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Risk-Based Vulnerability Assessment of the Indian River Lagoon to Climate Change

INTERIM REPORT No. 3

July 2, 2018

Prepared for: Indian River Lagoon Council

Prepared by:

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Introduction

This is our second Interim Report which provides a summary of IRL Phase I Vulnerability Assessment activities completed through April 2018 under Contract with the IRL Council. Phase I Steps include:

1. Communication and Consultation
2. Establishing the Context for the Vulnerability Assessment
3. Risk Identification
4. Risk Analysis
5. Risk Evaluation: Comparing Risks

Each is addressed in turn.

Step 1. Communication and Consultation

The scope of the contractual task for Step 1 is described as follows:

> Identify key stakeholders and prepare a schedule for stakeholder involvement. Key partners and stakeholders are likely well represented in the newly organized Management Conference (MC). In addition to the IRL Management Conference, contractor will work with IRLNEP to engage with IRL counties, cities and specific sources of climate change expertise along the IRL and Florida.

This task was completed as reported in the First Interim Report. However, we continue to conduct meetings and conference calls with stakeholders throughout the watershed as summarized in **Table 1.** This included a presentation before the IRLC STEM Committee on March 13, 2018.

Step 1. Percent completion 100%.

Step 2. Establishing the Context for the Vulnerability Assessment

The scope of the contractual task for Step 2 is described as follows:

> Compile list of organizational goals and associated Action Plans (CCMP 2008) that are susceptible to climate change.

A list of organizational goals and associated Action Plans – as contained in the 2008 CCMP - susceptible to climate change was included in the First Interim Report. However, during a subsequent meeting with Director DeFreese (January 24, 2018) it was agreed moving forward Steps 2 and 3 would not be constrained by the 2008 CCMP as new organizational goals and/or related Action Plans would likely be generated during its ongoing review and revision. During the March 2018 STEM meeting, we received a draft copy of proposed CCMP revisions and associated Action Plans. The list of organization goals and associated Action Plans was updated accordingly (see Step 3).

Step 2. Percent completion 100%.

Step 3. Risk Identification

The scope of the contractual task for Step 3 is described as follows:

> Create a broad list of climate change risks that might impact the ability of the IRLNEP to achieve its goals. The list will be reviewed and expanded upon using local knowledge and expertise of the project team, the MC, and other stakeholders as may be identified in Step 1.

A broad list of climate change risks (Risk Matrix) to newly proposed CCMP Action Plans is contained in **Attachments 1 – 3**. These correspond to the three IRL NEP program goals relevant to this project:

1. Restore and protect sediment and water quality
2. Restore and protect living and archeological resources
3. Identify and implement strategies to sustain active public engagement

The content of the risk matrices benefited enormously for input solicited from stakeholders (c.f. **Table 1**).

Step 3. Percent completion 100% (Attachments 1 - 3 and Table 1 updated for this report (#3).

Step 4. Risk Analysis

The scope of the contractual task for Step 4 is described as follows:

> Make an initial, high-level determination of the consequence, likelihood, spatial scale, and timeline of the impacts. This determination will be constructed as a preliminary summary matrix and vetted using the local knowledge and expertise of project team, the MC, and other stakeholders as may be identified in Step 1.

Risk Analysis matrices are contained in **Attachments 4 – 6**. The level of risk to each climate change stressor is expressed as a *Preliminary Score*. These scores are consistent with ongoing stakeholder polling. This analysis and additional stakeholder input will form the basis for completion of Step 5.

Step 4. Percent completion 100%.

Step 5. Risk Evaluation: Comparing Risks

The scope of the contractual task for Step 5 is described as follows:

> Develop a consequence/probability matrix, review and update with stakeholder input. This matrix will be constructed by expanding the preliminary summary matrix (Step 4) to include consequences and probability. This effort will be based upon the knowledge and expertise of the project team, input from the MC and other stakeholders as may be identified in Step 1.

The development of the consequence/probability matrix is predicated upon completion of Task 4; no interim deliverable is presented with this report.

Step 5. Percent completion 0%.

Table 1. Stakeholder outreach .

Stakeholder Outreach (180516)	Affiliation	Topic
Arpayoglou, Irene	DEP IRL Aquatic Preserves	Spoil Islands
Barile, Peter	Environmental Consultant	Nutrients
Beal, Jeff	ECERT	Natural Resources
Bell, Lexie	Morro Bay	NEP
Bohlan, Curtis	Casco Bay	NEP
Burke, Mya	Tampa Bay	NEP
Busha, Michael	TCRPC	Planning
Corbett, Catherine	Lower Columbia Estuary	NEP
Craghan, Michael	USEPA	General
Creswell, R	Florida Sea Grant	Climate stressors
Crosley, Mark	FIND	Spoil Islands
Culver, Matt	Brevard County	Boating & Waterways
Encomio, Vincent	FOS	Climate stressors
Evans, Jason	Stetson University	General
Gubles, Anthony	Brevard County	Wastewater
Hevia, Allison	Charlotte Harbor	NEP
Ilami, Fara	FWCC	Living shorelines
Johnston, Karina	Santa Monica Bay	NEP
LaMartina, Kathy	SFWMD	Surface water
Lindeman, Dr. Ken	FIT	General
Listopad, Claudia	Environmental Consultant	TMDL
Lunt, Jessica	Smithsonian Marine Station	Climate stressors
McClure, Bach	Brevard County	Storm Water
McCue, Tara	ECFRPC	Planning
McGarry, Mike	Brevard County	Dunes and Beaches
McGee, Darcie	Brevard County	General
Middlebrook, Mike	St. Lucie County	NRM
Otega, Jorge	San Juan Bay	NEP
Roddenberry, Annie	NERT	Natural Resources
Ruppert, Thomas	Florida Sea Grant	Legal
Shafer, Dave	Sarasota Bay	NEP
Smith, Brandon	Brevard County	SOIRL Program
Souto, Leesa	MRC	Natural Resources
Spratt, Robbyn	Brevard County	Storm Water
Traylor, Aaron	City of Melbourne	Wastewater
Trefry, Dr. John	FIT	Muck
Weaver, Robert	IRLRI	Natural Resources
Winston, Keith	Brevard Zoo	Living shorelines
Zierden, David	Florida State Climatologist	Climate trends
Zimmerman, Janet	FIND	Spoil Islands
		VC 180620

Interim Report #3 Attachment 1. Risk Identification - Water and Sediment Quality					Consistency with draft 2030 CCMP
Issue: Wastewater **Action:** Improve infrastructure to reduce or remove human sources of waste to IRL **Objective:** Attain and maintain water and sediment of sufficient quality to support a healthy estuarine ecosystem **Representative Action Plans:** W-3, W-6, W-8					Updated
Climate Stressor/Risk					
Warmer temperature	**Changes in precipitation**	**Increasing storminess**	**Acidification**	**Sea level rise**	
Decreased pollutant loadings due to increased bioremediation effectiveness caused by warmer temperatures	Increased pollutant loadings from WWTP and OSTDS during high rainfall events	Increased pollutant loadings from WWTP and OSTDS due to more frequent and intense storm events	Increased pollutant loadings due to changes in solubility and/or toxicity caused by acidification of lagoon water	Increased pollutant loadings from WWTP and OSTDS due to rising water table and sea level (erosion, inundation)	
Increased pollutant loadings due to changes in solubility and/or toxicity caused by warmer temperature					
Issue: Surface water (storm and fresh) **Action:** Reduce surface water discharge and pollutant loads to IRL **Objective:** Attain and maintain water and sediment of sufficient quality to support a healthy estuarine ecosystem **Representative Action Plans:** S-1, S-3, S-5, S-6, S-8, S-9					
Climate Stressor/Risk					
Warmer temperature	**Changes in precipitation**	**Increasing storminess**	**Acidification**	**Sea level rise**	
Increased pollutant loadings **(urban, rural)** due to changes in solubility and/or toxicity caused by warmer temperature	Increased pollutant loadings from surface water storage and conveyance infrastructure during high rainfall events	Increased pollutant loadings from surface water storage and conveyance infrastructure caused by more frequent and intense storm events	Increased pollutant loadings due to changes in solubility and/or toxicity caused by acidification	Increased pollutant loadings due to higher water table caused by sea level rise	
Increased pollutant loadings due to increased use of chemical treatments in surface water storage and conveyance systems to reduce more frequent algae blooms or expanding invasive plants caused by warmer temperature				Increased pollutant loadings due from water storage and conveyance infrastructure caused by rising water table and sea level (erosion, inundation)	
Increased pollutant loadings due to increased maintenance (cuttings, chemical applications) of greenspace caused by warmer temperature					

Interim Report #3 Attachment 1. Risk Identification - Water and Sediment Quality					Consistency with draft 2030 CCMP
Issue: Lagoon Hydrology (groundwater, natural flow) **Action:** Enhance scientific understanding of basin hydrology **Objective:** Provide scientific knowledge to better inform and advise strategies to support a healthy estuarine ecosystem **Representative Action Plans:** H-1, H-2, H-3, H-4, H-5					New
Climate Stressor/Risk					
Warmer temperature	**Changes in precipitation**	**Increasing storminess**	**Acidification**	**Sea level rise**	
Changes in thermohaline circulation due to warmer temperature	Changes in thermohaline circulation due to polyline conditions caused by intervals of higher rainfall and drought			Changes in circulation, groundwater and surface water hydrology due to rising water table and sea level (erosion, inundation)	
Issue: Marina and Boating Pollution **Action:** Implement marina and boating education and management plans to reduce impacts to ecosystem **Objective:** Reduction of nutrient and chemical pollutant loading, seabed disturbance and trash **Representative Action Plans:** MB-4, B-5					Updated
Climate Stressor/Risk					
Warmer temperature	**Changes in precipitation**	**Increasing storminess**	**Acidification**	**Sea level rise**	
Increased pollutant loadings from site runoff due to changes in solubility and/or toxicity caused by warmer temperature	Increased pollutant loadings from site runoff during high rainfall events, especially after extended periods of drought	Reduced pollutant loadings due to decrease in number of recreational boating days caused by more frequent and intense storm events		Increased pollutant loadings due to failure of pump out facilities, portable toilet dump stations, fuel stations, and rest rooms caused by rising water table and sea level (erosion, inundation)	
		Increased pollutant loadings from access facilities and associated infrastructure due to increased coastal erosion caused by more frequent and intense storm events			
Issue: Atmospheric Deposition **Action:** Research, develop and implement strategies to reduce or remove atmospheric pollutants **Objective:** Reduce nitrogen flux **Representative Action Plans:** AD-1					
Climate Stressor/Risk					
Warmer temperature	**Changes in precipitation**	**Increasing storminess**	**Acidification**	**Sea level rise**	
Increased atmospheric deposition of nitrogen and other pollutants due to increasing demand for electricity caused by warmer temperature	Increased atmospheric deposition of nitrogen and other pollutants during high rainfall events	Increased atmospheric deposition of nitrogen and other pollutants due to more frequent and intense storm events			

Interim Report #3 Attachment 1. Risk Identification - Water and Sediment Quality					Consistency with draft 2030 CCMP
Issue: Water Clarity **Action:** Implement strategies to improve water clarity **Objective:** Attain and maintain water clarity sufficient to support a healthy estuarine ecosystem **Representative Action Plans:** PS-3, OSDS-4, FSD-1, FSD-3, FSD-4, FSD-5, FSD-10, FSD-11, FSD-13, TMDL-1, TMDL-3					Not listed
Climate Stressor/Risk					
Warmer temperature	**Changes in precipitation**	**Increasing storminess**	**Acidification**	**Sea level rise**	
Decreased clarity due to an increase in the growth rates and survival of algae and other taxa induced by warmer temperature	Decreased clarity due to Increased pollutant loadings from WWTP and OSTDS during high rainfall events	Decreased clarity due to erosion of seabed and shoreline caused by more frequent and intense storm events		Increased clarity due to reduction in erosion of seabed caused by caused by increased bathymetry	
	Decreased clarity due to Increased pollutant loadings from surface water storage and conveyance infrastructure during high rainfall events	Decreased clarity due to Increased pollutant loadings from WWTP and OSTDS during more frequent and intense storm events		Decreased clarity due to erosion of shoreline caused by sea level rise	
		Decreased clarity due to Increased pollutant loadings from surface water storage and conveyance infrastructure caused by more frequent and intense storm events		Decreased clarity due to Increased pollutant loadings from WWTP caused by rising water table and sea level (erosion, inundation)	
				Decreased clarity due to increased pollutant loadings from water storage and conveyance infrastructure caused by rising water table and sea level (erosion, inundation)	
Issue: DO **Action:** Implement strategies to increase DO content **Objective:** Reduce frequency and duration of low DO events sufficient to support a healthy estuarine ecosystem **Representative Action Plans:** TMDL-1, TMDL-3					Not listed
Climate Stressor/Risk					
Warmer temperature	**Changes in precipitation**	**Increasing storminess**	**Acidification**	**Sea level rise**	
Decreased DO solubility due to warmer temperature	Increased pollutant loadings from WWTP and OSTDS high rainfall events	Decreased DO availability due to erosion of seabed and shoreline caused by caused by more frequent and intense storm events		Decreased DO availability due to Increased pollutant loadings from WWTP caused by rising water table and sea level (erosion, inundation)	
Decreased DO availability due to accelerated decomposition of organic matter caused by warmer temperature	Decreased DO availability due to Increased pollutant loadings from surface water storage and conveyance infrastructure during high rainfall events	Decreased DO availability due to Increased pollutant loadings from WWTP and OSTDS during more frequent and intense storm events		Decreased DO availability due to increased pollutant loadings from water storage and conveyance infrastructure caused by rising water table and sea level (erosion, inundation)	
Decreased DO availability due to more frequent algae blooms caused by warmer temperature		Decreased DO availability due to Increased pollutant loadings from surface water storage and conveyance infrastructure caused by more frequent and intense storm events			

Interim Report #3 Attachment 1. Risk Identification - Water and Sediment Quality					Consistency with draft 2030 CCMP
Issue: Chlorophyll a					Not listed
Action: Implement strategies to reduce Chlorophyll a					
Objective: Reduce frequency and duration of elevated Chlorophyll a events sufficient to support a healthy estuarine ecosystem					
Representative Action Plans: TMDL-1, TMDL-3					
Climate Stressor/Risk					
Warmer temperature	**Changes in precipitation**	**Increasing storminess**	**Acidification**	**Sea level rise**	
Increased Chlorophyll a concentration due to more frequent algae blooms caused by warmer temperature	Increased Chlorophyll a concentration due to increased pollutant loadings from WWTP and OSTDS during high rainfall events	Increased Chlorophyll a concentration due to erosion of seabed and shoreline caused by more frequent and intense storm events		Increased Chlorophyll a concentration due to Increased pollutant loadings from WWTP caused by rising water table and sea level (erosion, inundation)	
	Increased Chlorophyll a concentration due to Increased pollutant loadings from surface water storage and conveyance infrastructure during high rainfall events	Increased Chlorophyll a concentration due to Increased pollutant loadings from WWTP and OSTDS during more frequent and intense storm events		Increased Chlorophyll a concentration due to increased pollutant loadings from water storage and conveyance infrastructure caused by rising water table and sea level (erosion, inundation)	
		Increased Chlorophyll a concentration due to Increased pollutant loadings from surface water storage and conveyance infrastructure caused by more frequent and intense storm events			
Issue: Legacy nutrient, pollutant, and sediment loads					Modified
Action: Implement strategies to remove and/or reduce muck					
Objective: Restore natural sediments, decrease turbidity and nutrient flux sufficient to support a healthy estuarine ecosystem					
Representative Action Plans: M-1, M-3, M-4					
Climate Stressor/Risk					
Warmer temperature	**Changes in precipitation**	**Increasing storminess**	**Acidification**	**Sea level rise**	
		Decrease in water quality due to erosion and resuspension of seabed caused by more frequent and intense storm events		Decreased muck redistribution due to reduction in erosion of seabed by increased bathymetry	

Interim Report #3 Attachment 2. Risk Identification - Living and Archeological Resources

Consistency with draft 2030 CCMP

Target: Biodiversity **Action:** Develop a management strategy based upon a comprehensive assessment of biodiversity **Objective:** Restore and protect biodiversity **Representative Action Plans:** BD-1, BD-4				
Climate Stressor/Risk				
Warmer temperature	**Changes in precipitation**	**Increasing storminess**	**Acidification**	**Sea level rise**
Increased habitat and species disruption/migration due to warmer temperature	Increased habitat and species disruption due to polyhaline conditions caused by intervals of higher rainfall and extended periods of drought	Increased habitat and species disruption due to seabed and shoreline erosion caused by more frequent and intense storm events	Decreased vitality of calcifying organisms (i.e., shellfish) and other habitat dependent taxa due to more acidic conditions	Decreased habitat and species disruption due to less seabed erosion caused by deepening bathymetry
Increased habitat and species disruption due to elevated pollutant loadings caused by changes in solubility and/or toxicity induced by warmer temperature	Increased habitat and species disruption due to increased pollutant loadings from WWTP and OSTDS during high rainfall events	Increased habitat and species disruption due to increased pollutant loading from WWTP and OSTDS during more frequent and intense storm events		Increased habitat and species disruption due to increased pollutant loading from WWTP and OSTDS caused by rising water table and sea level (inundation, erosion)
Increased habitat and species disruption due to elevated pollutant loadings in surface water storage and conveyance infrastructure caused by caused by longer growing season induced by warmer temperature	Increased habitat and species disruption due to increased pollutant loadings from surface water storage and conveyance infrastructure caused by high rainfall events	Increased habitat and species disruption due to increased pollutant loading from surface water storage and conveyance infrastructure during more frequent and intense storm events		Increased habitat and species disruption due to increased pollutant loading from surface water storage and conveyance infrastructure caused by rising water table and sea level (inundation, erosion)
				Increased habitat and species disruption due to rising water table and sea level (inundation, erosion)

Target: Seagrass **Action:** Support the implementation of a strategy to restore and protect seagrass habitat **Objective:** Restore and protect a functioning ecosystem **Representative Action Plans:** SG-1, SG-3				
Climate Stressor/Risk				
Warmer temperature	**Changes in precipitation**	**Increasing storminess**	**Acidification**	**Sea level rise**
Increased habitat and species disruption due to warmer temperature	Increased habitat and species disruption due to polyhaline conditions caused by intervals of higher rainfall and extended periods of drought	Increased habitat and species disruption due to erosion of seabed and shoreline caused by more frequent and intense storm events	Decreased vitality of calcifying organisms (i.e., shellfish) and other habitat dependent taxa due to more acidic conditions	Decreased habitat and species disruption due to less seabed erosion and increased water clarity caused by deepening bathymetry
Increased habitat and species disruption due to increased pollutant loading caused by changes in solubility and/or toxicity induced by warmer temperature	Increased habitat and species disruption due to increased pollutant loadings from WWTP and OSTDS during high rainfall events	Increased habitat and species disruption due to increased pollutant loadings from WWTP and OSTDS during more frequent and intense storm events		Increased habitat and species disruption due to increased pollutant loadings from WWTP and OSTDS in response to rising water table and sea level (inundation, erosion)
Increased habitat and species disruption due to elevated pollutant loadings from surface water storage and conveyance infrastructure caused by warmer temperature	Increased habitat and species disruption due to increased pollutant loadings from surface water storage and conveyance infrastructure during high rainfall events	Increased habitat and species disruption due to increased pollutant loadings from surface water storage and conveyance infrastructure during more frequent and intense storm events		Increased habitat and species disruption due to increased pollutant loadings from surface water storage and conveyance infrastructure in response to rising water table and sea level (inundation, erosion)
Increased in carbon sequestration due to increased coverage caused by warmer temperature				Increased habitat and species opportunites due to submergence and flooding of upland areas caused by sea level rise

Updated

Interim Report #3 Attachment 2. Risk Identification - Living and Archeological Resources

Warmer temperature	Changes in precipitation	Increasing storminess	Acidification	Sea level rise	Consistency with draft 2030 CCMP
Target: Wetlands and Impounded Marshes **Action:** Support the implementation of a strategy to restore and protect wetland habitat **Objective:** Restore and maintain a functioning ecosystem **Representative Action Plans:** WL-1, WL-4, WL-6					Updated
Climate Stressor/Risk					
Increased habitat and species disruption due to warmer temperature	Increased habitat and species disruption due to polyhaline conditions caused by intervals of higher rainfall and extended periods of drought	Increased habitat and species disruption due to shoreline erosion caused by more frequent and intense storm events		Increased habitat and species disruption due to rising water table and sea level (inundation, erosion)	
Increased habitat and species disruption due to changes in evapotranspiration				Increased habitat and species opportunites due to submergence and flooding of upland areas caused by sea level rise	
Increased carbon sequestration due to transition expansion of mangrove habitat caused by warmer temperature				Increased habitat and species disruption due to upland barriers to existing wetland migration into upland areas during sea level rise	
				Change in carbon sequestration due to habitat and species disruption caused by warmer temperature	
Target: Rare, Threatened, Endangered, and Species of Special Concern **Action:** Support the implementation of a strategy to protect and manage species **Objective:** Species recovery **Representative Action Plans:** RTE-2, RTE-4, RTE-5					Updated
Climate Stressor/Risk					
Increased habitat and species disruption due to warmer temperature	Increased habitat and species disruption due to polyhaline conditions caused by intervals of higher rainfall and extended periods of drought	Increased habitat and species disruption due to erosion of seabed and shoreline caused by more frequent and intense storm events	Decreased vitality of calcifying organisms (i.e., shellfish) and other habitat dependent taxa due to more acidic conditions	Decreased habitat and species disruption due to less seabed erosion and increased water clarity caused by deepening bathymetry	
Increased habitat and species disruption due to lower oxygen solubility caused by warmer temperature	Increased habitat and species disruption due to increased pollutant loading from WWTP and OSTDS during high rainfall events	Increased habitat and species disruption due to increased pollutant loading from WWTP and OSTDS during more frequent and intense storm events		Increased habitat and species disruption due to increased pollutant loadings from WWTP and OSTDS caused by rising water table and sea level (inundation, erosion)	
Increased habitat and species disruption due to lower oxygen availability cause by more frequent algae blooms induced by warmer temperature	Increased habitat and species disruption due to increased pollutant loading from surface water storage and conveyance infrastructure during high rainfall events	Increased habitat and species disruption due to increased pollutant loading from surface water storage and conveyance infrastructure during more frequent and intense storm events		Increased habitat and species disruption due to increased pollutant loadings from surface water storage and conveyance infrastructure caused by rising water table and sea level (inundation, erosion)	
Increased habitat and species disruption due to lower oxygen availability caused by accelerated growth and decay of invasive plants within basin induced by warmer temperature				Increased habitat and species disruption due to rising water table and sea level (inundation, erosion)	

Interim Report #3 Attachment 2. Risk Identification - Living and Archeological Resources

Warmer temperature	Changes in precipitation	Increasing storminess	Acidification	Sea level rise	Consistency with draft 2030 CCMP
Target: Fisheries (Forage, Recreational, Commercial) **Action:** Support the implementation of a strategy to restore and protect fisheries **Objective:** Species recovery **Representative Action Plans**: FF-1, F-1, F-2, F-3, F-4, F-6					
Climate Stressor/Risk					
Increased habitat and species disruption due to warmer temperature	Increased habitat and species disruption due to polyhaline conditions caused by intervals of higher rainfall and extended periods of drought	Increased habitat and species disruption due to seabed and shoreline erosion caused by more frequent and intense storm events	Decreased vitality of calcifying organisms (i.e., shellfish) and other habitat dependent taxa due to more acidic conditions	Decreased habitat and species disruption due to less seabed erosion and increased water clarity caused by deepening bathymetry	Updated
Increased habitat and species disruption due to lower oxygen solubility caused by warmer temperature	Increased habitat and species disruption due to increased pollutant loadings from WWTP and OSTDS during high rainfall events	Increased habitat and species disruption due to increased pollutant loadings from WWTP and OSTDS during more frequent and intense storm events		Increased habitat and species disruption due to increased pollutant loadings from WWTP and OSTDS caused by rising water table and sea level (inundation, erosion)	
Increased habitat and species disruption due to lower oxygen availability cause by more frequent algae blooms induced by warmer temperature	Increased habitat and species disruption from surface water storage and conveyance infrastructure during high rainfall events	Increased habitat and species disruption due to increased pollutant loadings from surface water storage and conveyance infrastructure during more frequent and intense storm events		Increased habitat and species disruption due to increased pollutant loadings from surface water storage and conveyance infrastructure caused by rising water table and sea level (inundation, erosion)	
Target: Biotoxins, Infections, and Other Health Threats **Action:** Support the implementation of a strategy to reduce threats to ecosystem health **Objective:** Biotoxins, infections, diseases **Representative Action Plans: HAB-2, HAB-3**					
Climate Stressor/Risk					
Accelerated spread of existing or new threats to ecosystem health due to warmer temperature	Accelerated spread of existing or new threats to ecosystem health from WWTP and OSTDS during high rainfall events	Accelerated spread of existing or new threats to ecosystem health from WWTP and OSTDS during more frequent and intense storm events	Accelerated spread of existing or new threats to ecosystem health due to more acidic conditions	Accelerated spread of existing or new threats to ecosystem health from WWTP and OSTDS caused by rising water table and sea level (inundation, erosion)	Updated
	Accelerated spread of existing or new threats to ecosystem health from surface water storage and conveyance infrastructure during high rainfall events	Accelerated spread of existing or new threats to ecosystem health from surface water storage and conveyance infrastructure during more frequent and intense storm events		Accelerated spread of existing or new threats to ecosystem health from surface water storage and conveyance infrastructure caused by rising water table and sea level (inundation, erosion)	

Interim Report #3 Attachment 2. Risk Identification - Living and Archeological Resources

					Consistency with draft 2030 CCMP
Target: Exotic and Invasive Species **Target:** Remove exotic and invasive species to compliment habitat restoration **Objective:** Decrease exotic and invasive species competitive impacts on native habitats and species **Representative Action Plans:** IS-1, IS-2, IS-3					
Climate Stressor/Risk					
Warmer temperature	**Changes in precipitation**	**Increasing storminess**	**Acidification**	**Sea level rise**	
Accelerated spread of exotic and invasive species due to warmer temperature	Accelerated spread of exotic and invasive species due to polyhaline conditions caused by intervals of higher rainfall and extended periods of drought	Accelerated spread of exotic and invasive species from WWTP and OSTDS during more frequent and intense storm events		Reduction in upland exotic and invasive species due to rising water table and sea level (inundation, erosion)	Updated
Accelerated spread of exotic and invasive species due to increased wildfires caused by warmer temperature	Accelerated spread of exotic and invasive species from WWTP and OSTDS during high rainfall events	Accelerated spread of exotic and invasive species from surface water storage and conveyance infrastructure during more frequent and intense storm events		Accelerated spread of exotic and invasive species from WWTP and OSTDS caused by rising water table and sea level (inundation, erosion)	
	Accelerated spread of exotic and invasive specie from surface water storage and conveyance infrastructure during high rainfall events			Accelerated spread of exotic and invasive species from surface water storage and conveyance infrastructure caused by rising water table and sea level (erosion and inundation)	
Target: Living Shorelines **Action:** Support research to optimize function and resilience of installations **Objective:** Restore and protect shoreline habitat and ecosystem function **Representative Action Plans:** LS-1					New
Climate Stressor/Risk					
Warmer temperature	**Changes in precipitation**	**Increasing storminess**	**Acidification**	**Sea level rise**	
Increased habitat and species distribution due to warmer temperature	Increased habitat and species distribution due to polyhaline conditions caused by intervals of higher rainfall and extended periods of drought	Increased habitat and species disruption due to shoreline erosion caused by more frequent and intense storm events	Increased habitat and species disruption due to more acidic conditions	Increased habitat and species disruption due to rising water table and sea level (inundation, erosion)	
Target: Archeological resources (shell works, mounds, middens) **Objective:** Restore and protect **Representative Action Plans:** None					New
Climate Stressor/Risk					
Warmer temperature	**Changes in precipitation**	**Increasing storminess**	**Acidification**	**Sea level rise**	
Increased biological and chemical degradation due to warmer temperature	Increased chemical degradation due to higher rainfall	Increased physical and chemical degradation due to shoreline erosion and flooding during more frequent and intense storm events		Increased physical and chemical degradation due to rising water table and sea level (inundation, erosion)	

Interim Report #3 Attachment 3. Risk Identification - Stakeholder Engagement

					Consistency with draft 2030 CCMP
Target: Public Access					Not listed
Action: Implement strategies to increase public access					
Objective: Adequate and appropriate access					
Representative Action Plans: None					
Climate Stressor/Risk					
Warmer temperature	**Changes in precipitation**	**Increasing storminess**	**Acidification**	**Sea level rise**	
Decreased recreational activities due to warmer temperature	Decreased recreational activities due to increased number of high rainfall events	Decreased recreational activities, especially boating related, due to failure of infrastructure caused by more frequent and intense storm events		Decreased access due flooding of land or access infrastructure caused by rising water table and sea level	
Decreased recreational activities due to accelerated spread of existing or new viral, bacterial, fungal, and parasitic infections caused by warmer temperature	Decreased recreational activities due to increased habitat and species disruption due to polyhaline conditions caused by intervals of higher rainfall and extended periods of drought			Decreased access due increased presence of navigational obstacles caused by rising sea level	
Decreased recreational activities due to reduced water clarity caused by increased pollutant loadings					
Target: Public education and involvement					Updated
Action: Create a constituency of informed and involved stakeholders					
Objective: Achieve heightened public awareness of the ecosystem					
Representative Action Plans: C-2, C-3, C-4					
Climate Stressor/Risk					
Warmer temperature	**Changes in precipitation**	**Increasing storminess**	**Acidification**	**Sea level rise**	
Decreased volunteer participation in activities due to warmer temperature	Decreased volunteer participation in activities due to increased number of high rainfall events	Decreased volunteer participation in activities due to more frequent and intense storm events	Decreased volunteer participation in activities due to learned helplessness and self efficacy issues	Decreased volunteer participation in activities due to learned helplessness and self efficacy issues	
Decreased volunteer participation in activities due to learned helplessness and self efficacy issues	Decreased volunteer participation in activities due to learned helplessness and self efficacy issues	Decreased volunteer participation in activities due to learned helplessness and self efficacy issues			

Interim Report #3 Attachment 4. Risk Analysis - Sediment and Water Quality

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Wastewater	Warmer temperature	Increased pollutant loadings due to changes in solubility and/or toxicity caused by warmer temperature		1	1	2	2	6	Medium
Wastewater	Warmer temperature	Decreased pollutant loadings due to increased bioremediation effectiveness caused by warmer temperatures	Yes					na	High
Wastewater	Changes in precipitation	Increased pollutant loadings from WWTP during high rainfall events		2	3	2	2	9	Moderate
Wastewater	Increased storminess	Increased pollutant loadings from WWTP and OSTDS due to more frequent and intense storm events		2	3	2	3	10	Moderate
Wastewater	Acidification	Increased pollutant loadings due to changes in solubility and/or toxicity caused by acidification of lagoon water		1	1	2	2	6	Moderate
Wastewater	Sea level rise	Increased pollutant loadings from WWTP and OSTDS due to rising water table and sea level (inundation, erosion)		2	3	2	2	9	High

Interim Report #3 Attachment 4. Risk Analysis - Sediment and Water Quality

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Surfacewater	Warmer temperature	Increased pollutant loadings (**urban, rural**) due to changes in solubility and/or toxicity caused by warmer temperature		2	2	2	2	8	Moderate
Surfacewater	Warmer temperature	Increased pollutant loadings due to increased use of chemical treatments in surface water storage and conveyance infrastructure to reduce more frequent algae blooms or expanding invasive plants caused by warmer temperature		1	1	2	2	6	Moderate
Surfacewater	Warmer temperature	Increased pollutant loadings due to increased maintenance (cuttings, chemical applications) of greenspace caused by warmer temperature		2	2	2	2	8	Moderate
Surfacewater	Changes in precipitation	Increased pollutant loadings from surface water storage and conveyance infrastructure during high rainfall events		2	3	2	3	10	Moderate
Surfacewater	Increased storminess	Increased pollutant loadings from surface water storage and conveyance infrastructure caused by more frequent and intense storm events		2	3	2	3	10	High
Surfacewater	Acidification	Increased pollutant loadings due to changes in solubility and/or toxicity caused by acidification		1	1	2	2	6	Moderate
Surfacewater	Sea level rise	Increased pollutant loadings due to higher water table caused by sea level rise		1	1	2	2	6	Moderate
Surfacewater	Sea level rise	Increased pollutant loadings due from water storage and conveyance infrastructure caused by rising water table and sea level (inundation, erosion)		2	3	2	3	10	High

Interim Report #3 Attachment 4. Risk Analysis - Sediment and Water Quality

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Lagoon hydrology	Warmer temperature	Changes in thermohaline circulation due to warmer temperature		1	2	3	2	8	Moderate
Lagoon hydrology	Changes in precipitation	Changes in thermohaline circulation due to polyline conditions caused by intervals of higher rainfall and drought		1	2	3	2	8	Moderate
Lagoon hydrology	Increased storminess	na						na	
Lagoon hydrology	Acidification	na						na	
Lagoon hydrology	Sea level rise	Changes in circulation, groundwater and surface water hydrology due to rising water table and sea level (inundation, erosion)		2	3	3	2	10	High

Interim Report #3 Attachment 4. Risk Analysis - Sediment and Water Quality

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Marina and Boat Pollution	Warmer temperature	Increased pollutant loadings from site runoff due to changes in solubility and/or toxicity caused by warmer temperature		1	1	1	2	5	Moderate
Marina and Boat Pollution	Changes in precipitation	Increased pollutant loadings from site runoff during high rainfall events, especially after extended periods of drought		1	1	1	2	5	Moderate
Marina and Boat Pollution	Increased storminess	Reduced pollutant loadings due to decrease in number of recreational boating days caused by more frequent and intense storm events	Yes					na	Low
Marina and Boat Pollution	Increased storminess	Increased pollutant loadings from access facilities and associated infrastructure due to increased coastal erosion caused by more frequent and intense storm events		1	2	1	2	6	High
Marina and Boat Pollution	Acidification	na						na	
Marina and Boat Pollution	Sea level rise	Increased pollutant loadings due to failure of pump out facilities, portable toilet dump stations, fuel stations, and rest rooms caused by rising water table and sea level (inundation, erosion)		1	2	1	2	6	High

Interim Report #3 Attachment 4. Risk Analysis - Sediment and Water Quality

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Atmospheric Deposition	Warmer temperature	Increased atmospheric deposition of nitrogen and other pollutants due to increasing demand for electricity caused by warmer temperature		1	2	3	2	8	Low
Atmospheric Deposition	Changes in precipitation	Increased atmospheric deposition of nitrogen and other pollutants during high rainfall events		1	2	3	2	8	Low
Atmospheric Deposition	Increased storminess	Increased atmospheric deposition of nitrogen and other pollutants due to more frequent and intense storm events		1	2	3	2	8	Low
Atmospheric Deposition	Acidification	na						na	
Atmospheric Deposition	Sea level rise	na						na	

Interim Report #3 Attachment 4. Risk Analysis - Sediment and Water Quality

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Water Clarity	Warmer temperature	Decreased clarity due to an increase in the growth rates and survival of algae and other taxa induced by warmer temperature		2	3	3	2	10	High
Water Clarity	Changes in precipitation	Decreased clarity due to increased pollutant loadings from WWTP during high rainfall events		2	3	2	3	10	Moderate
Water Clarity	Changes in precipitation	Decreased clarity due to increased pollutant loadings from surface water storage and conveyance infrastructure during high rainfall events		2	3	2	3	10	Moderate
Water Clarity	Increased storminess	Decreased clarity due to erosion of seabed and shoreline caused by more frequent and intense storm events		1	2	2	2	7	High
Water Clarity	Increased storminess	Decreased clarity due to increased pollutant loadings from WWTP and OSTDS during more frequent and intense storm events		2	3	2	3	10	High
Water Clarity	Increased storminess	Decreased clarity due to increased pollutant loadings from surface water storage and conveyance infrastructure caused by more frequent and intense storm events		2	3	2	3	10	High
Water Clarity	Acidification	na						na	
Water Clarity	Sea level rise	Increased clarity due to reduction in erosion of seabed caused by caused by increased bathymetry	Yes					na	Moderate
Water Clarity	Sea level rise	Decreased clarity due to erosion of shoreline caused by sea level rise		1	2	2	2	7	High
Water Clarity	Sea level rise	Decreased clarity due to increased pollutant loadings from WWTP caused by rising water table and sea level (inundation, erosion)		2	3	2	3	10	High

Interim Report #3 Attachment 4. Risk Analysis - Sediment and Water Quality

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Water Clarity	Sea level rise	Decreased clarity due to increased pollutant loadings from water storage and conveyance infrastructure caused by rising water table and sea level (inundation, erosion)		2	3	2	3	10	High

Interim Report #3 Attachment 4. Risk Analysis - Sediment and Water Quality

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
DO	Warmer temperature	Decreased DO solubility due to warmer temperature		3	3	3	3	12	High
DO	Warmer temperature	Decreased DO availability due to accelerated decomposition of organic matter caused by warmer temperature		1	3	3	2	9	Moderate
DO	Warmer temperature	Decreased DO availability due to more frequent algae blooms caused by warmer temperature		3	3	3	3	12	High
DO	Changes in precipitation	Increased pollutant loadings from WWTP and OSTDS high rainfall events		2	3	2	3	10	Moderate
DO	Changes in precipitation	Decreased DO availability due to Increased pollutant loadings from surface water storage and conveyance infrastructure during high rainfall events		2	3	2	3	10	Moderate
DO	Increased storminess	Decreased DO availability due to erosion of seabed and shoreline caused by caused by more frequent and intense storm events		1	2	2	2	7	High
DO	Increased storminess	Decreased DO availability due to Increased pollutant loadings from WWTP and OSTDS during more frequent and intense storm events		2	3	2	2	9	High
DO	Increased storminess	Decreased DO availability due to Increased pollutant loadings from surface water storage and conveyance infrastructure caused by more frequent and intense storm events		2	3	2	3	10	High
DO	Acidification	na						na	
DO	Sea level rise	Decreased DO availability due to Increased pollutant loadings from WWTP caused by rising water table and sea level (inundation, erosion)		2	3	2	3	10	High
DO	Sea level rise	Decreased DO availability due to increased pollutant loadings from water storage and conveyance infrastructure caused by rising water table and sea level (inundation, erosion)		2	3	2	3	10	High

Interim Report #3 Attachment 4. Risk Analysis - Sediment and Water Quality

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Ch a	Warmer temperature	Increased Chlorophyll a concentration due to more frequent algae blooms caused by warmer temperature		3	3	3	3	12	High
Ch a	Changes in precipitation	Increased Chlorophyll a concentration due to increased pollutant loadings from WWTP and OSTDS during high rainfall events		2	3	2	3	10	Moderate
Ch a	Changes in precipitation	Increased Chlorophyll a concentration due to Increased pollutant loadings from surface water storage and conveyance infrastructure during high rainfall events		2	3	2	3	10	Moderate
Ch a	Increased storminess	Increased Chlorophyll a concentration due to erosion of seabed and shoreline caused by more frequent and intense storm events		1	2	2	2	7	Moderate
Ch a	Increased storminess	Increased Chlorophyll a concentration due to Increased pollutant loadings from WWTP and OSTDS during more frequent and intense storm events		2	3	2	2	9	Moderate
Ch a	Increased storminess	Increased Chlorophyll a concentration due to Increased pollutant loadings from surface water storage and conveyance infrastructure caused by more frequent and intense storm events		2	3	2	3	10	Moderate
Ch a	Acidification	na						na	
Ch a	Sea level rise	Increased Chlorophyll a concentration due to Increased pollutant loadings from WWTP caused by rising water table and sea level (inundation, erosion)		2	3	2	2	9	Moderate

Interim Report #3 Attachment 4. Risk Analysis - Sediment and Water Quality

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Ch a	Sea level rise	Increased Chlorophyll a concentration due to increased pollutant loadings from water storage and conveyance infrastructure caused by rising water table and sea level (inundation, erosion)		2	3	2	3	10	Moderate

Interim Report #3 Attachment 4. Risk Analysis - Sediment and Water Quality

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Legacy nutrients	Warmer temperature	na						na	
Legacy nutrients	Changes in precipitation	na						na	
Legacy nutrients	Increased storminess	Decrease in water quality due to erosion and resuspension of seabed caused by more frequent and intense storm events		1	2	2	2	7	High
Legacy nutrients	Increased storminess	na						na	
Legacy nutrients	Acidification	na						na	
Legacy nutrients	Sea level rise	Decreased muck redistribution due to reduction in erosion of seabed by increased bathymetry	Yes					na	Moderate

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Interim Report #3 Attachment 5. Risk Analysis - Living and Archeological Resources

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Biodiversity	Warmer temperature	Increased habitat and species disruption due to warmer temperature		1	2	3	2	8	Moderate
Biodiversity	Warmer temperature	Increased habitat and species disruption due to elevated pollutant loadings caused by changes in solubility and/or toxicity induced by warmer temperature		1	2	3	2	8	Moderate
Biodiversity	Warmer temperature	Increased habitat and species disruption due to elevated pollutant loadings in surface water storage and conveyance infrastructure caused by caused by longer growing season induced by warmer temperature		2	2	2	2	8	Moderate
Biodiversity	Changes in precipitation	Increased habitat and species disruption due to polyhaline conditions caused by intervals of higher rainfall and extended periods of drought		1	2	3	2	8	Moderate
Biodiversity	Changes in precipitation	Increased habitat and species disruption due to increased pollutant loadings from WWTP and OSTDS during high rainfall events		2	3	2	2	9	Moderate
Biodiversity	Changes in precipitation	Increased habitat and species disruption due to increased pollutant loadings from surface water storage and conveyance infrastructure caused by high rainfall events		2	3	2	2	9	Moderate
Biodiversity	Increased storminess	Increased habitat and species disruption due to erosion of seabed and shoreline caused by more frequent and intense storm events		1	2	3	2	8	Moderate
Biodiversity	Increased storminess	Increased habitat and species disruption due to increased pollutant loading from WWTP and OSTDS during more frequent and intense storm events		2	3	2	2	9	Moderate

Interim Report #3 Attachment 5. Risk Analysis - Living and Archeological Resources

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Biodiversity	Increased storminess	Increased habitat and species disruption due to increased pollutant loading from surface water storage and conveyance infrastructure during more frequent and intense storm events		2	3	2	2	9	Moderate
Biodiversity	Acidification	Decreased vitality of calcifying organisms (i.e., shellfish) and other habitat dependent taxa due to more acidic conditions		1	3	3	2	9	High
Biodiversity	Sea level rise	Decreased habitat and species disruption due to less seabed erosion caused by deepening bathymetry	Yes					na	Moderate
Biodiversity	Sea level rise	Increased habitat and species disruption due to increased pollutant loading from WWTP and OSTDS caused by rising water table and sea level (inundation, erosion)		2	3	2	2	9	High
Biodiversity	Sea level rise	Increased habitat and species disruption due to increased pollutant loading from surface water storage and conveyance infrastructure caused by rising water table and sea level (inundation, erosion)		1	3	2	2	8	Moderate
Biodiversity	Sea level rise	Increased habitat and species disruption due to rising water table and sea level (inundation, erosion)		1	3	3	2	9	Moderate

Interim Report #3 Attachment 5. Risk Analysis - Living and Archeological Resources

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Seagrass	Warmer temperature	Increased habitat and species disruption due to warmer temperature		1	2	3	2	8	Moderate
Seagrass	Warmer temperature	Increased habitat and species disruption due to increased pollutant loading caused by changes in solubility and/or toxicity induced by warmer temperature		1	2	3	2	8	Moderate
Seagrass	Warmer temperature	Increased habitat and species disruption due to elevated pollutant loadings from surface water storage and conveyance infrastructure caused by warmer temperature		2	3	2	2	9	Moderate
Seagrass	Warmer temperature	Change in carbon sequestration due to habitat and species disruption caused by warmer temperature		1	2	3	2	8	Moderate
Seagrass	Changes in precipitation	Increased habitat and species disruption due to polyhaline conditions caused by intervals of higher rainfall and extended periods of drought		1	2	3	2	8	Moderate
Seagrass	Changes in precipitation	Increased habitat and species disruption due to increased pollutant loadings from WWTP and OSTDS during high rainfall events		2	3	2	2	9	Moderate
Seagrass	Changes in precipitation	Increased habitat and species disruption due to increased pollutant loadings from surface water storage and conveyance infrastructure during high rainfall events		2	3	2	2	9	High
Seagrass	Increased storminess	Increased habitat and species disruption due to erosion of seabed and shoreline caused by more frequent and intense storm events		1	2	3	2	8	Moderate
Seagrass	Increased storminess	Increased habitat and species disruption due to increased pollutant loadings from WWTP and OSTDS during more frequent and intense storm events		2	3	2	2	9	Moderate

Interim Report #3 Attachment 5. Risk Analysis - Living and Archeological Resources

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Seagrass	Increased storminess	Increased habitat and species disruption due to increased pollutant loadings from surface water storage and conveyance infrastructure during more frequent and intense storm events		2	3	2	2	9	Moderate
Seagrass	Acidification	Decreased vitality of calcifying organisms (i.e., shellfish, epiphytes) and other habitat dependent taxa due to more acidic conditions		1	3	3	2	9	High
Seagrass	Sea level rise	Decreased habitat and species disruption due to less seabed erosion and increased water clarity caused by deepening bathymetry	Yes					na	Moderate
Seagrass	Sea level rise	Increased habitat and species disruption due to increased pollutant loadings from WWTP and OSTDS in response to rising water table and sea level (inundation, erosion)		2	3	2	2	9	Moderate
Seagrass	Sea level rise	Increased habitat and species disruption due to increased pollutant loadings from surface water storage and conveyance infrastructure in response to rising water table and sea level (inundation, erosion)		2	3	2	2	9	Moderate
Seagrass	Sea level rise	Increased habitat and species opportunites due to submergence and flooding of upland areas caused by sea level rise	Yes					na	Moderate

Interim Report #3 Attachment 5. Risk Analysis - Living and Archeological Resources

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Wetlands and Impounded Marshes	Warmer temperature	Increased habitat and species disruption due to warmer temperature		1	2	3	3	9	Moderate
Wetlands and Impounded Marshes	Warmer temperature	Increased habitat and species disruption due to changes in evapotranspiration		1	2	3	2	8	Moderate
Wetlands and Impounded Marshes	Warmer temperature	Change in carbon sequestration due to habitat and species disruption caused by warmer temperature		1	2	3	2	8	Moderate
Wetlands and Impounded Marshes	Changes in precipitation	Increased habitat and species disruption due to polyhaline conditions caused by intervals of higher rainfall and extended periods of drought		1	2	3	2	8	Moderate
Wetlands and Impounded Marshes	Increased storminess	Increased habitat and species disruption due to shoreline erosion caused by more frequent and intense storm events		2	3	3	2	10	High
Wetlands and Impounded Marshes	Acidification	na						na	
Wetlands and Impounded Marshes	Sea level rise	Increased habitat and species disruption due to rising water table and sea level (inundation, erosion)		2	3	3	2	10	High
Wetlands and Impounded Marshes	Sea level rise	Increased habitat and species opportunites due to submergence and flooding of upland areas caused by sea level rise	Yes					na	Moderate
Wetlands and Impounded Marshes	Sea level rise	Increased habitat and species disruption due to upland barriers to existing wetland migration into upland areas during sea level rise		3	3	3	2	11	High
Wetlands and Impounded Marshes	Sea level rise	Change in carbon sequestration due to habitat and species disruption caused by warmer temperature		1	2	3	2	8	Moderate

Interim Report #3 Attachment 5. Risk Analysis - Living and Archeological Resources

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Rare, threatened, endangered, and SOSC	Warmer temperature	Increased habitat and species disruption due to warmer temperature		1	2	3	2	8	Moderate
Rare, threatened, endangered, and SOSC	Warmer temperature	Increased habitat and species disruption due to lower oxygen solubility caused by warmer temperature		1	2	3	2	8	Moderate
Rare, threatened, endangered, and SOSC	Warmer temperature	Increased habitat and species disruption due to lower oxygen availability cause by more frequent algae blooms induced by warmer temperature		1	2	3	2	8	Low
Rare, threatened, endangered, and SOSC	Warmer temperature	Increased habitat and species disruption due to lower oxygen availability caused by accelerated growth and decay of invasive plants within basin induced by warmer temperature		1	2	3	2	8	Low
Rare, threatened, endangered, and SOSC	Changes in precipitation	Increased habitat and species disruption due to polyhaline conditions caused by intervals of higher rainfall and extended periods of drought		1	2	3	2	8	Moderate
Rare, threatened, endangered, and SOSC	Changes in precipitation	Increased habitat and species disruption due to increased pollutant loading from WWTP and OSTDS during high rainfall events		2	3	2	2	9	Moderate
Rare, threatened, endangered, and SOSC	Changes in precipitation	Increased habitat and species disruption due to increased pollutant loading from surface water storage and conveyance infrastructure during high rainfall events		2	3	2	2	9	Moderate
Rare, threatened, endangered, and SOSC	Increased storminess	Increased habitat and species disruption due to erosion of seabed and shoreline caused by more frequent and intense storm events		1	2	3	2	8	Moderate
Rare, threatened, endangered, and SOSC	Increased storminess	Increased habitat and species disruption due to increased pollutant loading from WWTP and OSTDS during more frequent and intense storm events		2	3	2	2	9	Moderate

Interim Report #3 Attachment 5. Risk Analysis - Living and Archeological Resources

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Rare, threatened, endangered, and SOSC	Increased storminess	Increased habitat and species disruption due to increased pollutant loading from surface water storage and conveyance infrastructure during more frequent and intense storm events		2	3	2	2	9	Moderate
Rare, threatened, endangered, and SOSC	Acidification	Decreased vitality of calcifying organisms (i.e., shellfish, epiphytes) and other habitat dependent taxa due to more acidic conditions		1	3	3	2	9	High
Rare, threatened, endangered, and SOSC	Sea level rise	Decreased habitat and species disruption due to less seabed erosion and increased water clarity caused by deepening bathymetry	Yes					na	Moderate
Rare, threatened, endangered, and SOSC	Sea level rise	Increased habitat and species disruption due to increased pollutant loadings from WWTP and OSTDS caused by rising water table and sea level (inundation, erosion)		2	3	2	2	9	Moderate
Rare, threatened, endangered, and SOSC	Sea level rise	Increased habitat and species disruption due to increased pollutant loadings from surface water storage and conveyance infrastructure caused by rising water table and sea level (inundation, erosion)		2	3	2	2	9	Moderate
Rare, threatened, endangered, and SOSC	Sea level rise	Increased habitat and species disruption due to rising water table and sea level (inundation, erosion)		1	3	3	2	9	Moderate

Interim Report #3 Attachment 5. Risk Analysis - Living and Archeological Resources

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Fisheries	Warmer temperature	Increased habitat and species disruption due to warmer temperature		1	2	3	2	8	Moderate
Fisheries	Warmer temperature	Increased habitat and species disruption due to lower oxygen solubility caused by warmer temperature		1	2	3	2	8	Moderate
Fisheries	Warmer temperature	Increased habitat and species disruption due to lower oxygen availability cause by more frequent algae blooms induced by warmer temperature		1	2	3	2	8	Low
Fisheries	Changes in precipitation	Increased habitat and species disruption due to polyhaline conditions caused by intervals of higher rainfall and extended periods of drought		1	2	3	2	8	Moderate
Fisheries	Changes in precipitation	Increased habitat and species disruption due to increased pollutant loadings from WWTP and OSTDS during high rainfall events		2	3	2	2	9	Moderate
Fisheries	Changes in precipitation	Increased habitat and species disruption from surface water storage and conveyance infrastructure during high rainfall events		2	3	2	2	9	Moderate
Fisheries	Increased storminess	Increased habitat and species disruption due to seabed and shoreline erosion caused by more frequent and intense storm events		1	2	3	2	8	Moderate
Fisheries	Increased storminess	Increased habitat and species disruption due to increased pollutant loadings from WWTP and OSTDS during more frequent and intense storm events		2	3	2	2	9	Moderate
Fisheries	Increased storminess	Increased habitat and species disruption due to increased pollutant loadings from surface water storage and conveyance infrastructure during more frequent and intense storm events		2	3	2	2	9	Moderate

Interim Report #3 Attachment 5. Risk Analysis - Living and Archeological Resources

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Fisheries	Acidification	Decreased vitality of calcifying organisms (i.e., shellfish) and other habitat dependent taxa due to more acidic conditions		1	3	3	2	9	High
Fisheries	Sea level rise	Decreased habitat and species disruption due to less seabed erosion and increased water clarity caused by deepening bathymetry	Yes					na	Moderate
Fisheries	Sea level rise	Increased habitat and species disruption due to increased pollutant loadings from WWTP and OSTDS caused by rising water table and sea level (i.e., inundation, erosion)		2	3	2	2	9	Moderate
Fisheries	Sea level rise	Increased habitat and species disruption due to increased pollutant loadings from surface water storage and conveyance infrastructure caused by rising water table and sea level (inundation, erosion)		2	3	2	2	9	Moderate

Interim Report #3 Attachment 5. Risk Analysis - Living and Archeological Resources

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Biotoxins, infections, and other health threats	Warmer temperature	Accelerated spread of existing or new threats to ecosystem health due to warmer temperature		1	2	3	2	8	Low
Biotoxins, infections, and other health threats	Changes in precipitation	Accelerated spread of existing or new threats to ecosystem health from WWTP and OSTDS during high rainfall events		1	1	3	2	7	Low
Biotoxins, infections, and other health threats	Changes in precipitation	Accelerated spread of existing or new threats to ecosystem health from surface water storage and conveyance infrastructure during high rainfall events		1	1	3	2	7	Low
Biotoxins, infections, and other health threats	Increased storminess	Accelerated spread of existing or new threats to ecosystem health from WWTP and OSTDS during more frequent and intense storm events		1	1	3	2	7	Low
Biotoxins, infections, and other health threats	Increased storminess	Accelerated spread of existing or new threats to ecosystem health from surface water storage and conveyance infrastructure during more frequent and intense storm events		1	1	3	2	7	Low
Biotoxins, infections, and other health threats	Acidification	Accelerated spread of existing or new threats to ecosystem health due to more acidic conditions		1	1	3	2	7	Low
Biotoxins, infections, and other health threats	Sea level rise	Accelerated spread of existing or new threats to ecosystem health from WWTP and OSTDS caused by rising water table and sea level (inundation, erosion)		1	1	3	2	7	Low
Biotoxins, infections, and other health threats	Sea level rise	Accelerated spread of existing or new threats to ecosystem health from surface water storage and conveyance infrastructure caused by rising water table and sea level (inundation, erosion)		1	1	3	2	7	Low

Interim Report #3 Attachment 5. Risk Analysis - Living and Archeological Resources

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Exotic and invasive species	Warmer temperature	Accelerated spread of exotic and invasive species due to warmer temperature		1	2	3	2	8	Moderate
Exotic and invasive species	Warmer temperature	Accelerated spread of exotic and invasive species due to increased wildfires caused by warmer temperature		1	2	2	2	7	Moderate
Exotic and invasive species	Changes in precipitation	Accelerated spread of exotic and invasive species due to polyhaline conditions caused by intervals of higher rainfall and extended periods of drought		1	2	3	2	8	Moderate
Exotic and invasive species	Changes in precipitation	Accelerated spread of exotic and invasive species from WWTP and OSTDS during high rainfall events		1	1	3	2	7	Moderate
Exotic and invasive species	Changes in precipitation	Accelerated spread of exotic and invasive specie from surface water storage and conveyance infrastructure during high rainfall events		1	1	3	2	7	Moderate
Exotic and invasive species	Increased storminess	Accelerated spread of exotic and invasive species from WWTP and OSTDS during more frequent and intense storm events		1	1	2	2	6	Moderate
Exotic and invasive species	Increased storminess	Accelerated spread of exotic and invasive species from surface water storage and conveyance infrastructure during more frequent and intense storm events		1	1	2	2	6	Moderate
Exotic and invasive species	Sea level rise	Reduction in upland exotic and invasive species due to rising water table and sea level (inundation, erosion)	Yes					na	Moderate
Exotic and invasive species	Sea level rise	Accelerated spread of exotic and invasive species from WWTP and OSTDS caused by rising water table and sea level (inundation, erosion)		1	1	2	2	6	Moderate
Exotic and invasive species	Sea level rise	Accelerated spread of exotic and invasive species from surface water storage and conveyance infrastructure caused by rising water table and sea level (erosion and inundation)		1	1	2	2	6	Moderate

Interim Report #3 Attachment 5. Risk Analysis - Living and Archeological Resources

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Living shorelines	Warmer temperature	Increased habitat and species distribution due to warmer temperature		1	1	3	2	7	Moderate
Living shorelines	Changes in precipitation	Increased habitat and species distribution due to polyhaline conditions caused by intervals of higher rainfall and extended periods of drought		1	1	3	2	7	Moderate
Living shorelines	Increased storminess	Increased habitat and species disruption due to shoreline erosion caused by more frequent and intense storm events		2	3	3	3	11	High
Living shorelines	Acidification	Increased habitat and species disruption due to more acidic conditions		1	1	3	2	7	Moderate
Living shorelines	Sea level rise	Increased habitat and species disruption due to rising water table and sea level (inundation, erosion)		2	3	3	2	10	High
Archeological resources	Warmer temperature	Increased biological and chemical degradation due to warmer temperature		1	1	3	2	7	Moderate
Archeological resources	Changes in precipitation	Increased chemical degradation due to higher rainfall		1	1	3	2	7	Moderate
Archeological resources	Increased storminess	Increased physical and chemical degradation due to shoreline erosion and flooding during more frequent and intense storm events		2	3	3	2	10	High
Archeological resources	Acidification	na						na	
Archeological resources	Sea level rise	Increased physical and chemical degradation due to rising water table and sea level (inundation, erosion)		2	3	3	2	10	High

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Interim Report #3 Attachment 6. Risk Analysis - Stakeholder Engagement

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Public access	Warmer temperature	Decreased recreational activities due to warmer temperature		1	1	3	2	7	Moderate
Public access	Warmer temperature	Decreased recreational activities due to accelerated spread of existing or new viral, bacterial, fungal, and parasitic infections caused by warmer temperature		2	2	3	3	10	High
Public access	Warmer temperature	Decreased recreational activities due to reduced water clarity caused by increased pollutant loadings		2	2	3	2	9	Moderate
Public access	Changes in precipitation	Decreased recreational activities due to increased number of high rainfall events		1	1	3	2	7	Low
Public access	Changes in precipitation	Decreased recreational activities due to increased habitat and species disruption due to polyhaline conditions caused by intervals of higher rainfall and extended periods of drought		1	2	3	2	8	Moderate
Public access	Increased storminess	Decreased recreational activities, especially boating related, due to failure of infrastructure caused by more frequent and intense storm events		2	2	3	2	9	Moderate
Public access	Acidification	na							
Public access	Sea level rise	Decreased access due flooding of land or access infrastructure caused by rising water table and sea level		2	2	3	2	9	Moderate
Public access	Sea level rise	Decreased access due increased presence of navigational obstacles caused by rising sea level		2	3	3	2	10	High

Interim Report #3 Attachment 6. Risk Analysis - Stakeholder Engagement

Organizational goal	Climate Stressor	Risk	Opportunity	Consequence	Likelihood	Spatial Extent	Time Horizon	Preliminary Score	Confidence
Public education and involvement	Warmer temperature	Decreased volunteer participation in activities due to warmer temperature		1	1	3	2	7	Moderate
Public education and involvement	Warmer temperature	Decreased volunteer participation in activities due to learned helplessness and self efficacy issues		1	1	3	2	7	Moderate
Public education and involvement	Changes in precipitation	Decreased volunteer participation in activities due to increased number of high rainfall events		1	1	3	2	7	Low
Public education and involvement	Changes in precipitation	Decreased volunteer participation in activities due to learned helplessness and self efficacy issues		1	1	3	2	7	Moderate
Public education and involvement	Increased storminess	Decreased volunteer participation in activities due to more frequent and intense storm events		1	1	3	2	7	Low
Public education and involvement	Increased storminess	Decreased volunteer participation in activities due to learned helplessness and self efficacy issues		1	1	3	2	7	Moderate
Public education and involvement	Acidification	Decreased volunteer participation in activities due to learned helplessness and self efficacy issues		1	1	3	2	7	Low
Public education and involvement	Sea level rise	Decreased volunteer participation in activities due to learned helplessness and self efficacy issues		1	1	3	2	7	Moderate