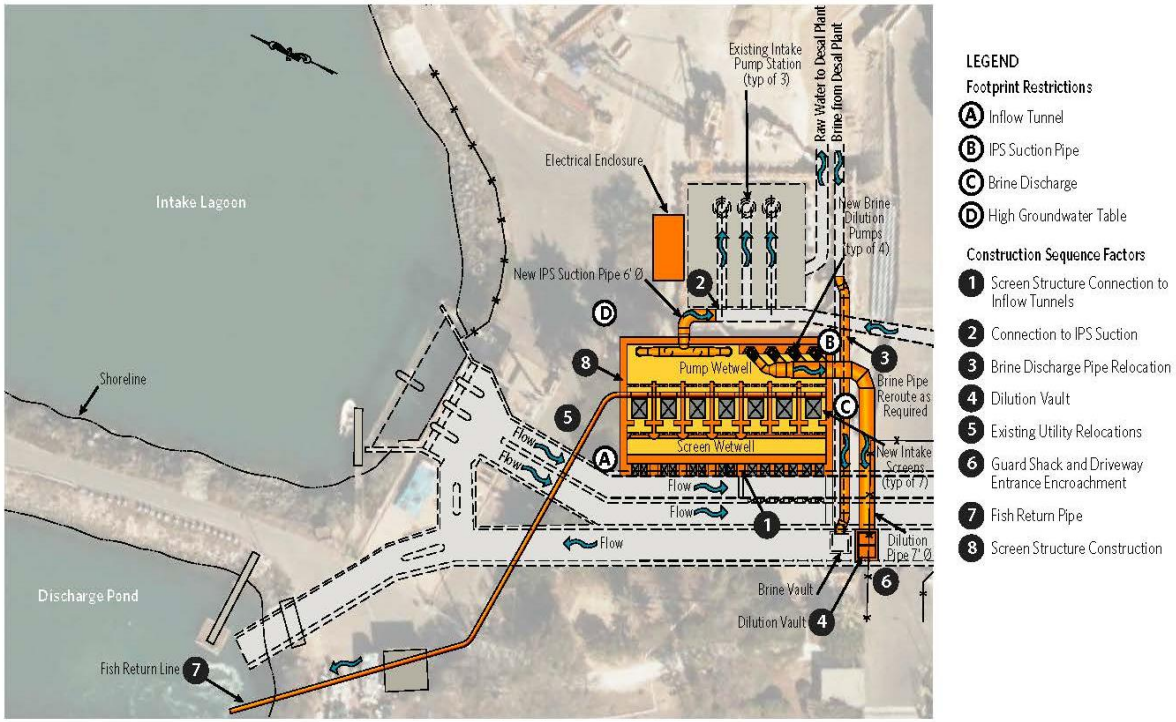
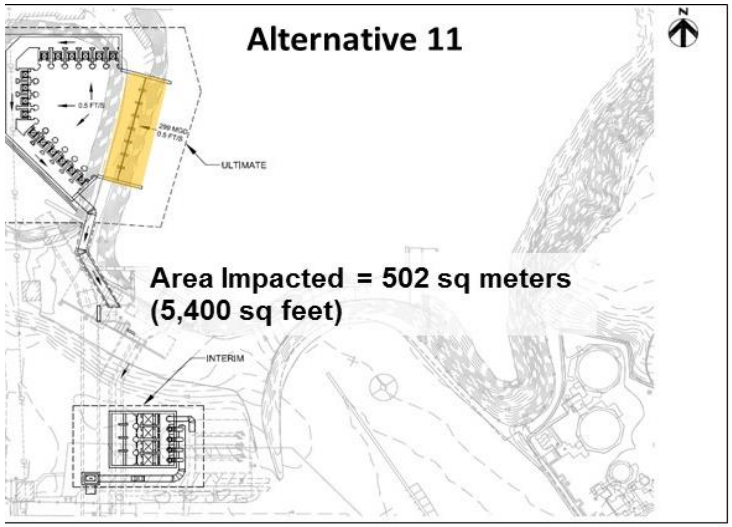
APPENDIX CCC
EVALUATION OF ADDITIONAL INTAKE ALTERNATIVES 1, 11, 12, 13, AND 14

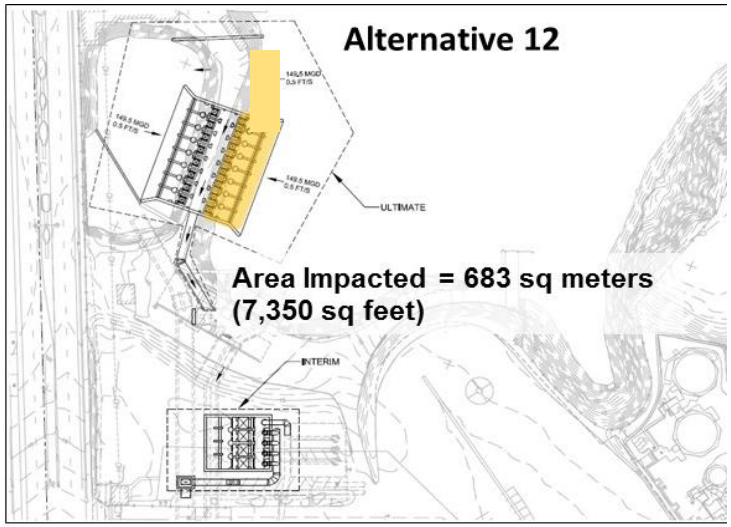


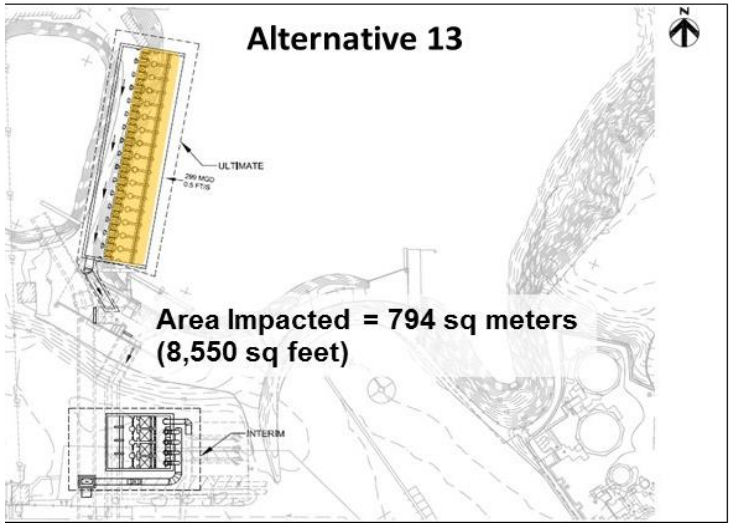
Proposed Intake Configuration (Alternative 1)

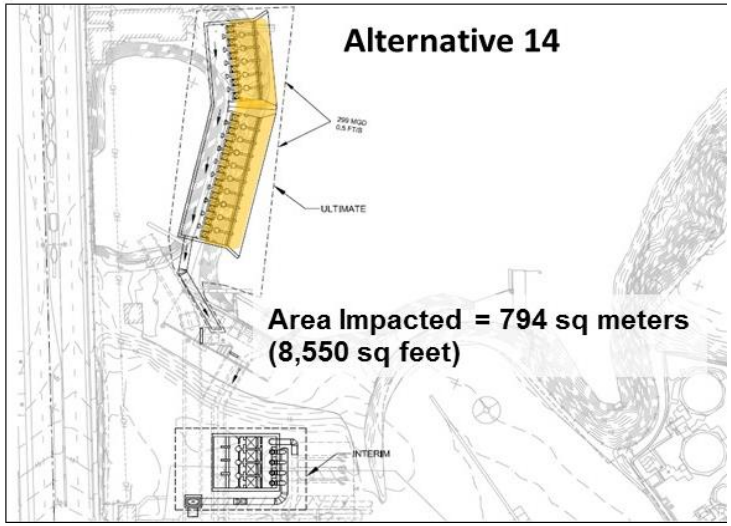
Construction Cost $48,619,910

Fish Return Productivity Loss 0.85 lbs/day





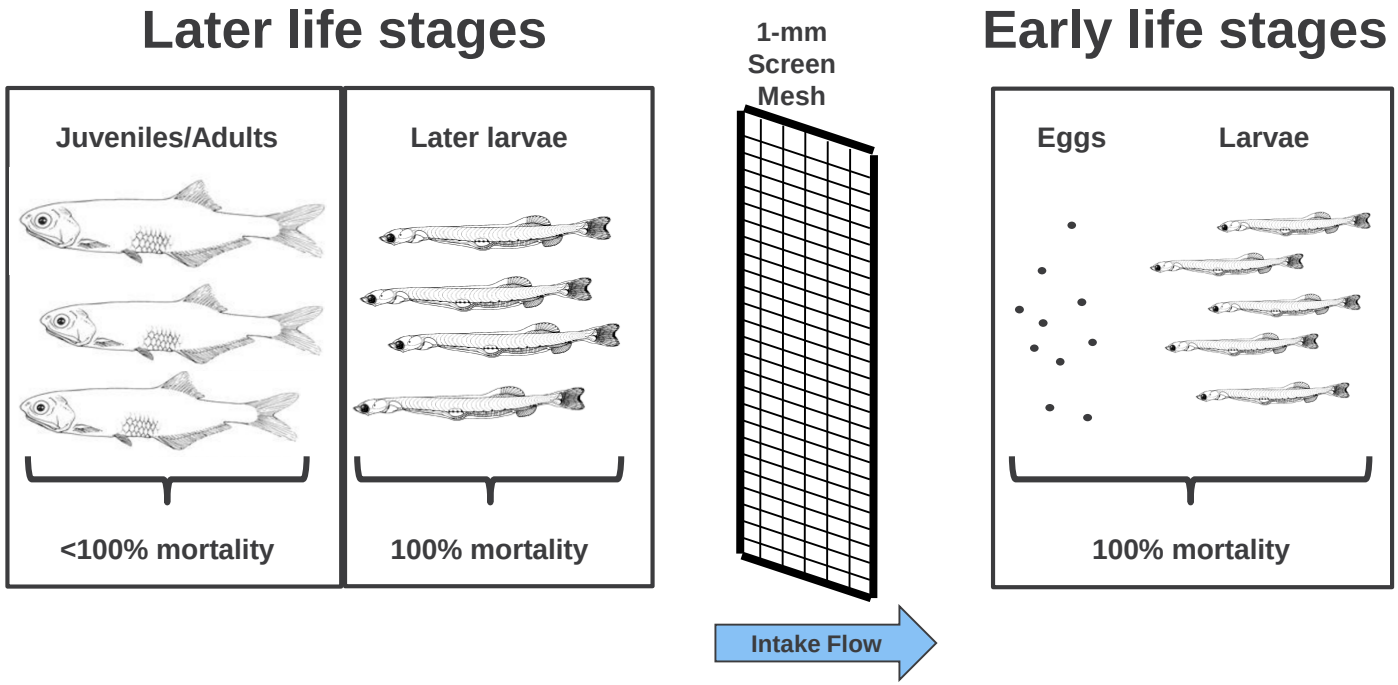




Construction cost	**$111,108,022 to $113,428,430**
Increased Capital and Operating Cost	**$6,462,184/year to $6,711,795/year**
Net Reduction from Alternative 1 Productivity Loss	**0.53 lbs/day to 0.65 lbs/day**
Incremental Cost to Achieve Reduced Mortality	**$27,847/lb to $34,695/lb**

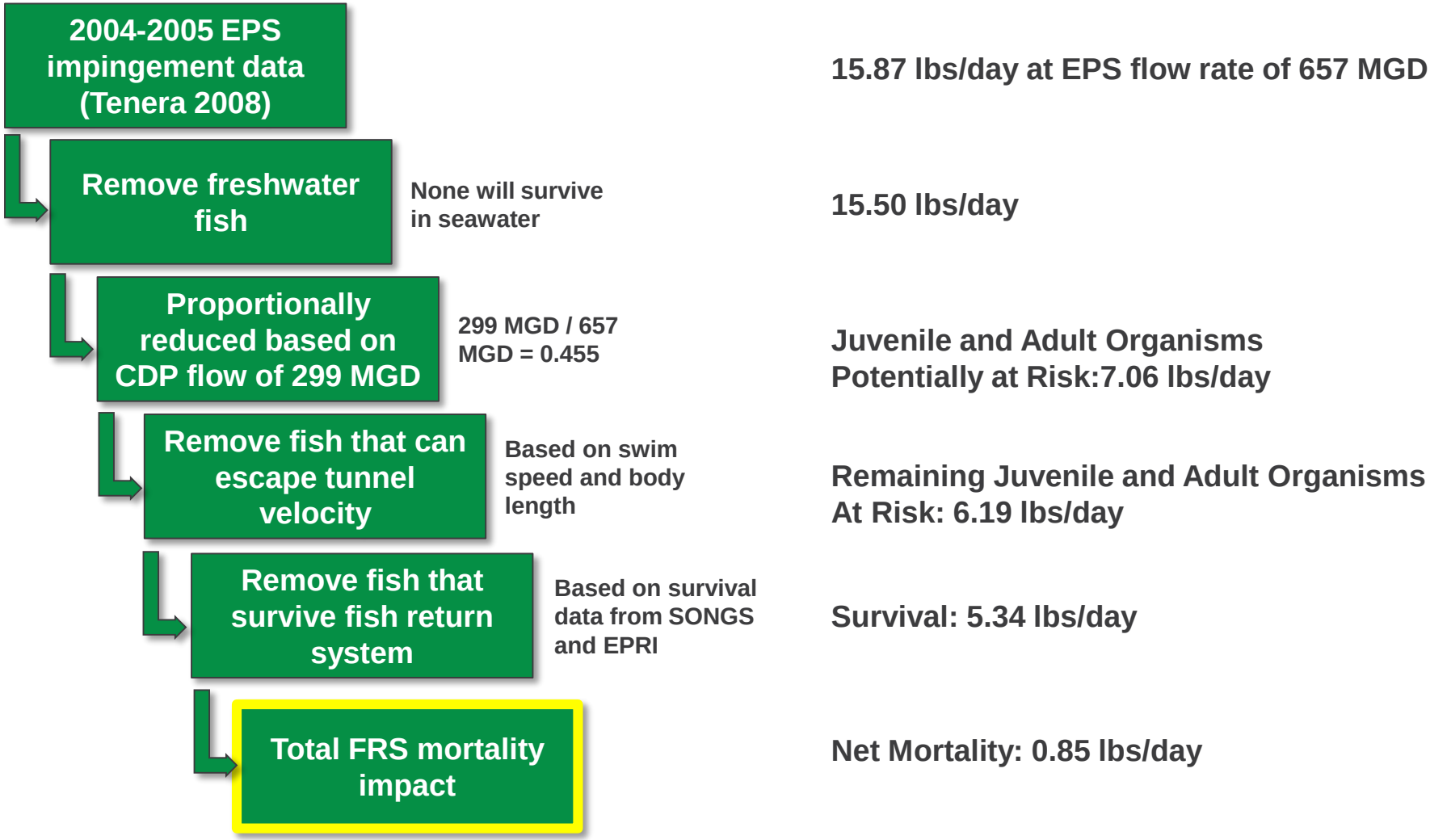
MARINE LIFE MORTALITY ASSESSMENT INTAKE ALTERNATIVES 1, 11, 12, 13, AND 14

Accounting for Entrainment and Fish Return Mortality

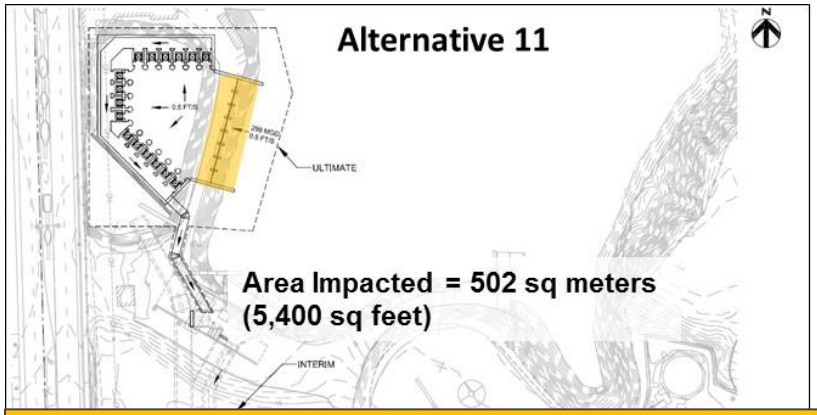


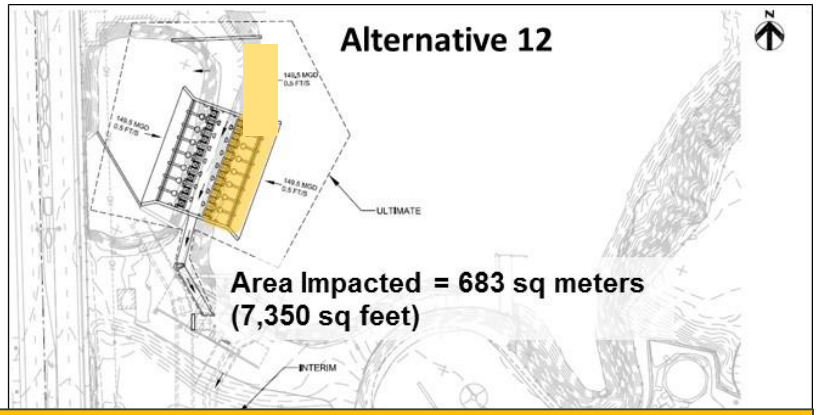
- Mortality estimates include the following conservative assumptions:
  - For each of the alternatives,100% mortality of eggs and larvae entrained even through the flow augmentation system which includes a fish-friendly pumps and a flow conveyance hydraulically optimized to minimize injurious shear, turbulence and a fish return system which includes fish-friendly organism collection system and a flow conveyance hydraulically optimized to minimize shear mortality
  - Reduced velocities in the intake tunnels under stand-alone operations will allow more juveniles and adults to escape.
    - For Alternative 1, the number of juveniles and adults that were able to escape was assumed to be zero for those taxon that could not be estimated because length frequency data were not available.
    - For Alternatives 11, 12, 13, and 14, it was optimistically assumed that 100% of the juveniles and adults would be able to escape and no fish collection buckets or fish return system would be required due to the velocity was <0.5 fps at all locations.

Fish Return Marine Life Mortality Alternative 1

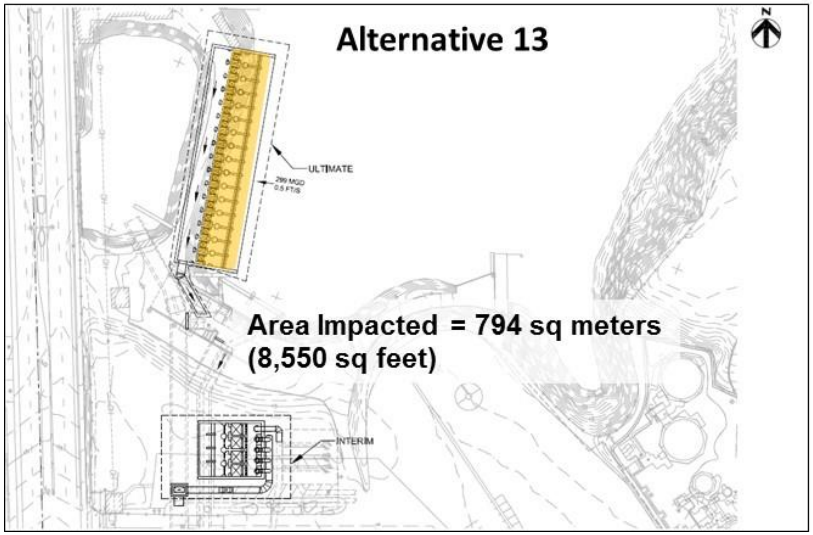


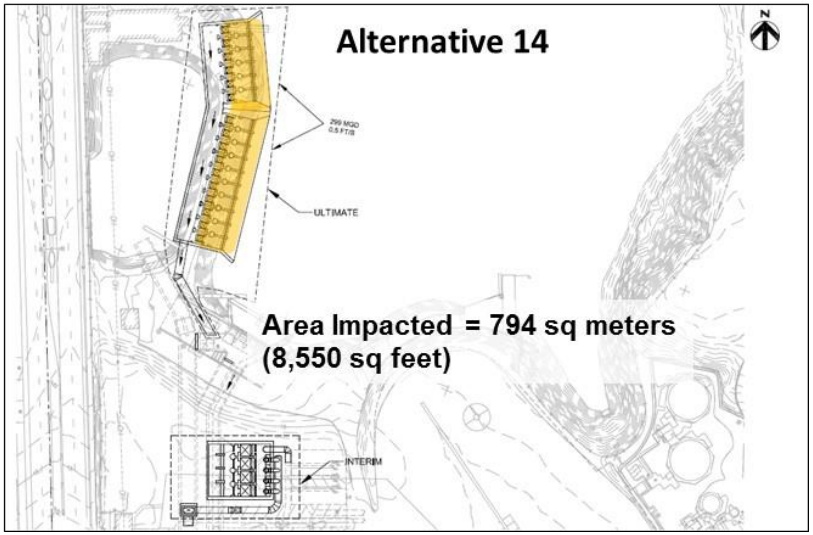
Marine Life Mortality Comparison between the Proposed Screening Location and the Lagoon Screen Locations





Note that the design has expanded from 8 to 16 screens to ensure that no velocity upstream of the screen face is above 0.5 ft/sec





Marine Life Mortality Comparison between the Proposed Screening Location and the Lagoon Screen Locations

Intake alternative	Rirrap length (ft)	Width (ft)	Footpint area (ft^2)	Footprint area (m^2)	Productivy ($WWg/m^2/yr$)[1]	Lost fish biomass (WWg/yr)	Lost fish biomass (WWkg/yr)
11	180	30	5,400	502	66.5	33,361	33.36
12	245	30	7,350	683	66.5	45,409	45.41
13	285	30	8,550	794	66.5	52,822	52.82
14	285	30	8,550	794	66.5	52,822	52.82

[1] Productivity estimate from Johnson et al. 1994

ANALYSIS OF ALTERNATIVES 11, 12, 13, AND 14 – SCHEDULE FOR COMPLETION OF IMPROVEMENTS

Required Approvals Alternatives 11, 12, 13, and 14

Carlsbad Desalination Project

- Local
  - Water Purchase Agreement
  - NRG – Land Lease
  - CEQA
  - PDP
- State
  - State Lands Commission Lease
  - Drinking Water Permit
  - Coastal Development Permit
  - RWQCB Water Code Determination
- Federal
  - NPDES Permit

Intake System Modifications

- Local
  - Water Purchase Agreement Amendment
  - NRG – Land Lease Amendment
  - CEQA
  - PDP Amendment
- State
  - State Lands Commission Lease Amendment
  - Drinking Water Permit Amendment
  - CA Fish and Wildlife 1602 Streambed Alteration Agreement
  - Coastal Development Permit Amendment
  - RWQCB Water Code Determination
- Federal
  - NPDES Permit Renewal
  - 401 Certification
  - NMFS/NOAA Take Permit
  - Army Corp of Engineers Section 404/Nationwide Permit

Additional Requirements Alternatives 11, 12, 13, and 14

- Two phases of permitting, engineering, financing and construction
- Additional permits required:
  - Army Corps 404, which would include a NMFS biological opinion
  - RWQCB 401 Water Quality Certification
  - CEQA and NEPA review
- Complex construction in marine wetlands

Construction Phasing Alternatives 11,12, 13, and 14

Phase 1

- Improvements include construction of an intake vault connected to the existing EPS intake tunnels and the CDP intake pump station, and installation of temporary screens and dilution pumps
- Complete permitting, 30% design, contractor selection, WPA revisions, and financing late 2017
- Final engineering and construction 18 months
- Improvements ready to go into service mid to 2019

Phase 2

- Improvements include construction of an intake vault in the EPS discharge pond installation of 1 mm screens, interconnection with the Phase 1 intake vault, remove temporary screens
- Complete permitting, 30% design contractor selection, WPA revisions, and financing late 2019
- Final engineering and construction 24 months
- Improvements ready to go into service 2022

ANALYSIS OF ALTERNATIVES 11, 12, 13, AND 14 – COST OF IMPROVEMENTS

Capital Cost Alternatives 1, 11, 12, 13, and 14 (2017 $)

Construction Cost	Intake/Discharge Improvements with Through Screen Velocity 0.5 fps	Intake/Discharge with Velocity 0.5 fps All Locations											
Alternative	**1 – Original Proposal**	**11 - Screens Arranged Inside Discharge Pond**			**12 - Screen Oriented Back to Back**			**13 -Screens in Straight Alignment Along Pond Berm**			**14 - Screens in Bent Alignment Along Pond Berm**		
Improvement Phase	**NA**	**Interim**	**Final**	**Total**	**Interim**	**Final**	**Total**	**Interim**	**Final**	**Total**	**Interim**	**Final**	**Total**
Construction Costs		**18 month**	**24 month**		**18 month**	**24 month**		**18 month**	**24 month**		**18 month**	**24 month**	
Additional Permitting	$3,150,000	3,150,000	2,000,000	5,150,000	3,150,000	2,000,000	5,150,000	3,150,000	2,000,000	5,150,000	3,150,000	2,000,000	5,150,000
Intake/Outfall Construction	$34,675,000	23,183,000	63,714,000	86,897,000	23,183,000	62,585,000	85,768,000	23,183,000	62,267,000	85,450,000	23,183,000	64,408,000	87,591,000
Construction Management	$2,373,529	2,400,000	3,000,000	5,400,000	2,400,000	3,000,000	5,400,000	2,400,000	3,000,000	5,400,000	2,400,000	3,000,000	5,400,000
Construction Insurance	$1,000,000	Inc. Line 7	Inc. Line 7	Inc. Line 7	Inc. Line 7	Inc. Line 7	Inc. Line 7	Inc. Line 7	Inc. Line 7	Inc. Line 7	Inc. Line 7	Inc. Line 7	Inc. Line 7
Construction Rent	$309,000	200,000	600,000	800,000	200,000	600,000	800,000	200,000	600,000	800,000	200,000	600,000	800,000
Post Construction Entrainment Study	$1,200,000	-	1,200,000	1,200,000	-	1,200,000	1,200,000	-	1,200,000	1,200,000	-	1,200,000	1,200,000
Subtotal	**$42,707,529**	**28,933,000**	**70,514,000**	**99,447,000**	**28,933,000**	**69,385,000**	**98,318,000**	**28,933,000**	**69,067,000**	**98,000,000**	**28,933,000**	**71,208,000**	**100,141,000**
Transaction Costs, legal	$972,401	652,018	1,603,086	2,255,103	652,018	1,577,697	2,229,715	652,018	1,570,437	2,222,454	652,018	1,603,086	2,255,103
Capitalize Interest	$2,554,752	1,408,624	4,314,390	5,723,014	1,408,624	4,245,053	5,653,677	1,408,624	4,225,101	5,633,725	1,408,624	4,297,040	5,705,664
Additional 6 Mo Debt Service Reserve	$1,362,806	921,136	2,381,630	3,302,765	921,136	2,343,912	3,265,047	921,136	2,333,125	3,254,260	921,136	2,381,630	3,302,765
Debt Underwriting	$398,684	267,327	657,265	924,592	267,327	646,856	914,183	267,327	643,879	911,206	267,327	657,265	924,592
Additional 1 month O&M Reserve	$237,229	208,333	62,500	270,833	208,333	62,500	270,833	208,333	62,500	270,833	208,333	62,500	270,833
Outstanding Equity Fee	$386,509	193,649	634,822	828,471	193,649	624,768	818,417	193,649	621,893	815,542	193,649	634,822	828,471
Total Project Cost	**$48,619,910**	**32,584,088**	**80,167,692**	**112,751,780**	**32,584,088**	**78,885,786**	**111,469,874**	**32,584,088**	**78,523,934**	**111,108,022**	**32,584,088**	**80,844,342**	**113,428,430**
Incremental Increase				**64,131,870**			**62,849,964**			**62,488,112**			**64,808,520**

Annual Cost Alternatives 1, 11, 12, 13, and 14 (2017 $)

Annual Cost	Intake/Discharge Improvements with Through Screen Velocity 0.5 fps	Intake/Discharge with Velocity 0.5 fps All Locations											
Alternative	**1 – Original Proposal**	**11 - Screens Arranged Inside Discharge Pond**			**12 - Screen Oriented Back to Back**			**13 -Screens in Straight Alignment Along Pond Berm**			**14 - Screens in Bent Alignment Along Pond Berm**		
Improvement Phase	**NA**	**Interim**	**Final**	**Total**	**Interim**	**Final**	**Total**	**Interim**	**Final**	**Total**	**Interim**	**Final**	**Total**
Annual Costs													
Construction Debt Charge	2,391,911	1,842,272	4,763,259	6,605,531	1,842,272	4,687,823	6,530,095	1,842,272	4,666,249	6,508,521	1,842,272	4,763,259	6,605,531
Construction Equity Charge	1,154,708	899,870	2,244,591	3,144,460	899,870	2,207,134	3,107,003	899,870	2,197,161	3,097,031	899,870	2,349,762	3,249,632
Additional O&M Charge	2,846,748	2,500,000	750,000	3,250,000	2,500,000	750,000	3,250,000	2,500,000	750,000	3,250,000	2,500,000	750,000	3,250,000
Total Annual Costs	**6,393,367**	**5,242,141**	**7,757,850**	**12,999,991**	**5,242,141**	**7,644,957**	**12,887,098**	**5,242,141**	**7,613,410**	**12,855,552**	**5,242,141**	**7,863,022**	**13,105,163**
Incremental Increase				**6,606,624**			**6,493,731**			**6,462,184**			**6,711,795**

Benefit/Cost Analysis Alternatives 1, 11, 12, 13, and 14 (2017 $)

Cost/Benefit Analysis	Intake/Discharge Improvements with Through Screen Velocity 0.5 fps	Intake/Discharge with Velocity 0.5 fps All Locations			
Alternative	**1 – Original Proposal**	**11 - Screens Arranged Inside Discharge Pond**	**12 - Screen Oriented Back to Back**	**13 -Screens in Straight Alignment Along Pond Berm**	**14 - Screens in Bent Alignment Along Pond Berm**
Productivity Loss (lbs/d)	0.85	0.20	0.27	0.32	0.32
Reduction in Productivity Loss (lbs/d)		0.65	0.58	0.53	0.53
Reduction in Productivity Loss (lbs/yr)		237.25	211.70	193.45	193.45
Incremental Cost increase ($/yr)		$6,606,624	$6,493,731	$6,462,184	$6,711,795
Unit Cost of Reduced Mortality ($/lb)		**$27,847**	**$30,674**	**$33,405**	**$34,695**

FEASIBILITY DETERMINATION
INTAKE ALTERNATIVES 1, 11, 12, 13, AND 14

Feasibility Determination
Alternatives 1, 11, 12, 13, 14, and 20

Comparison of Cost, Schedule, and Environmental Benefits								
Intake Alternatives 1, 11, 12, 13, and 14								
	Cost (2017 $)			Schedule	Environmental Cost/Benefit			
Alternative	Capital Cost	Annual Cost ($/Year)	Annual Cost Increase ($/Year)	Construction Schedule (Years)	Reduction in marine Life Mortality (lbs per day)	Additional Mortality Reduction (lbs per day)	Benefit Cost Ratio ($/lb)[1,2]	Feasibility Determination
1	$48,619,910	$6,916,213	NA	2.1	6.21	NA	NA	Feasible
11	$112,751,780	$12,999,991	$6,606,624	3.7	6.86	0.65	$27,847	Infeasible - significant additional cost, unfavorable B/C ratio.
12	$111,469,874	$12,887,098	$6,493,731	3.7	6.79	0.58	$30,674	Infeasible - significant additional cost, unfavorable B/C ratio.
13	$111,108,022	$12,855,552	$6,462,184	3.7	6.74	0.53	$33,405	Infeasible - significant additional cost, unfavorable B/C ratio.
14	$113,428,430	$13,105,163	$6,711,795	3.7	6.74	0.53	$34,695	Infeasible - significant additional cost, unfavorable B/C ratio.

1. Annual capital cost increase ($/year) divided by additional mortality reduction (lbs/year).
2. These costs are incurred starting in the year the intake improvements are completed and continue through 2045.