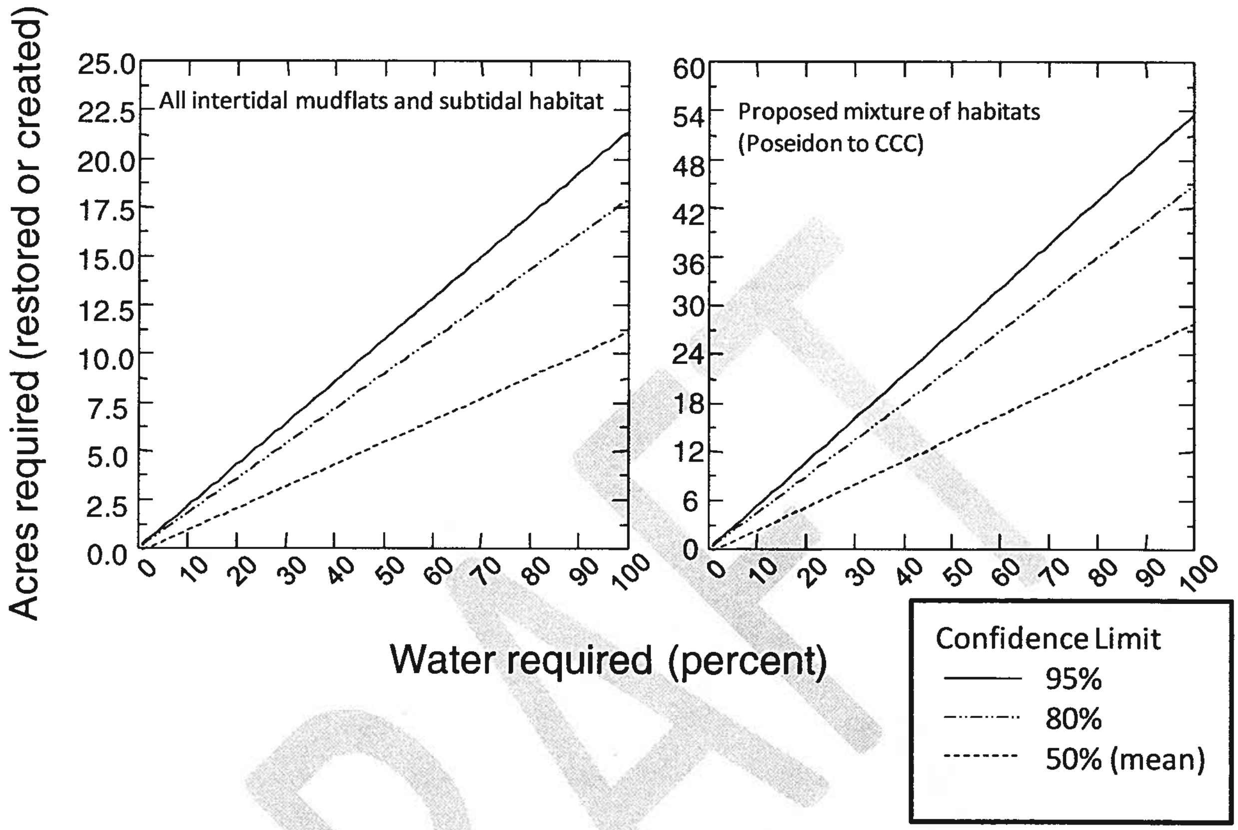


Like the estimate produced by Poseidon and used by Nordby, if CDP requires 100% new water the estimate of impingement based on the arithmetic mean is ~1715 kg. Note though that if the 80 or 95% confidence limit is used the value increases to 2700 kg (80% CL) or 3250 kg (95% CL).

Next I estimated the production of fish as a result of the restoration or creation of new wetland habitat (***not the acreage to be restored or created as a result of entrainment mitigation)***, under two scenarios. First, assuming the new wetland would be all intertidal mudflat or subtidal habitats. Second using a mixture of habitats of which 40% is intertidal mudflats or subtidal.



Finally I combined production and loss to investigate the acreage needed to mitigate impingement losses over a range in values for water required above that provided by operations of the powerplant.



In both graphs there are three estimates of acreage required. These are based on the three confidence limits (see figure 1). The left and right graphs differ based on the design of habitats in the mitigation wetland. If 100 percent of water is needed (304 mgd) then the acreage need to mitigate impingement ranges from ~11-21 (if all the acres are intertidal mudflats or subtidal) to 28-54 (if the wetland is a mixture of habitats – 40% of which are intertidal wetlands or subtidal). Following the 80% CL precedent (from the entrainment assessment) the range in values would be 18 -45 acres depending on the wetland mix of habitats.

It is important to note the following:

1) If wetland acres are going to be used to mitigate impingement impacts they need to be new acres not those already required by the entrainment mitigation.
2) The approach taken here is based entirely on the approach proposed by Poseidon. There may be other ways to estimate impingement and impacts due to impingement that do not rely on conversion to wetland acreage.
3) **As calculated** the impacts of impingement are significant and should require mitigation.

4) Based on the **as calculated** impacts the cost of some impingement reduction technologies – particularly a fish return system (FRS) may be reasonable. At SONGS the FRS routinely returns 70% of the individuals that would have been impinged.