2023 COASTAL MASTER PLAN

INTERACTION OF PROTECTION AND RESTORATION PROJECTS

SUPPLEMENTAL MATERIAL H6.8

REPORT: VERSION 01

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COASTAL PROTECTION AND RESTORATION AUTHORITY

This document was developed in support of the 2023 Coastal Master Plan being prepared by the Coastal Protection and Restoration Authority (CPRA). CPRA was established by the Louisiana Legislature in response to Hurricanes Katrina and Rita through Act 8 of the First Extraordinary Session of 2005. Act 8 of the First Extraordinary Session of 2005 expanded the membership, duties, and responsibilities of CPRA and charged the new authority to develop and implement a comprehensive coastal protection plan, consisting of a master plan (revised every six years) and annual plans. CPRA's mandate is to develop, implement, and enforce a comprehensive coastal protection and restoration master plan.

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EXECUTIVE SUMMARY

This report describes the simulation modeling results projecting coastal flood risk and damage in the year 2070. The document presents an analysis of interactions between structural risk reduction projects and coastal restoration projects. This is based on comparisons between the future without action (FWOA) landscape, the future with master plan (FWMP) landscape, and a landscape in which only the 2023 Coastal Master Plan's structural risk reduction projects have been implemented (future with risk only, or FWRO); no restoration projects are present, and protection projects are assumed to be implemented in keeping with the Coastal Master Plan's recommended implementation schedule.

Results described in this analysis were simulated with the Coastal Louisiana Risk Assessment (CLARA) model and are presented for two scenarios representing different rates of future sea level rise (SLR), changes to hurricane intensity, and other key environmental factors. Flood damage results reflect a single scenario of projected future population change in Louisiana's coastal parishes. These conditions serve as a baseline against which individual risk reduction projects and the 2023 Coastal Master Plan can be compared against to evaluate benefits. However, the scenarios shown represent only two of many possible futures for the Louisiana coast and should be interpreted as plausible projections rather than likely predictions for future flood risk outcomes.

The document presents and describes results for five different regions of Louisiana's coast: Pontchartrain/Breton, Barataria, Terrebonne, Central Coast, and the Chenier Plain. This approach is consistent with the presentation of biophysical outcomes from the Integrated Compartment Model (ICM), which served as a key input for this analysis. Each chapter first provides an overview of the region, focusing on the structural risk reduction and coastal restoration projects recommended for construction in each implementation period. Ensuing sections discuss the impact of restoration projects on the regional topography and bathymetry, CLARA estimates of flood depths at different annual exceedance probabilities (AEPs) with and without the restoration and structural risk reduction projects, and risk estimates summarized using the Coastal Master Plan's key risk metrics.

The CLARA model was originally created by researchers at RAND Corporation to support development of Louisiana's 2012 Coastal Master Plan. It is designed to estimate flood depth exceedances, direct economic damage exceedances, and expected annual damage in dollars (EADD) and expected annual structural damage (EASD) in the Louisiana coastal zone. The model uses high-resolution hydrodynamic simulations of storm surge and waves as inputs. Monte Carlo simulation is used to estimate risk under a range of assumptions about future environmental and economic conditions and with different combinations of structural and nonstructural risk reduction projects on the landscape.

Coastwide, the master plan's structural risk reduction projects are projected to reduce both EADD and EASD in Year 50 by 41% in the higher scenario and 49% in the lower scenario, relative to a FWOA landscape. The addition of the master plan's coastal restoration projects yields marginal additional risk reduction of 2.1 to 2.5% for both metrics and scenarios, although the relative contribution of

restoration to damage reduction varies substantially by coastal region.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATIONS

AEP ..... ANNUAL EXCEEDANCE PROBABILITY
ADCIRC ..... ADVANCED CIRCULATION
CLARA ..... COASTAL LOUISIANA RISK ASSESSMENT
CPRA ..... COASTAL PROTECTION AND RESTORATION AUTHORITY
EADD ..... EXPECTED ANNUAL DAMAGE IN DOLLARS
EASD ..... EXPECTED ANNUAL STRUCTURAL DAMAGE
FWMP ..... FUTURE WITH MASTER PLAN
FWOA ..... FUTURE WITHOUT ACTION
FWRO ..... FUTURE WITH RISK REDUCTION ONLY
GIWW ..... GULF INTRACOASTAL WATERWAY
HSDRRS ..... HURRICANE STORM DAMAGE AND RISK REDUCTION SYSTEM
ICM ..... INTEGRATED COMPARTMENT MODEL
IPET ..... INTERAGENCY PERFORMANCE EVALUATION TASKFORCE
MTTG ..... MORGANZA TO THE GULF
SLR ..... SEA LEVEL RISE

1.0 INTRODUCTION

1.1 PURPOSE OF THIS REPORT

This report describes simulation modeling results projecting future coastal flood risk and damage. The document presents an analysis of interactions between structural risk reduction projects and coastal restoration projects. This is based on comparisons between the future without action (FWOA) landscape, the future with master plan (FWMP) landscape, and a landscape in which only the 2023 Coastal Master Plan's structural risk reduction projects have been implemented (future with risk only, or FWRO); no restoration projects are present, and protection projects are assumed to be implemented in keeping with the Coastal Master Plan's recommended implementation schedule. Because fewer projects are assumed to be implemented in 2040 (Year 20) than 2070 (Year 50), and because many restoration projects require years or decades to achieve their desired impacts on the landscape, the risk profiles of the FWMP and FWRO cases are nearly identical in 2040. For that reason, this report focuses on discussion of results in the year 2070.

Results are presented for two scenarios representing different rates of future sea level rise (SLR), changes to hurricane intensity, and other key environmental factors. Flood damage results reflect a single scenario of projected future population change in Louisiana's coastal parishes. These conditions serve as a baseline against which individual risk reduction projects and the 2023 Coastal Master Plan can be compared to evaluate benefits. However, the scenarios shown represent only two of many possible futures for the Louisiana coast and should be interpreted as plausible projections rather than likely predictions for future flood risk outcomes. Results described in this analysis were simulated with the Coastal Louisiana Risk Assessment (CLARA) model to inform the development of Louisiana's 2023 Coastal Master Plan.

This document presents and describes results for five different regions of Louisiana's coast: Pontchartrain/Breton, Barataria, Terrebonne, Central Coast, and the Chenier Plain. This approach is consistent with the presentation of biophysical outcomes from the Integrated Compartment Model (ICM), which served as a key input for this analysis. This report should be of interest to the Coastal Protection and Restoration Authority (CPRA) and technical professionals and researchers in the field of flood risk assessment.

1.2 THE CLARA MODEL

The CLARA model was originally created by researchers at RAND Corporation to support development of Louisiana's 2012 Coastal Master Plan. It is designed to estimate flood depth exceedances, direct economic damage exceedances, expected annual damage in dollars (EADD), and expected annual structural damage (EASD) in the Louisiana coastal zone. The model uses high-resolution hydrodynamic

simulations of storm surge and waves as inputs. Monte Carlo simulation is used to estimate risk under a range of assumptions about future environmental and economic conditions and with different combinations of structural and nonstructural risk reduction projects on the landscape.

The CLARA model is well described in prior peer-reviewed and published literature, so this report does not include detailed descriptions of the basic methodological approach and assumptions. For interested readers, an introduction to the model can be found in Johnson et al. (2023), Fischbach et al. (2012), and Johnson et al. (2013). Model improvements for the 2017 Coastal Master Plan are described in Fischbach et al. (2017), and published examples of CLARA model results can be found in Fischbach et al. (2019), Meyer and Johnson (2019), and Fischbach et al. (2017). Model improvements for Louisiana's 2023 Coastal Master Plan are described in Fischbach et al. (2021). Finally, an overall summary of the CLARA methodology as applied in the 2023 analysis can be found in Johnson et al. (2023).

CLARA estimates flood depths at different annual exceedance probabilities (AEPs; e.g., 1% annual chance or 1 in 100-year flood depth) for grid cells across the Louisiana coast. In addition to depth results, two primary metrics are presented for flood exposure and damage estimates from the CLARA model in this report: 1) the exposure of single family residences to flooding at one of three severity thresholds; and 2) projected flood damage across all asset types summarized as EADD or EASD, an alternate metric designed to be less sensitive to high-value assets in comparatively wealthier areas. The exposure thresholds are based on flood depths with a 2% (1 in 50-year) chance of occurring, and the comparisons are based on a structure inventory estimated for Year 0 that does not vary over time.[1] The thresholds include:

- **Structures Where Flooded**: CLARA model projections show non-zero flood depths for the grid cell in which the structure is located.
- **Moderate Exposure:** CLARA model projections show flood depths above the first-floor elevation of the structure — a threshold beyond which moderate to major damage is expected to occur.
- **Severe Exposure**: CLARA model projections show flood depths that are 2 or more feet above the first-floor elevation of the structure — major damage to structure and contents would be expected.

[1] CLARA damage estimates take into account population change over time (see Hauer et al., 2022), but these changes are not directly incorporated into the inventory of structures. As a result, structure exposure is based on the inventory at Year 0, and the number of structures remains fixed over the period of analysis. For more information, see Fischbach et al. (2021).

Results are mapped for each community and summarized across the region as a whole. Mapped exposure results highlight the percent of homes at or above the moderate exposure threshold. Methods used for estimating EADD and EASD with CLARA are described in separate reports (Fischbach et al., 2021; Johnson et al., 2023).

1.3 ORGANIZATION OF THIS REPORT

This report is organized around five regions identified for coastal Louisiana (from east to west): Pontchartrain/Breton, Barataria, Terrebonne, Central Coast, and the Chenier Plain. Each chapter first provides an overview of the region, focusing on the structural risk reduction and coastal restoration projects recommended for construction in each implementation period. Ensuing sections discuss the impact of restoration projects on the regional topography and bathymetry, CLARA estimates of flood depths at different AEPs with and without the restoration and structural risk reduction projects, and risk estimates summarized as EADD, EASD, and exposure in differentially impacted communities. Each chapter concludes with a discussion of highlights and key themes from the new analysis.

2.0 PONTCHARTRAIN/BRETON

The Pontchartrain/Breton region is bounded on the east by two sounds of the Gulf of Mexico, Breton Sound and Chandeleur Sound and on the west by the Mississippi River. The lower extent of the region also contains the active Mississippi River Delta. The ecology of the region is dominated by coastal intertidal areas, including intermediate, brackish, and saline marshes, and subtidal and submerged bottoms, including subtidal soft bottoms and submerged aquatic vegetation, with human development concentrated along the limited high ground. Much of this development centers on the Mississippi River and the north shore of Lake Pontchartrain and includes a combination of urban, suburban, and rural/agricultural development. This includes the New Orleans Metropolitan Area, with a highly concentrated population of 1.2 million persons. North of Lake Pontchartrain, most of the development occurs along a series of Pleistocene terraces, the oldest and highest of each are located in the Florida Parishes stretching from East Baton Rouge Parish to St. Tammany Parish. This includes the North Shore suburban communities of Mandeville, Covington, Abita Springs, Madisonville, Pearl River, Lacombe, and Slidell.

While the elevation of the Pleistocene terraces provides a degree of protection from coastal storm and riverine flood events for many of the communities located on the North Shore, the communities located along the Mississippi River are reliant upon additional structural protection (Figure 1). A series of federal river levees and floodwalls reinforce the natural levees of the Mississippi River, providing protection from riverine flooding for communities in the Pontchartrain/Breton region from the River Parishes to the Mississippi River Delta. In addition, the Greater New Orleans Hurricane and Storm Damage Risk Reduction System (HSDRRS), a series of levees and floodwalls engineered to provide a 100-year level of risk reduction against tropical events and related rainfall and storm surges, was constructed following Hurricane Katrina to protect the densely populated locations within Orleans, Jefferson, St. Bernard, St. Charles, and Plaquemines parishes.

2.1 2023 COASTAL MASTER PLAN PROJECTS

Twenty-three projects have been selected for the Pontchartrain/Breton region in the 2023 Coastal Master Plan (Figure 1). These projects include 15 marsh creation projects, two ridge restoration projects, two river diversions, and one hydrologic restoration project; these are intended to maintain important landscape features and functions, such as a broad estuarine gradient. Structural risk reduction projects were selected that benefit several communities on the east bank of the Mississippi River as well as communities on the North Shore, which are expected to face significantly increased storm surge-based flood risk into the future. The major structural protection projects include the Lake Pontchartrain Barrier, Slidell Ring Levees, Braithwaite to White Ditch levee improvements, and new construction of the St. James-Ascension Parishes Storm Surge Protection system spanning from Geismar to Gramercy.

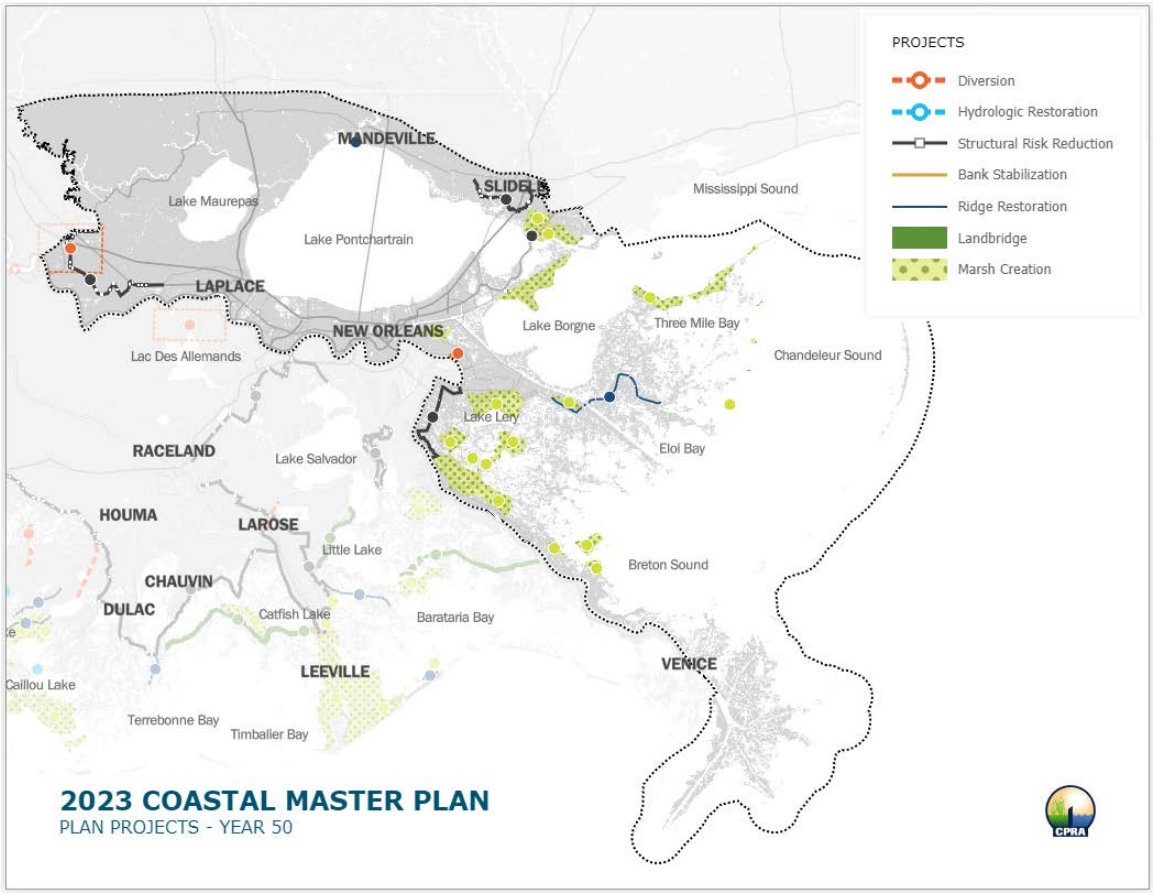

Figure 1. 2023 Coastal Master Plan projects located in the Pontchartrain/Breton region.

2.2 IMPACTS ON LANDSCAPE ELEVATIONS

ICM results show increased land elevations through many of the marshy areas of the Pontchartrain/Breton region over the first portion of the 50-year simulation period, which correspond to more surface roughness and bottom friction for storms traveling over these areas (Figure 2). These increased friction and topographic values are expected to decrease the ability of storm surge to move inland. However, by Year 50, the models indicate less of an effect. At that time, topographic elevations are projected to increase by about 1 foot around Lake Catherine and the Rigolets. Greater increases of 3 to 4 feet are projected between Delacroix and Braithwaite, although grid cells immediately soundward of the Braithwaite levees may decrease by approximately 1 foot.

Despite these changes in topography and frictional characteristics, Advanced Circulation model (ADCIRC) simulations project that SLR is the most influential factor in increasing water levels, storm

surge, and waves. Under the lower and higher scenarios, increasing sea level will lead to greater peak water surface elevations and peak wave heights in the region.

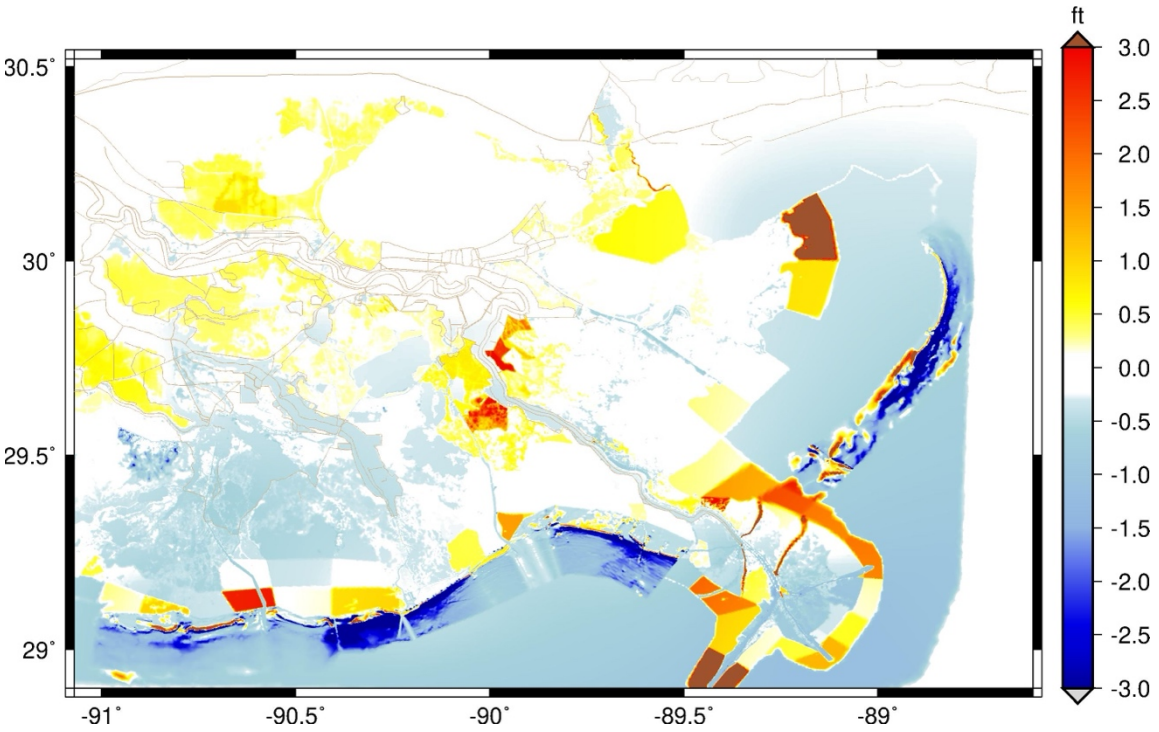

Figure 2. Change in topographic elevation in the higher scenario in Year 20.

2.3 FLOOD DEPTH IMPACTS

CLARA simulations for the Pontchartrain/Breton region show increases in both the extent and depth of flooding over the 50-year period of analysis across the region. In a FWOA, flood depths increase linearly over time in the lower scenario, but in the higher scenario, flood depth trends accelerate over time, particularly in the period between Years 40 and 50. The highest hazard, today and in future, are in the less populated eastern and more coastward parts of the region, including the marshy areas of the Breton Sound Basin in Plaquemines and St. Bernard parishes and fishing villages such as Delacroix and Yscloskey. These communities are already at extremely high risk, but the densely populated elevated land along the Mississippi River, and atop the Pleistocene terrace stretching from the North Shore in St. Tammany Parish west to East Baton Rouge Parish, are expected to show notable increases through the 50-year simulation period even with the master plan's risk reduction projects in place (Figure 3 and Figure 4).

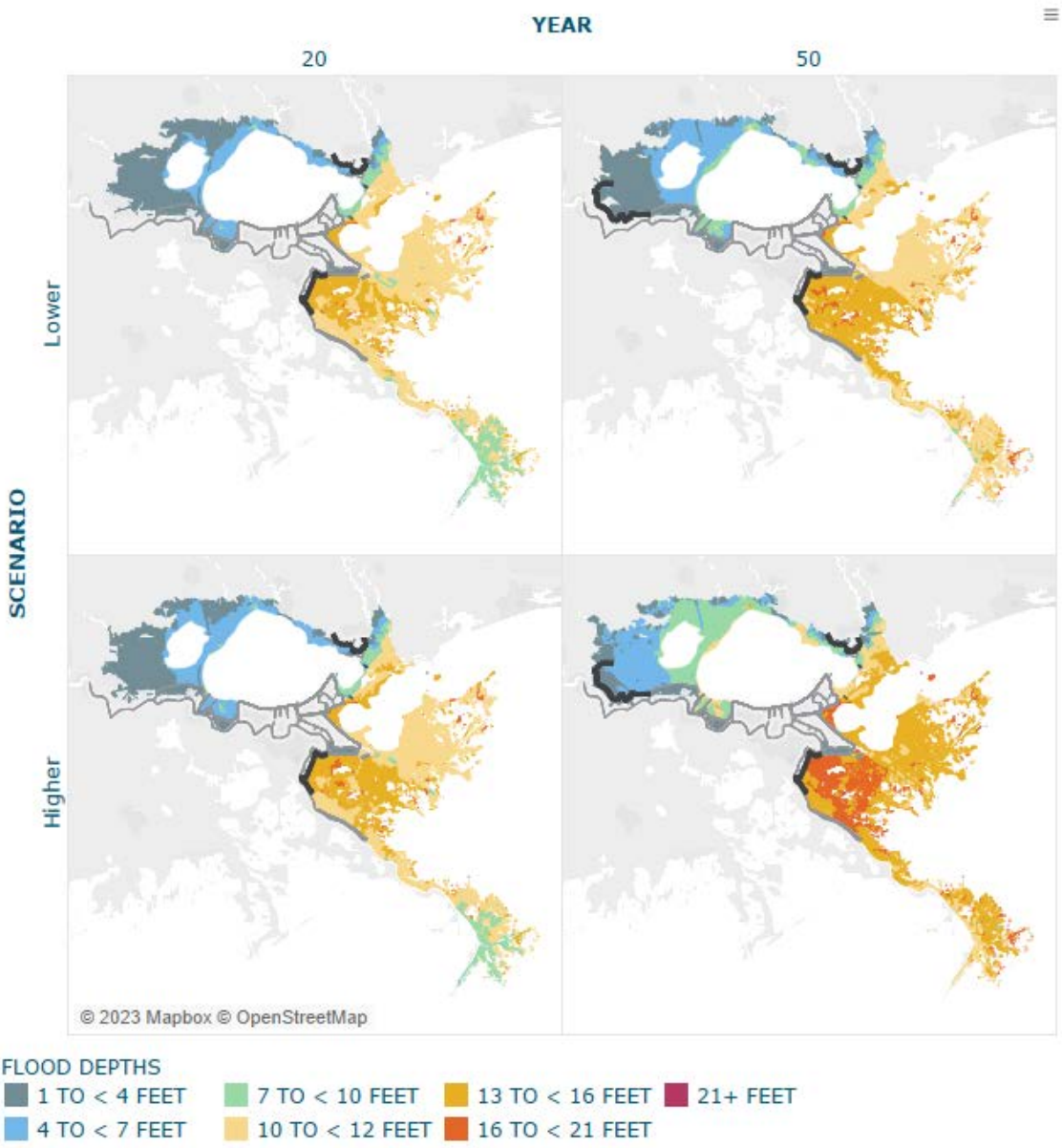

Figure 3. Risk Reduction Only Projects 10% (1 in 10-year) AEP flood depths in Years 20 and 50 in the Pontchartrain/Breton region — Interagency Performance Evaluation Taskforce (IPET) fragility, 50% pumping scenario, 50th percentile.

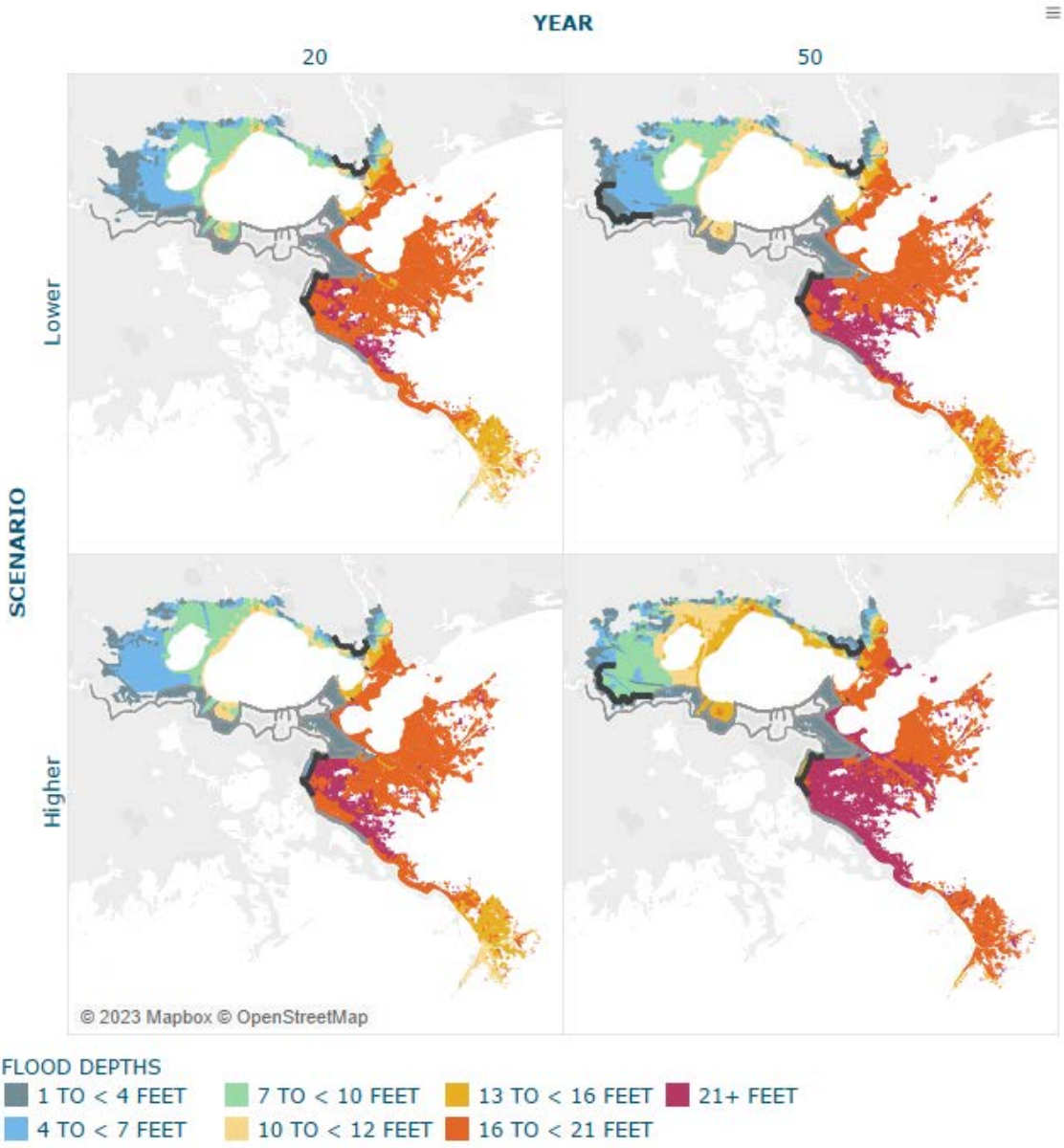

Figure 4. Risk Reduction Only Projects 1% (1 in 100-year) AEP flood depths in Years 20 and 50 in the Pontchartrain/Breton region —IPET fragility, 50% pumping scenario, 50th percentile.

Figure 5 shows the difference between FWRO and FWMP flood depths. Brown shades indicate areas where the FWMP reduces flood depths further than the FWRO. Substantial reductions in 10% AEP and 1% AEP flood depths in the master plan, compared to the FWRO case, are primarily concentrated in

sparsely populated areas of St. Bernard Parish between Braithwaite and Delacroix (Figure 5). These reductions range up to 6 feet in both the lower and higher scenarios, and smaller reductions of 1 to 3 feet also occur around Lake Catherine and the Rigolets. Minor reductions in the 1% AEP flood depths are also projected in the area north of lakes Pontchartrain and Maurepas for Year 50 of the higher scenario (Figure 6).

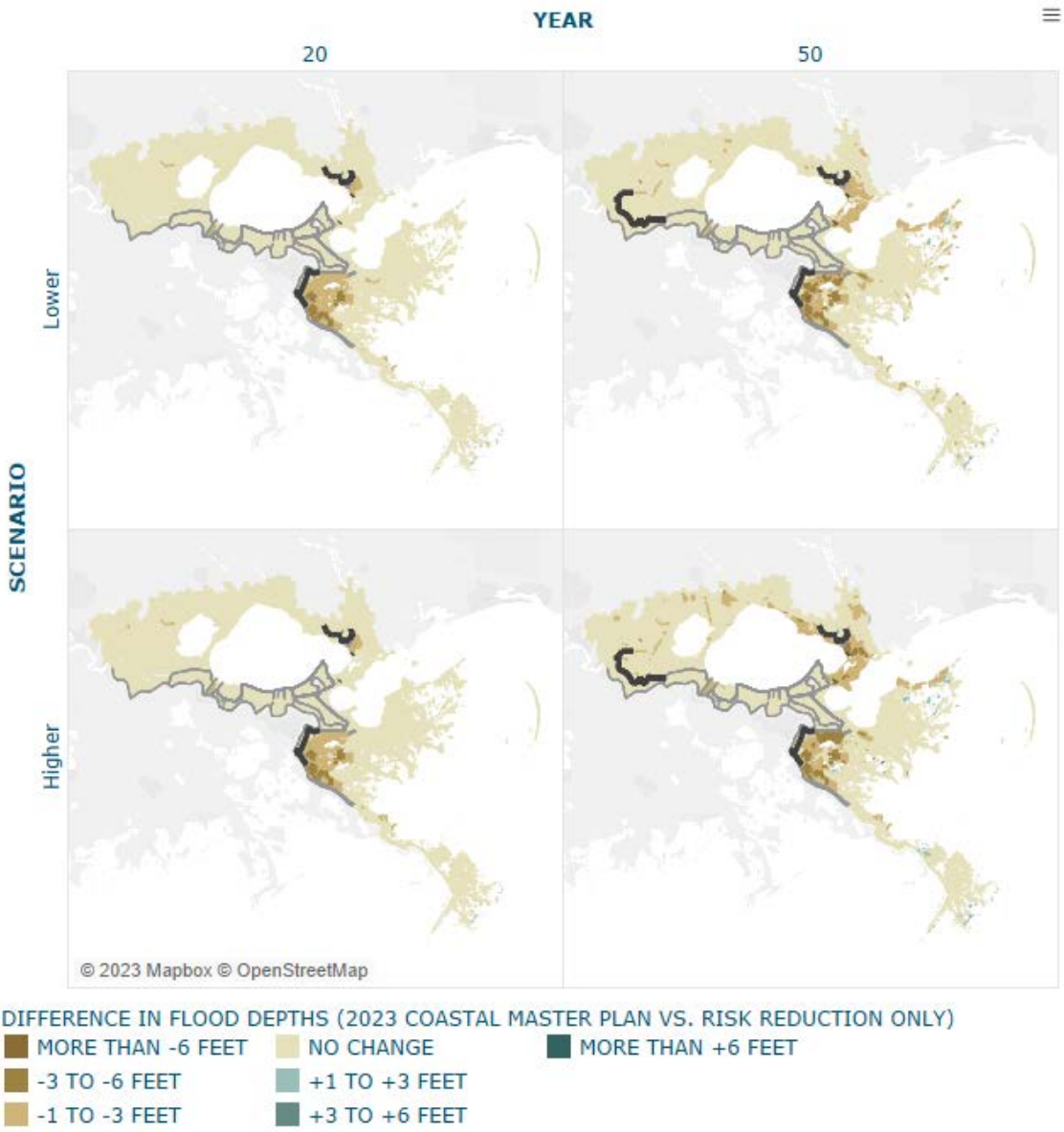

Figure 5. Difference in 2023 Coastal Master Plan and Risk Reduction Only Projects 10% (1 in 10-year) AEP flood depths in Years 20 and 50 in the Pontchartrain/Breton region — IPET fragility, 50% pumping scenario, 50th percentile.

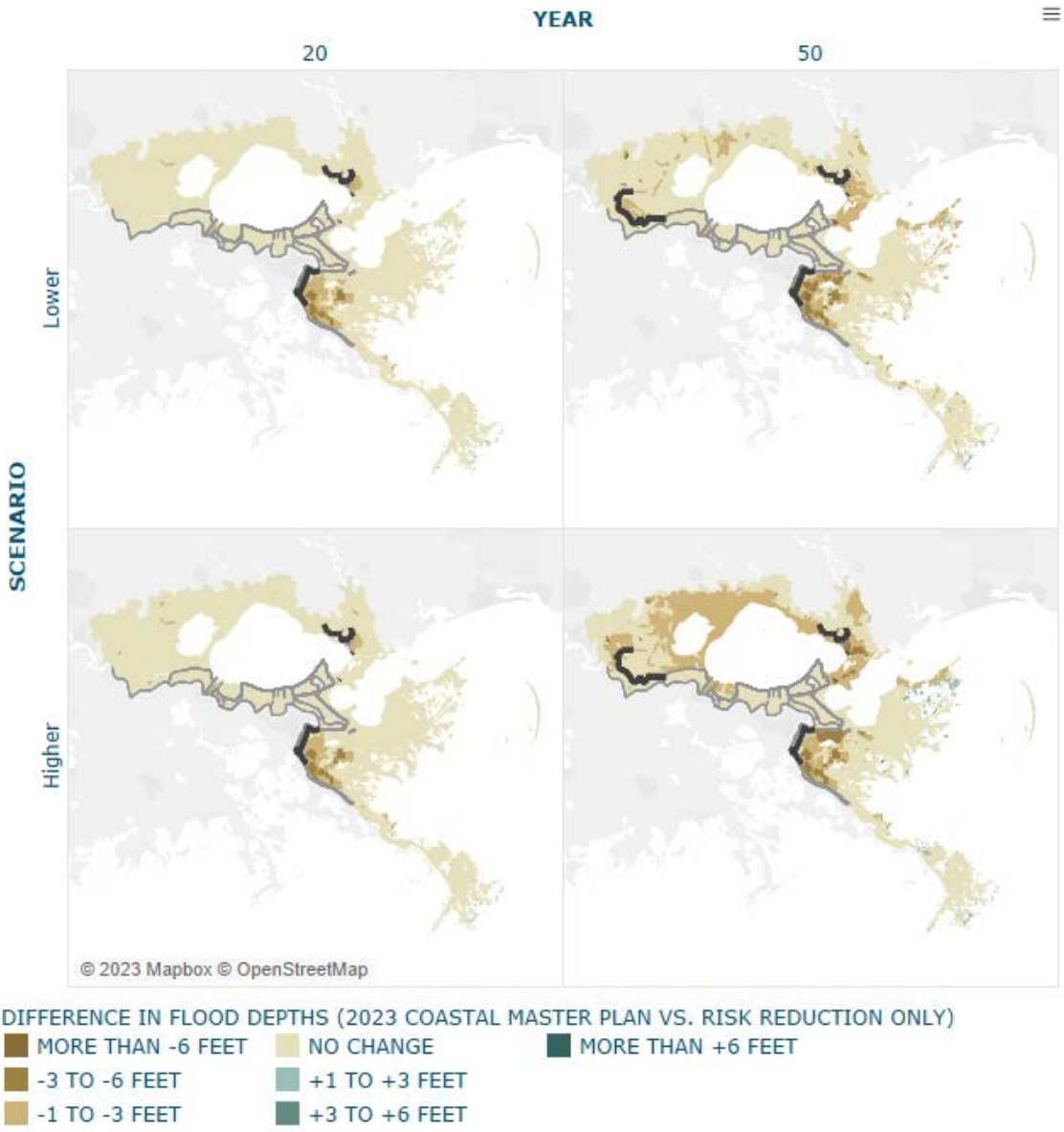

Figure 6. Difference in 2023 Coastal Master Plan and Risk Reduction Only Projects 1% (1 in 100-year) AEP flood depths in Years 20 and 50 in the Pontchartrain/Breton region — IPET fragility, 50% pumping scenario, 50th percentile.

2.4 FLOOD DAMAGE IMPACTS

Collectively, risk reduction in the Pontchartrain/Breton region is primarily provided by structural protection projects, as might be expected by the four major projects selected by the master plan (Figure 7). In the FWRO case, these projects reduce Year 50 EADD and EASD by approximately 31% in both the lower and higher scenarios compared to a FWOA. The marginal risk reduction associated with implementing the master plan restoration projects is an order of magnitude smaller, approximately 3% in the lower scenario and 5% in the higher scenario.

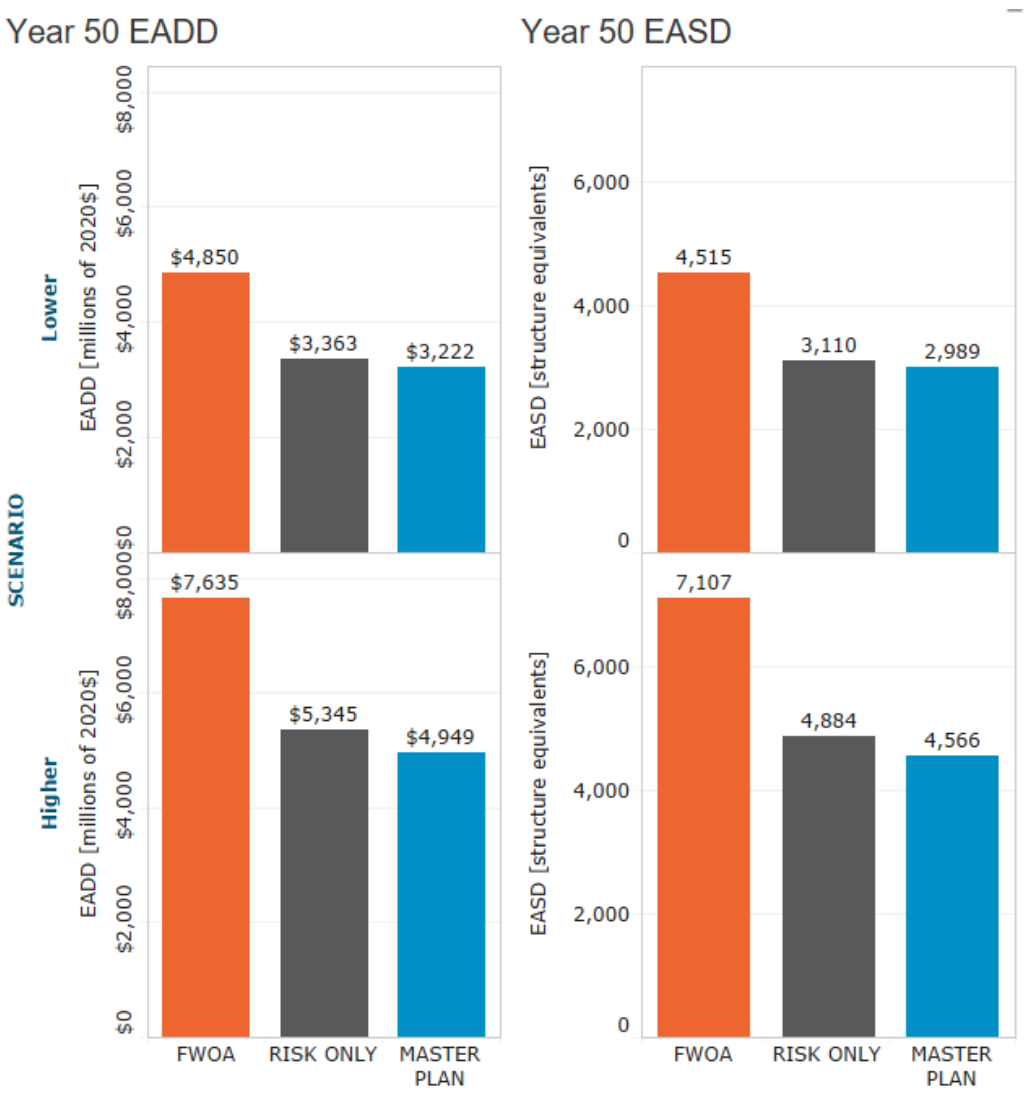

Figure 7. EADD and EASD comparison in Year 50 in the Pontchartrain/Breton region — IPET fragility, 50% pumping scenario, 50th percentile.

Figure 8 presents maps showing the additional EADD reduction by community from the restoration projects in the FWMP when compared to FWRO damage reduction alone. Green shades illustrate areas where the FWMP yields additional EADD reduction, while orange/red shades indicate where the FWMP EADD is higher than FWRO. Figure 8 shows that risk reduction from the coastal restoration projects is fairly small in Year 20, with Slidell actually experiencing a small increase in risk for both scenarios. However, by Year 50, restoration projects produce meaningful reductions in EADD and EASD. The majority of this impact accrues to North Shore communities such as Slidell, Mandeville, and Covington. In the higher scenario, however, appreciable benefits are even seen within HSDRRS in communities like Kenner, and west of Lake Maurepas extending into Ascension Parish. This is notable because these areas do not experience changes in topobathy elevations; the reductions are attributable to restoration projects at the mouth of Lake Pontchartrain like the Fritchie North and New Orleans East marsh creation projects.

Interestingly, the marginal reduction in overall EADD and EASD does not translate into a commensurate reduction in exposure at the 2% AEP level. The master plan is projected to yield a modest increase in the number of single family residences not exposed to inundation at the 50-year return period, but the shifts between exposure levels are less than 1% of the totals in the FWRO case. This is likely because much of the additional EADD/EASD benefit from restoration is coming from depth reduction at higher AEP levels (e.g., 10% AEP) in Pontchartrain, a pattern not as evident in other regions.

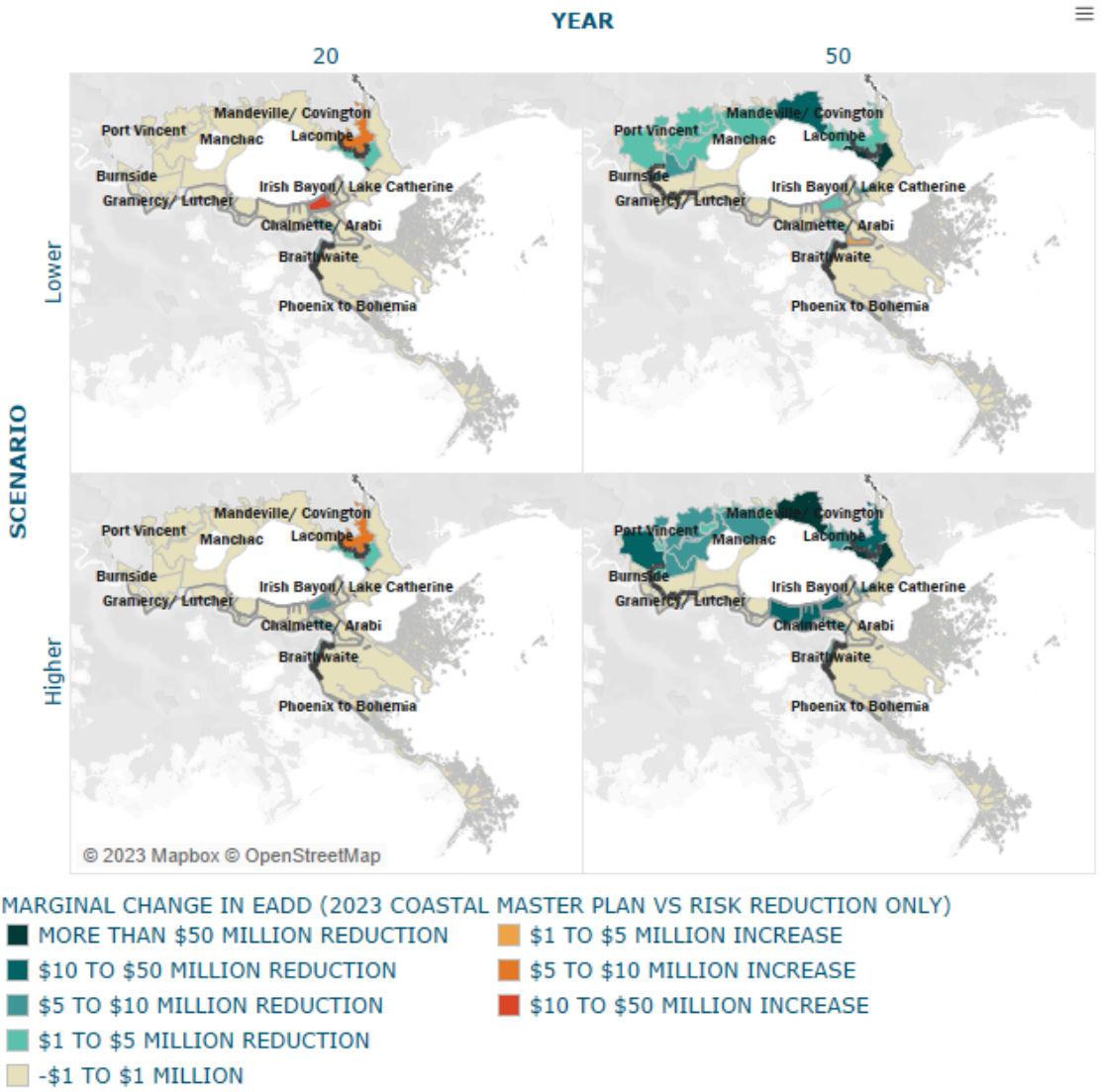

Figure 8. Difference in EADD Between 2023 Coastal Master Plan and Risk Reduction Only Projects in Years 20 and 50 in the Pontchartrain/Breton region — IPET fragility, 50% pumping scenario, 50th percentile.

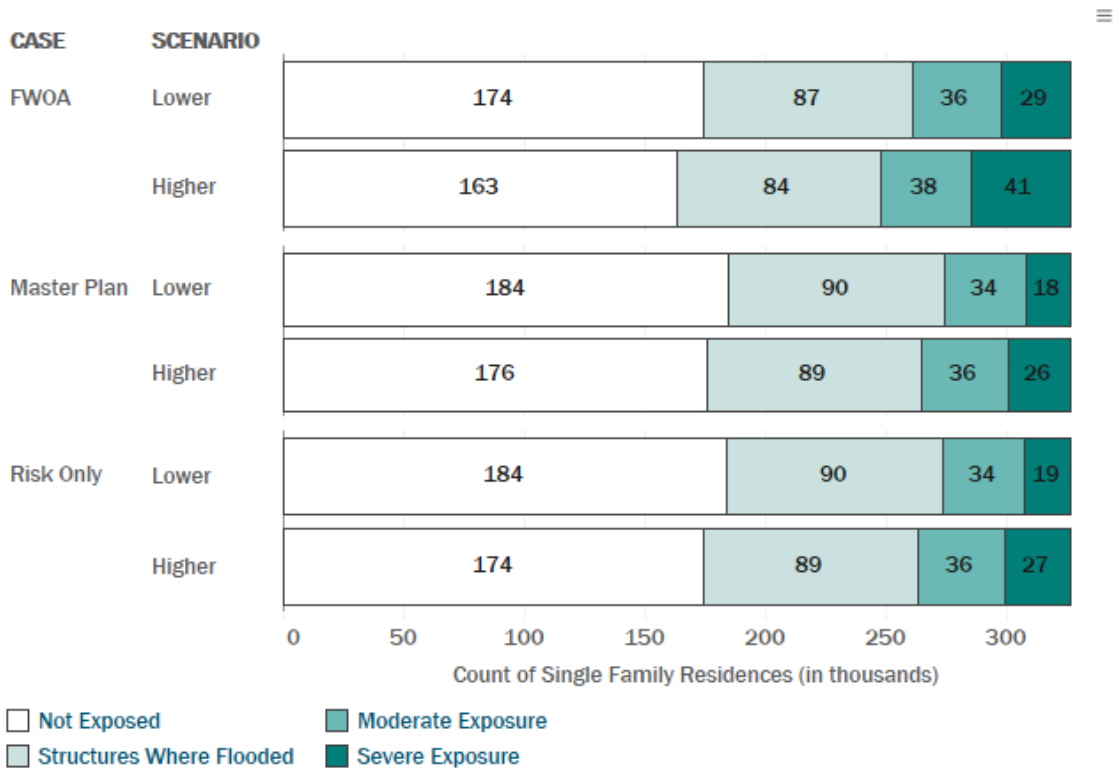

Figure 9. Single family residence structure exposure comparison by scenario in Year 50 in the Pontchartrain/Breton region — IPET fragility, 50% pumping scenario, 50th percentile.

3.0 BARATARIA

The natural elevation of the banks of Bayou Lafourche and the Mississippi River provides a degree of protection from coastal storm and riverine flood events for the communities located along them. However, the proximity of many of these communities to the Gulf makes them especially vulnerable to storm surge and other tropical weather hazards, many of which are powerful enough to overtop the natural levees. In addition, Lake Salvador and many of the interior lakes and waterways between Bayou Lafourche and the Mississippi River provide direct avenues for storm surge to push into the upper portion of the Barataria region and threaten communities in the region.

To address the heightened vulnerability of the Barataria region, many of the communities located along the primary waterways rely upon structural protection. A series of federal river levees and floodwalls reinforce the natural levees of the Mississippi River, providing protection from riverine flooding for communities in the Barataria region from the River Parishes to lower Plaquemines Parish. This includes the heavily urbanized West Bank communities within the New Orleans Metropolitan Area, a location that is further protected by HSDRRS, a series of levees, floodwalls, and gates engineered to provide a 100-year level of risk reduction against tropical events and related rainfall and storm surges. HSDRRS was constructed following Hurricane Katrina to protect the densely populated New Orleans Metropolitan Area, including several West Bank communities such as Algiers and Belle Chasse as well as smaller communities in St. Charles Parish such as Ama. Downriver of HSDRRS in Plaquemines Parish, the communities of lower Plaquemines Parish are protected by both non-Federal and Federal levees, including New Orleans to Venice, a Federal levee constructed to HSDRRS standards to provide storm risk reduction to Plaquemines Parish communities on both the east bank and west bank of the Mississippi River.

The Barataria region also contains several densely populated communities located along Bayou Lafourche, many of which are located south of the Gulf Intracoastal Waterway (GIWW). These communities are protected by the Larose to Golden Meadow Hurricane Protection Project, a ring levee approximately 48 miles in length enclosing the areas along the east and west banks of Bayou Lafourche from the GIWW at Larose to just south of Golden Meadow. Designed to provide a 100-year level of hurricane protection, the project also provides for the construction of navigable floodgates on Bayou Lafourche at the upper and lower limits of the project area. Finally, the residents of Grand Isle are protected by a 13-foot-high levee constructed by the U.S. Army Corps of Engineers in 2010. Commonly known as the burrito levee, this 7.7-mile-long feature is designed to protect the 1,700 structures on the island from a surge event with a 2% chance of occurring in any year.

3.1 2023 COASTAL MASTER PLAN PROJECTS

The 2023 Coastal Master Plan selects 13 projects located in the Barataria region (Figure 10), with six being marsh creation and two being diversions that could produce appreciable land gain. In addition

to the Upper Barataria Risk Reduction project and Lafitte Ring Levee, two landbridges and two ridge restoration projects are also recommended for the region. The diversions are located in the upper basin and Bayou Lafourche, while the marsh creation projects are in the lower basin south of Lafitte, with the greatest acreage between Golden Meadow and Port Fourchon.

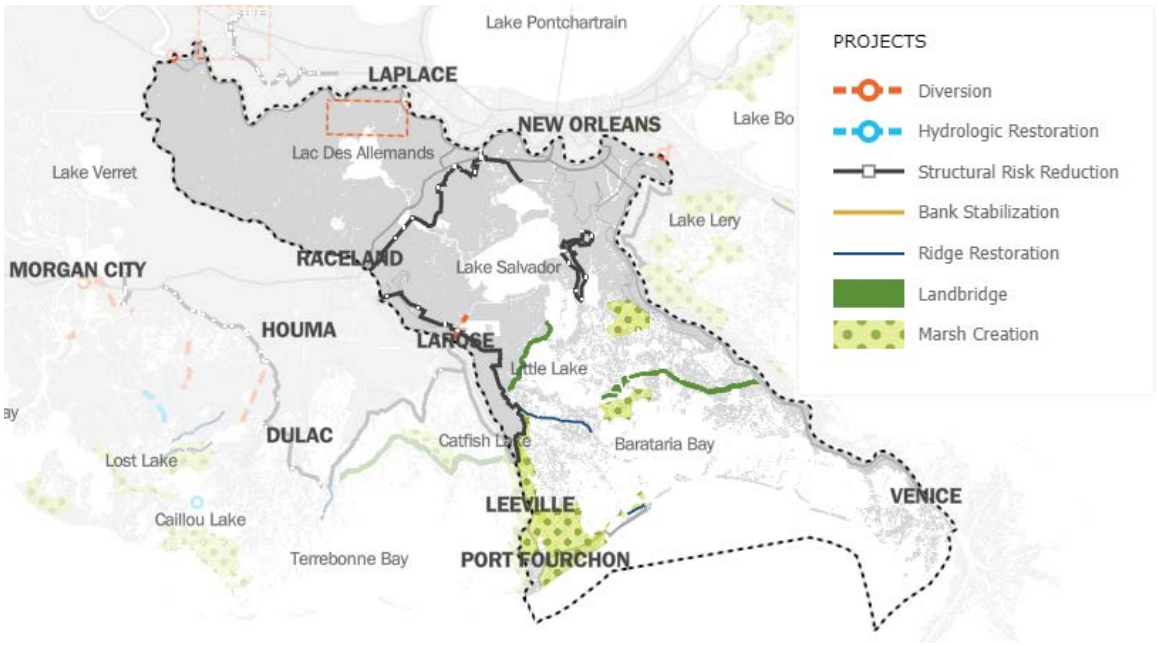

Figure 10. 2023 Coastal Master Plan projects located in the Barataria region.

3.2 IMPACTS ON LANDSCAPE ELEVATIONS

ICM results show that the Barataria and Terrebonne regions have the greatest potential for land gain via coastal restoration projects selected for the master plan, in terms of their impacts on topographic and bathymetric elevations (Figure 11). Between Golden Meadow, Port Fourchon, and Grand Isle, elevations could increase by up to 5 feet with implementation of the SE Golden Meadow, Belle Pass-Golden Meadow, and East Bayou Lafourche marsh creation projects. The swamps north of Little Lake between Cut Off and Lafitte could also see between 1 and 2 feet of additional elevation. Bayou west of Port Sulphur and Diamond are projected to increase elevations by approximately 1 foot in the lower scenario and 2 feet in the higher. Topobathy is virtually unchanged, however, in the Upper Barataria Basin.

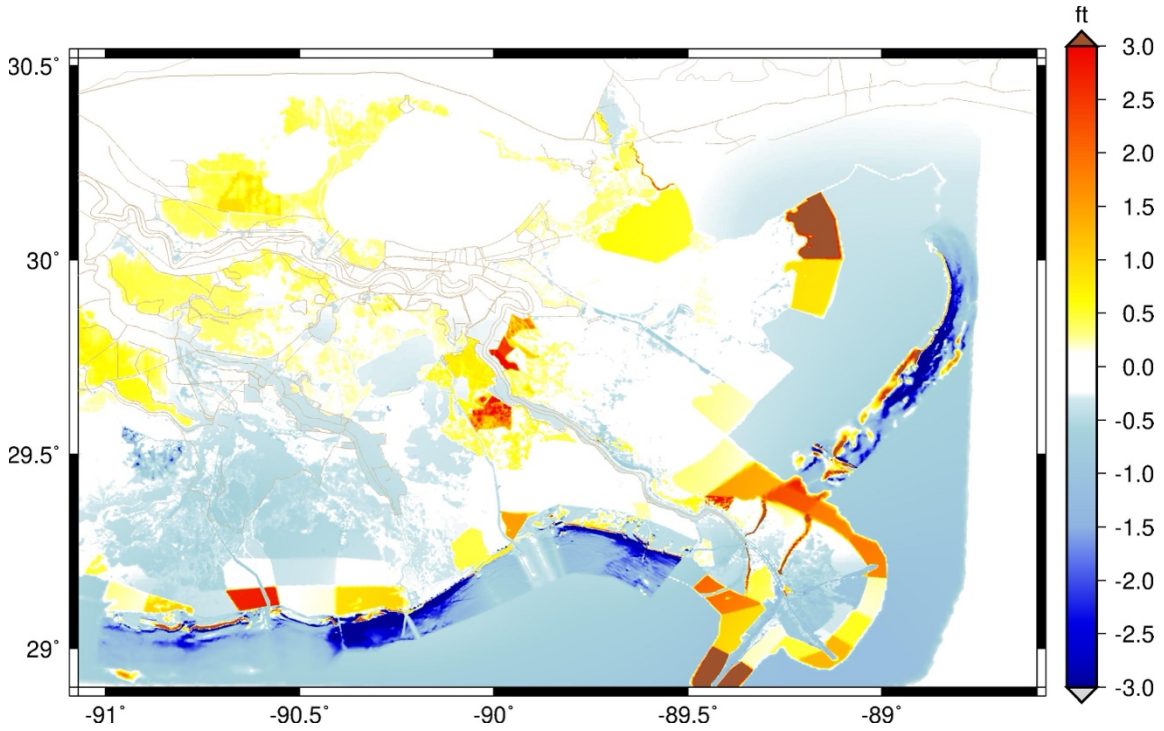

Figure 11. Change in topographic elevation in the higher scenario in Year 20.

3.3 FLOOD DEPTH IMPACTS

Projections for the Barataria region show increases in the extent and depth of flooding over the 50-year period of analysis in each case modeled (Figure 12 & Figure 13). Consistent with the surge and wave results, the most notable change in hazard over time for the FWOA case is the expansion of floodplains in the Upper Barataria region, particularly in the low-lying area between Bayou Lafourche and the Mississippi River. Increased mean sea levels along with higher initial water levels in nearby water bodies such as Lake Salvador allow storm surge to push further inland, encroaching upon agricultural lands bordering populated communities along Bayou Lafourche and the Mississippi River and nearly reaching Donaldsonville at the head of Bayou Lafourche.

The Upper Barataria Risk Reduction project is slated for implementation beginning in Year 11. In Year 20 for both environmental scenarios, the project is estimated to lower 1% AEP flood depths by 1 to 3 feet for most of the area on the northwestern side of the levee (Johnson et al., 2023). The areas closest to the levee should see more substantial depth reductions of 3 to 6 feet. On the unprotected side of the project, flood depths are projected to increase by 1 to 3 feet across the parts of Lafourche, St. Charles, and Jefferson communities outside of the protection system. In Year 50 the pattern is largely similar in the lower scenario, though flood depth reductions of 3 to 6 feet are more widespread across the protected parts of St. Charles and Lafourche, with shallower depths extending further to the

north and west. In the higher scenario, the areas experiencing flooding stretch even further to the west. Additionally, the depth reduction is less than in the lower scenario, with only the areas directly surrounding Lac des Allemands seeing flood depth reduction in the 3 to 6 feet range (the rest of the area sees reductions in the 1 to 3 feet range).

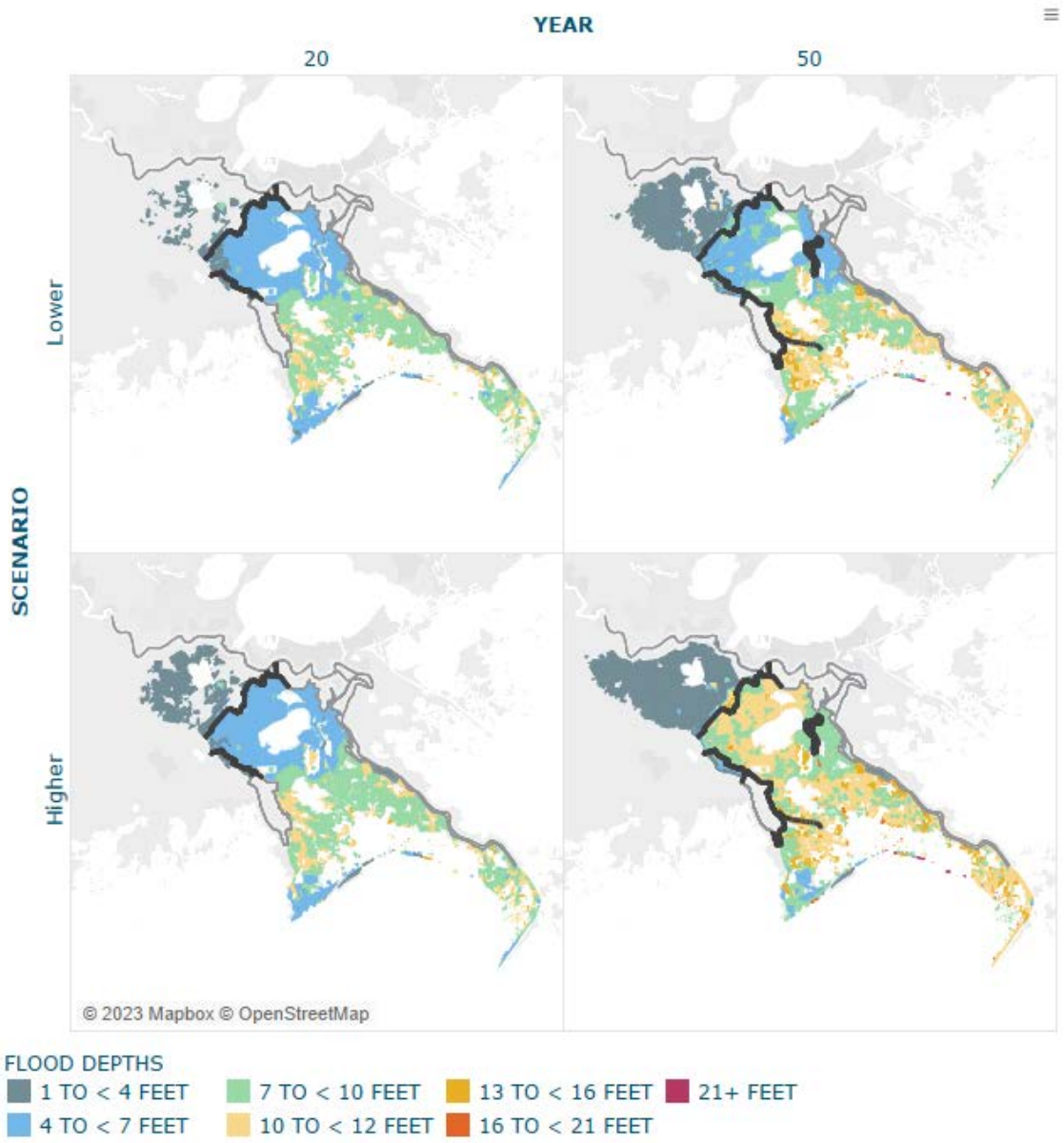

Figure 12. Risk Reduction Only Projects 10% (1 in 10-year) AEP flood depths in Years 20 and 50 in the Barataria region — IPET fragility, 50% pumping scenario, 50th percentile.

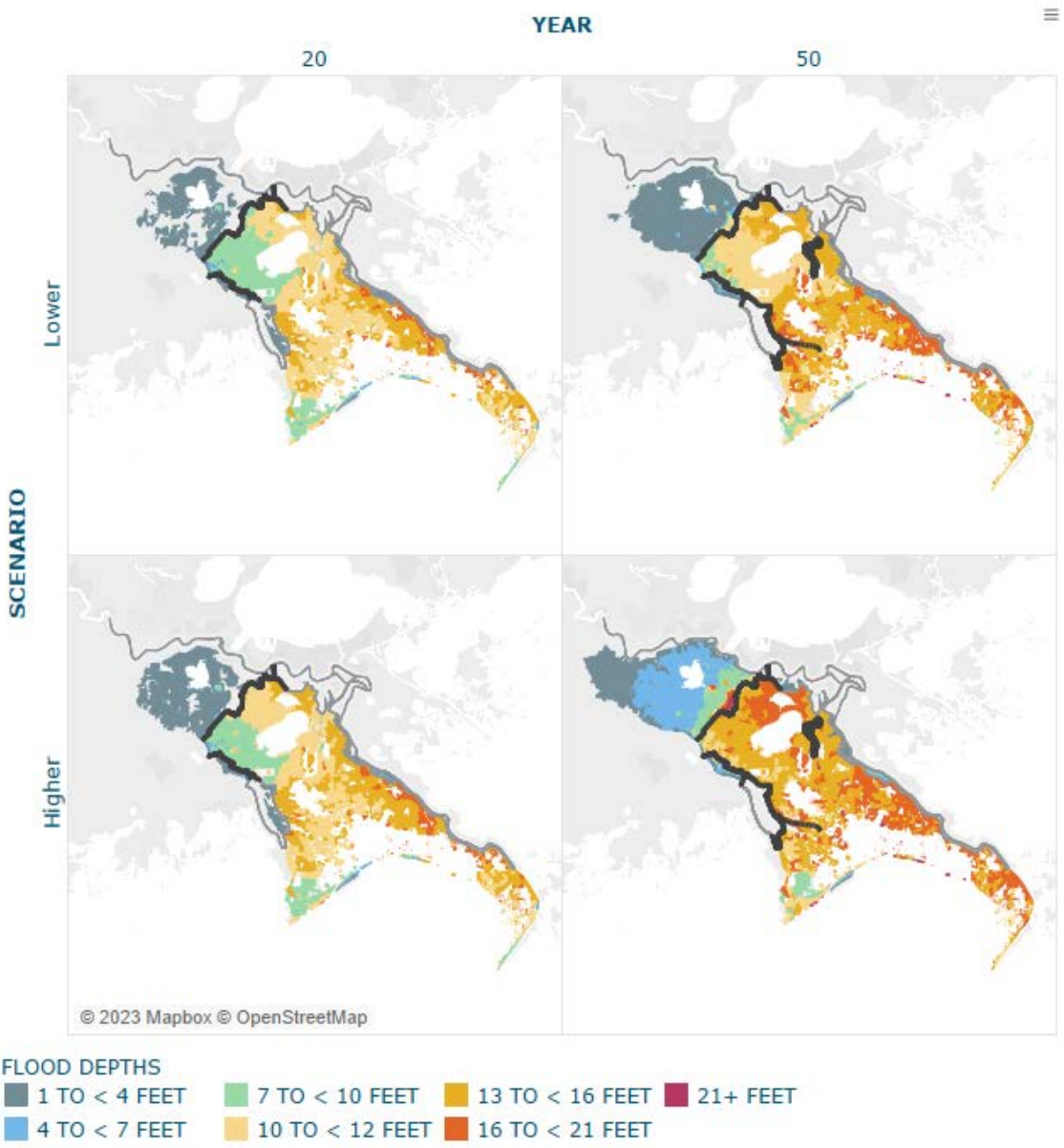

Figure 13. Risk Reduction Only Projects 1% (1 in 100-year) AEP flood depths in Years 20 and 50 in the Barataria region — IPET fragility, 50% pumping scenario, 50th percentile.

Flood depths at the 10-year return period are impacted by restoration projects in several parts of the Lower Barataria Basin (Figure 14). In Year 20 of both scenarios, restoration efforts increase flood depths by 1 to 3 feet directly southeast of Lafitte and Golden Meadow, while depths decrease by up to

6 feet between Port Fourchon and Grand Isle. In the latter area, reductions in some grid cells exceed 6 feet by Year 50, and the areas south of Lafitte and the West Bank leveed communities start to see modest reductions in 10-year flood depths.

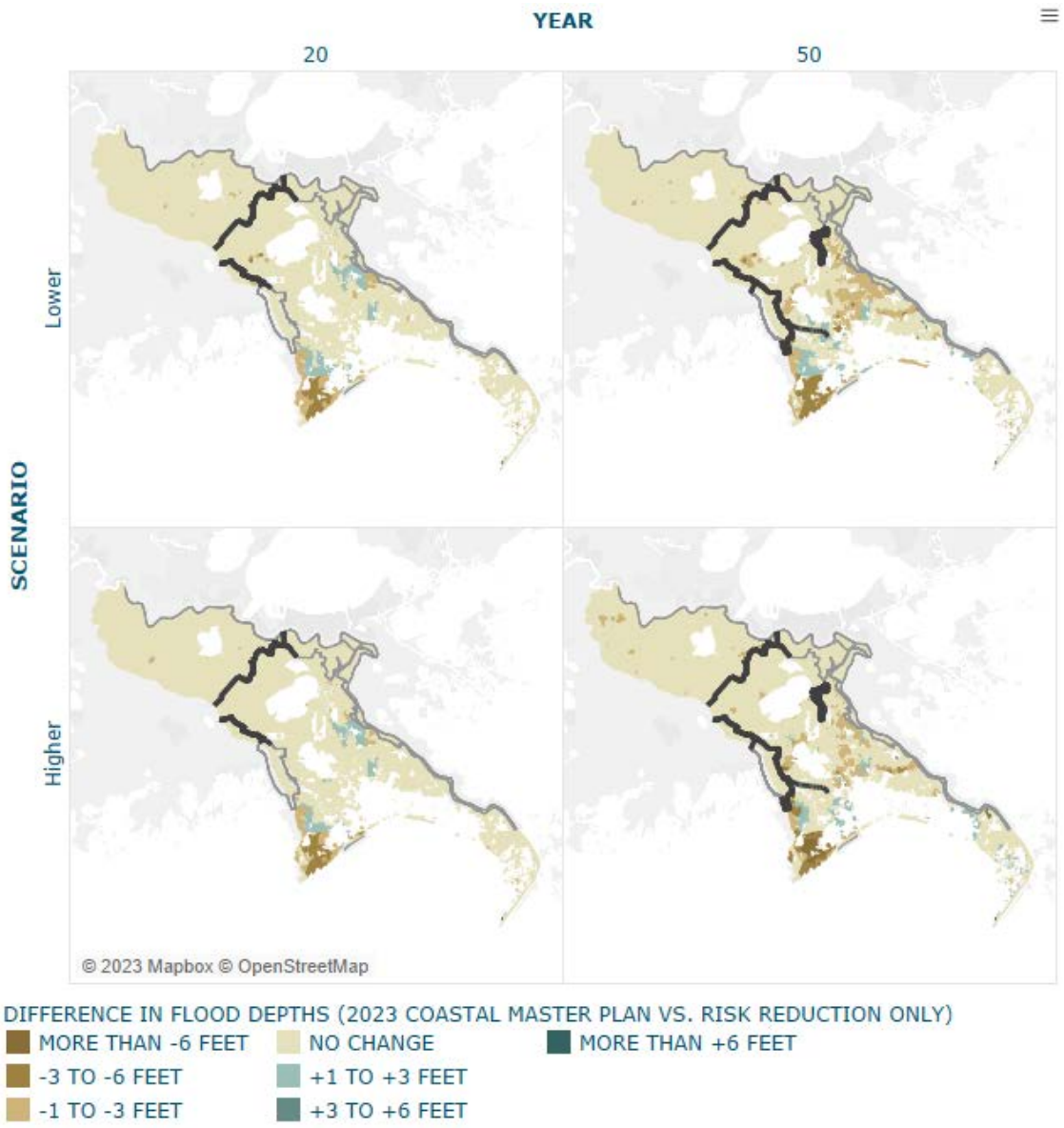

Figure 14. Difference in 2023 Coastal Master Plan and Risk Reduction Only Projects 10% (1 in 10-year) AEP flood depths in Years 20 and 50 in the Barataria region — IPET fragility, 50% pumping scenario, 50th percentile.

Patterns are very similar at the 1% AEP (i.e., 100-year return period) in the Lower Barataria Basin as

the 10% AEP flood depth impacts (Figure 15). By Year 50, however, the restoration projects yield additional reductions of 1 to 3 feet at the 100-year return period higher in the region, behind the Upper Barataria Risk Reduction structural protection project and between lakes Salvador and Cataouatche.

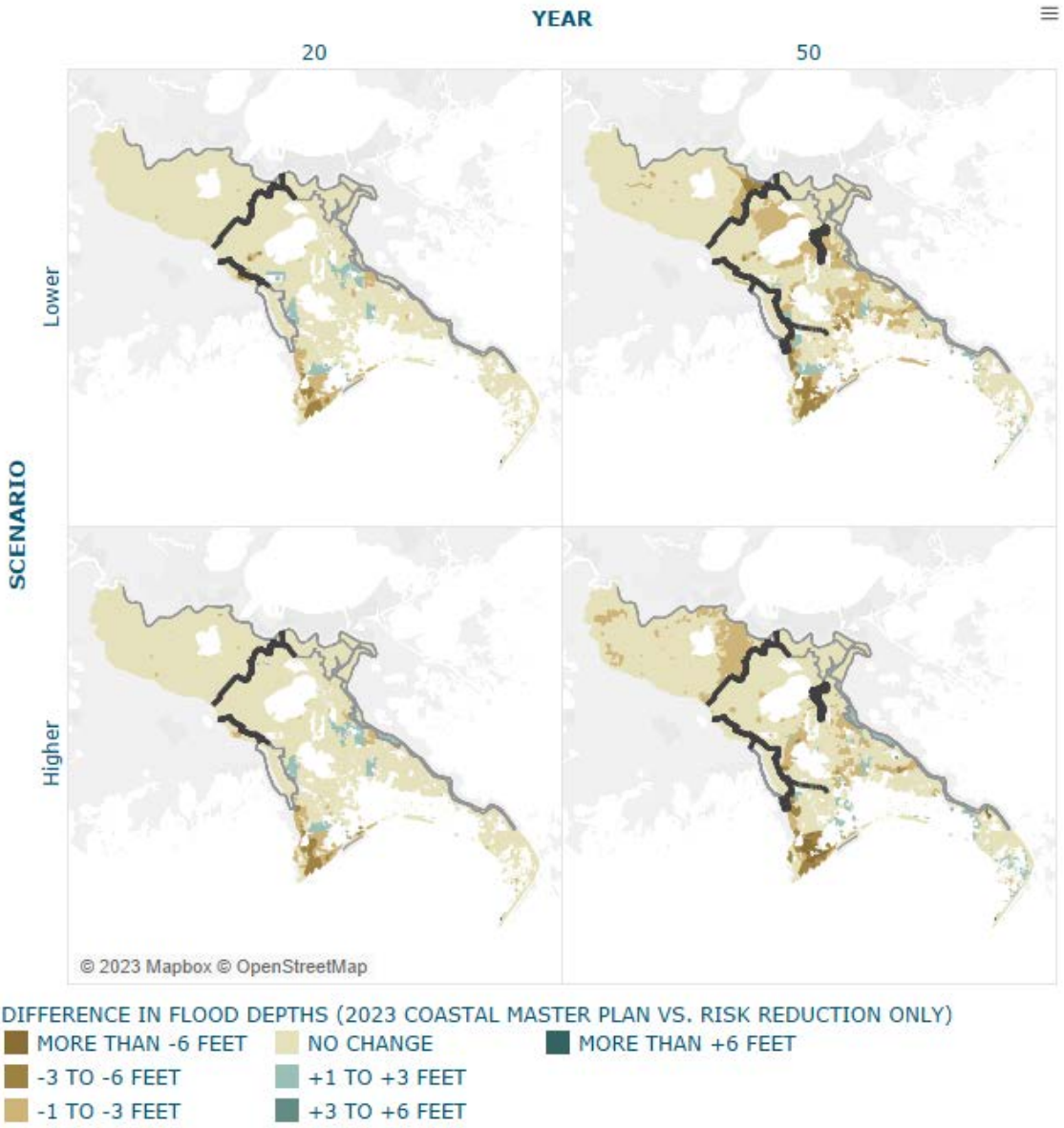

Figure 15. Difference in 2023 Coastal Master Plan and Risk Reduction Only Projects 1% (1 in 100-year) AEP flood depths in Years 20 and 50 in the Barataria region — IPET fragility, 50% pumping scenario, 50th percentile.

3.4 FLOOD DAMAGE IMPACTS

Across the entire Barataria region, Year 50 EADD in a FWOA case is approximately $2.5 billion in the lower scenario and $3.4 billion in the higher (Figure 16). The region's structural flood protection projects reduce that risk by 55% and 38% in the lower and higher scenarios, respectively. The implementation of selected coastal restoration projects only adds a marginal 1.4% of risk reduction on top of that ($34 million in the lower scenario, $50 million in the higher). Protection projects reduce EASD by similar percentages in the FWRO case, but restoration projects only add a further reduction of 0.6% and 0.3% to the master plan's performance.

The geographic distribution of benefits is somewhat complex, due to interactions of marsh creation projects with the region's levee systems (Figure 17). Overall, the greatest benefit accrues to communities also protected by the Upper Barataria Risk Reduction system, thanks to the ability of coastal marsh creation projects to reduce storm surges' progression inland to the upper basin. Communities around Port Fourchon also benefit, although the magnitude is modest due to the low development there. Lower topographic elevations southeast of Lafitte also increase risk in Lafitte and Belle Chasse. Exposure of single family residences in the region to inundation at the 2% AEP are very similar with and without the master plan's coastal restoration projects (Figure 18).

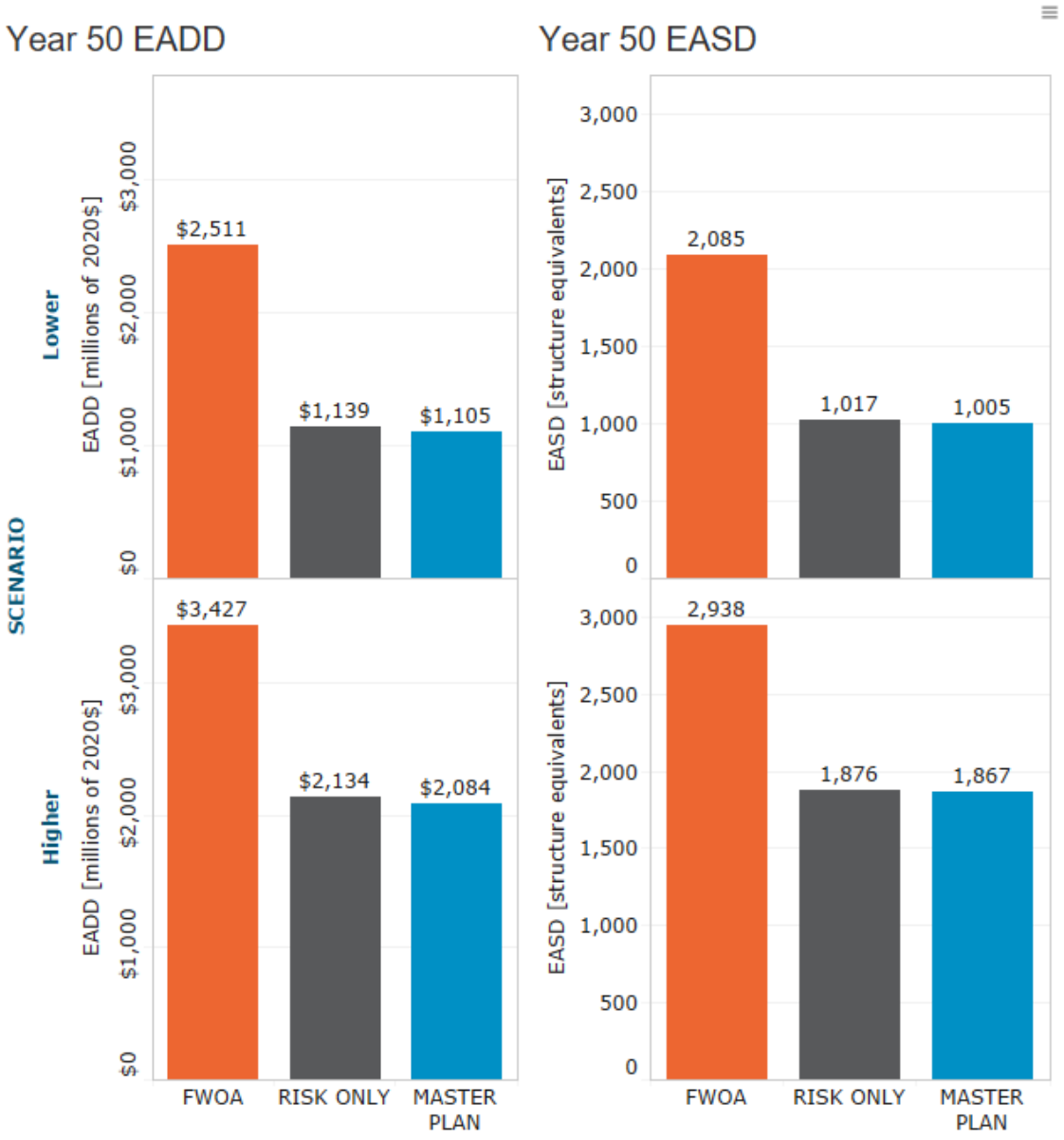

Figure 16. EADD and EASD comparison in Year 50 in the Barataria region — IPET fragility, 50% pumping scenario, 50th percentile.

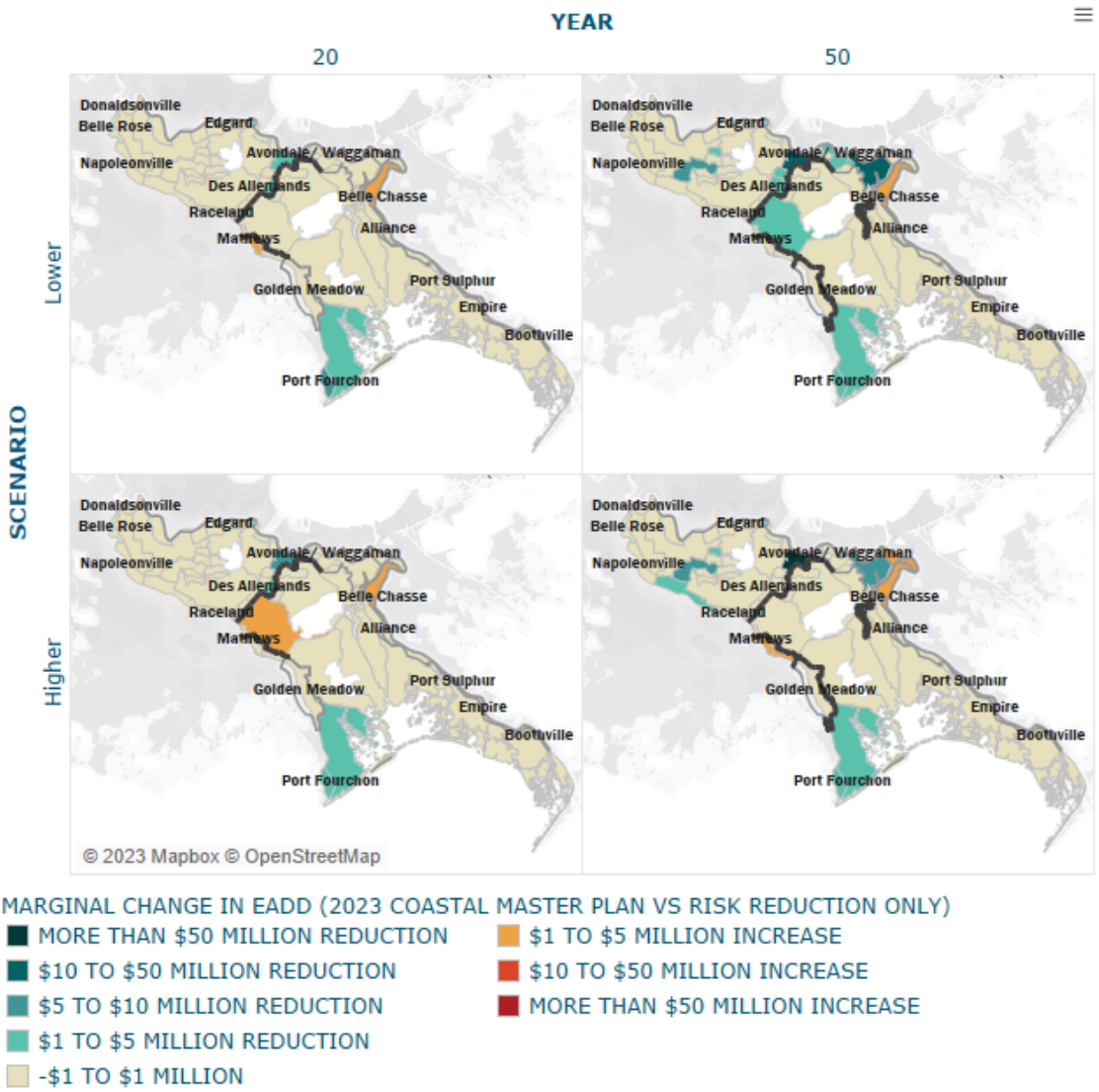

Figure 17. Difference in EADD between 2023 Coastal Master Plan and Risk Reduction Only Projects in Years 20 and 50 in the Barataria region — IPET fragility, 50% pumping scenario, 50th percentile.

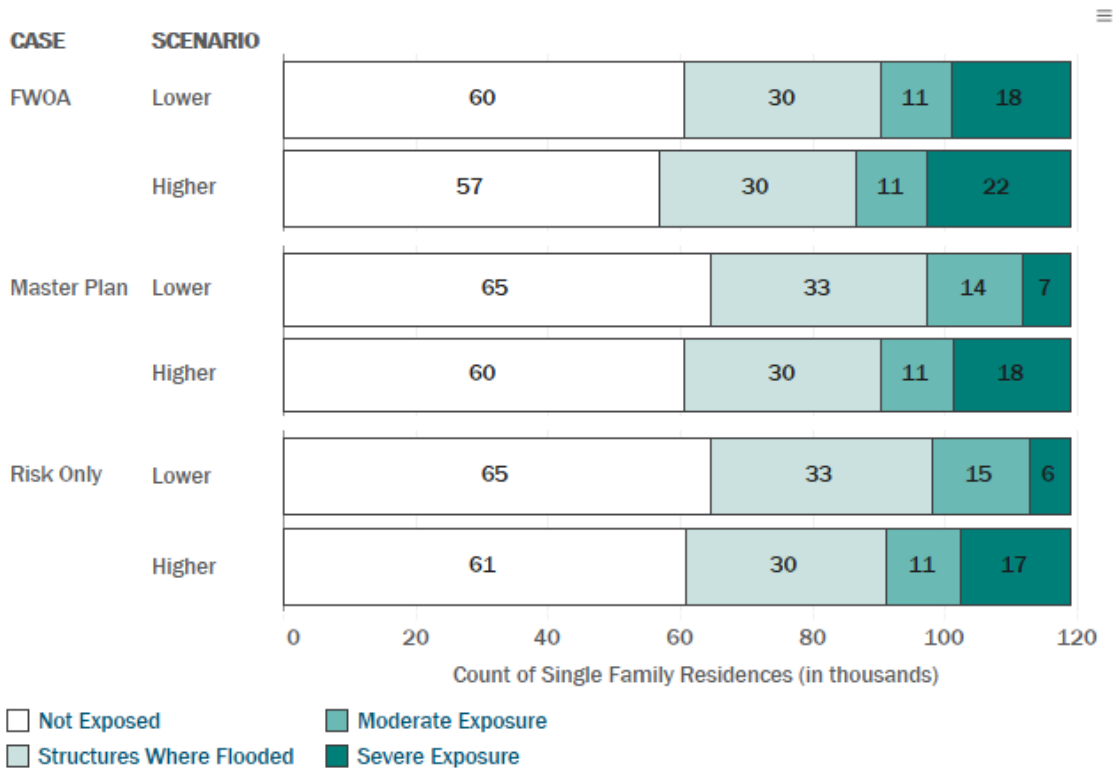

Figure 18. Single family residence structure exposure comparison by scenario in Year 50 in the Barataria region — IPET fragility, 50% pumping scenario, 50th percentile.

4.0 TERREBONNE

The Terrebonne region is bordered on the east by Bayou Lafourche, from Donaldsonville in the north to Port Fourchon in the south. On the west, the region is bounded by Bayou Shaffer and the bank of the Lower Atchafalaya River south of Morgan City to its mouth, then following the shoreline around Atchafalaya Bay to Point au Fer. Due to their high elevation relative to the surrounding landscape, the natural levees along the region's rivers and bayous have historically served as the site of human settlement in the region. In contrast, the lower portion of the region includes a combination of urban, suburban, and rural/agricultural development that transitions to a system primarily consisting of tidally influenced marshes connected to a series of wide, shallow lakes and bays, beyond which are found several chains of barrier islands.

The natural elevation of the distributary ridges of the region provides limited protection from coastal hazards for the communities located along them. The proximity of many of these communities to the Gulf makes them especially vulnerable to storm surge and other tropical weather hazards, many of which are powerful enough to overtop the natural levees. Currently, the Terrebonne region has limited structural protection on the eastern and western boundaries. This includes the Southern East Atchafalaya River Levee on the west and the Larose to Golden Meadow Hurricane Protection Project, a ring levee approximately 48 miles in length protecting communities along the east and west banks of Bayou Lafourche from the GIWW at Larose to just south of Golden Meadow. Bayou Lafourche is the dividing line between the Terrebonne and Barataria regions, with the west bank of the bayou located in the Terrebonne region. Designed to provide a 100-year level of hurricane protection, the Larose to Golden Meadow Hurricane Protection Project also provides for the construction of navigable floodgates on Bayou Lafourche at the upper and lower limits of the project area.

4.1 2023 COASTAL MASTER PLAN PROJECTS

For the 2023 Coastal Master Plan, 17 projects of all types were selected for the Terrebonne region. This includes two hydrologic restoration projects and two landbridges, six marsh creation projects, three ridge restorations, and the Atchafalaya River diversion project. The premier structural protection effort in the region is completion of the Morganza to the Gulf (MTTG) system, at an estimated cost of $3.9 billion. Other protection projects in the FWRO case include improvements to the existing Larose to Golden Meadow system and construction of an 18-foot levee protecting Amelia.

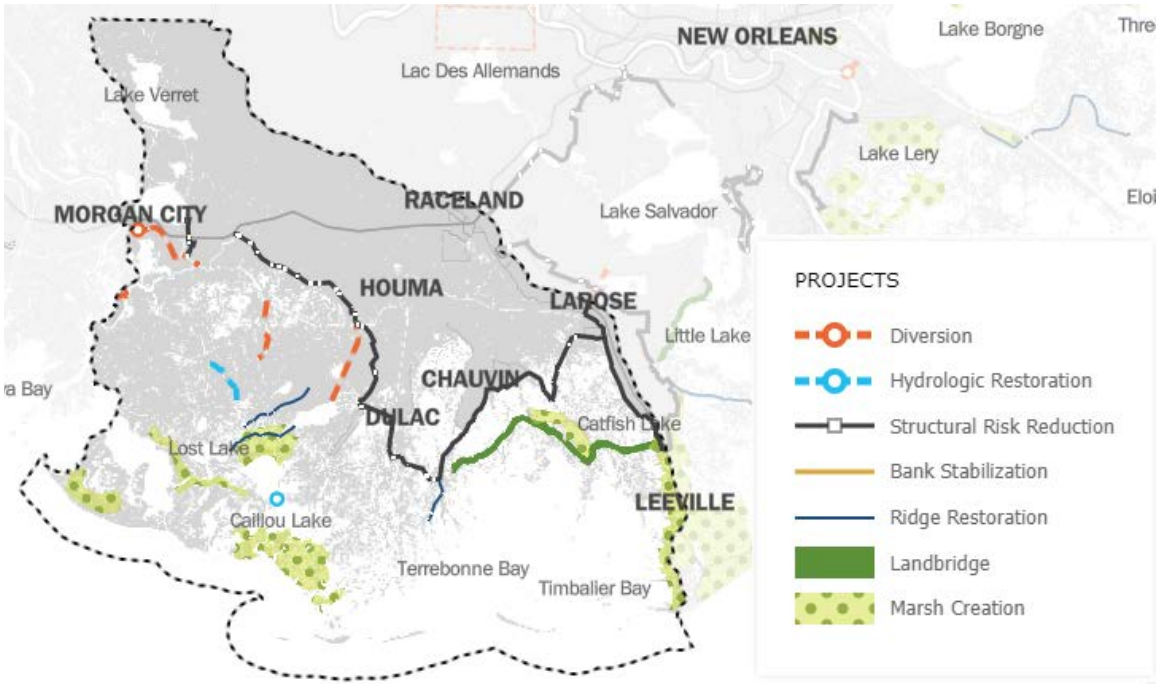

Figure 19. 2023 Coastal Master Plan projects located in the Terrebonne region.

4.2 IMPACTS ON LANDSCAPE ELEVATIONS

By Year 50, the area immediately west of Bayou Lafourche between Golden Meadow and Port Fourchon could see several feet of increased topographic/bathymetric elevations from the Belle Pass-Golden Meadow marsh creation project (Figure 20). Similar progress would be made along the Eastern Terrebonne Landbridge and the North Terrebonne Bay marsh creation project, as well as the West Terrebonne marsh creation effort south of Caillou Lake. However, areas along the GIWW south and east of Houma could see substantial losses of up to 6 feet of elevation. Land east of Amelia could see similar losses associated with the Atchafalaya diversions.

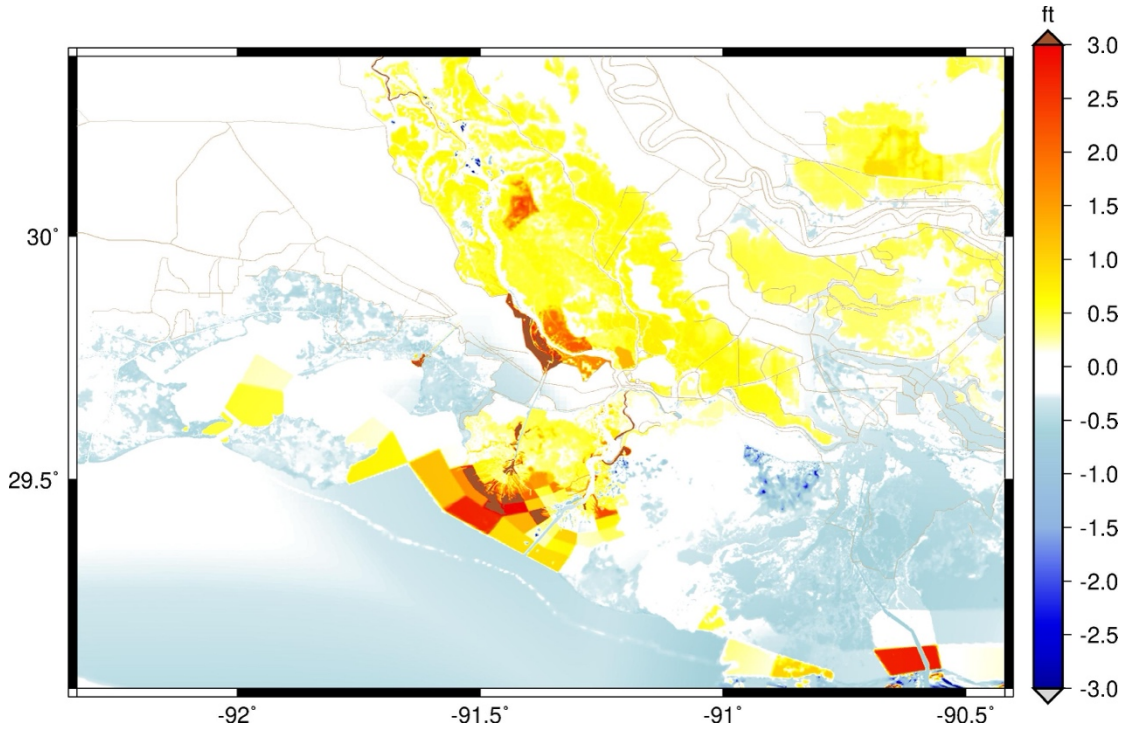

Figure 20. Change in topographic elevation in the higher scenario in Year 20.

4.3 FLOOD DEPTH IMPACTS

CLARA simulations for the Terrebonne region show increases in both the extent and depth of flooding over the 50-year period of analysis. Flood hazard is projected to increase decade over decade, with some areas currently benefiting from elevated features experiencing sudden non-linear growth in flood depth exceedances at multiple return periods. This temporal pattern is complicated by the presence of local protection features that are not federally accredited and lose their benefits over time with degradation and rising sea levels.

Flood depths with a 1% AEP increase quite substantially in a FWOA, jumping from 1 to 4 feet in Year 20 around the Houma community to 7 to 10 feet in Year 50 in Houma and Bayou Cane. Depth exceedances are more extreme in surrounding areas, over 13 feet in nearly all unprotected areas in the region south of LA-182 and east of LA-24. This exposes southward communities like Dulac and Montegut to extreme hazard, with 1% AEP flood depths over 10 feet in Year 20 (lower scenario) and up to over 21 feet in some areas east of Montegut by Year 50 (higher scenario). In that year, the 1% AEP extends consistently to the Terrebonne Ridge, resulting in some inundation to communities further inland along the ridge like Thibodaux. With the MTTG levee project fully implemented, 10% and 1% AEP flooding behind the protection system is drastically reduced (Figure 21 & Figure 22). For example, Houma does not see flooding at the 1% AEP in either environmental scenario at Year 20.

While flood risk levels are projected to increase in many locations where levee protection is reduced, flood risk is expected to drop in areas where land building is occurring. The deltas of the Atchafalaya River and Wax Lake Outlet make Terrebonne the only region where appreciable land building is expected to continue naturally even in a future without action. The master plan's coastal restoration projects enhance this process further, consequently reducing flood depths at a range of return periods throughout large portions of the region (Figure 23 & Figure 24). In the more extreme landscape of the higher scenario's Year 50, however, this benefit is largely overwhelmed by rising sea levels, limiting flood depth reductions to the area north of Amelia and in the footprint of the West Terrebonne marsh creation project.

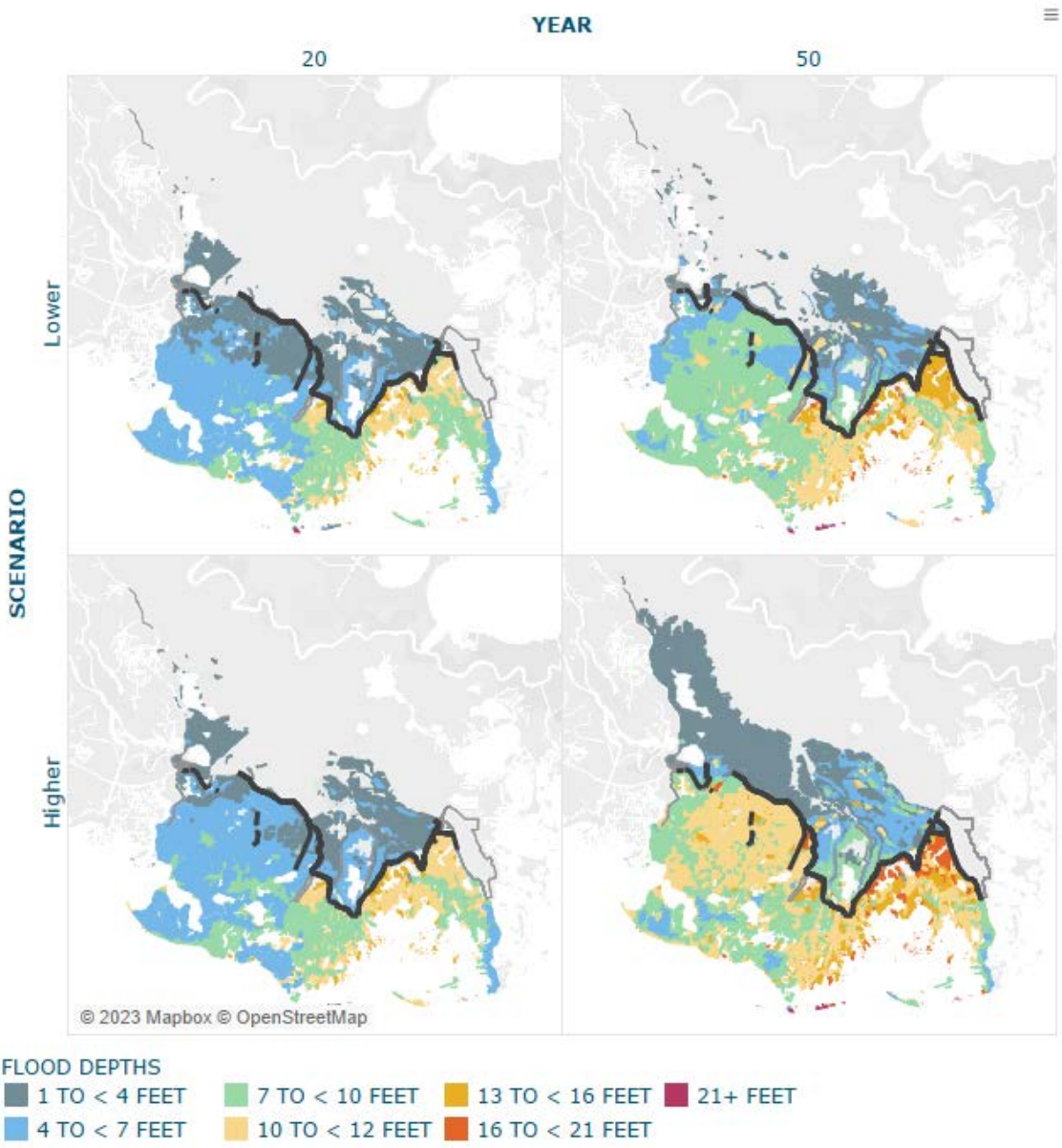

Figure 21. Risk Reduction Only Projects 10% (1 in 10-year) AEP flood depths in Years 20 and 50 in the Terrebonne region — IPET fragility, 50% pumping scenario, 50th percentile.

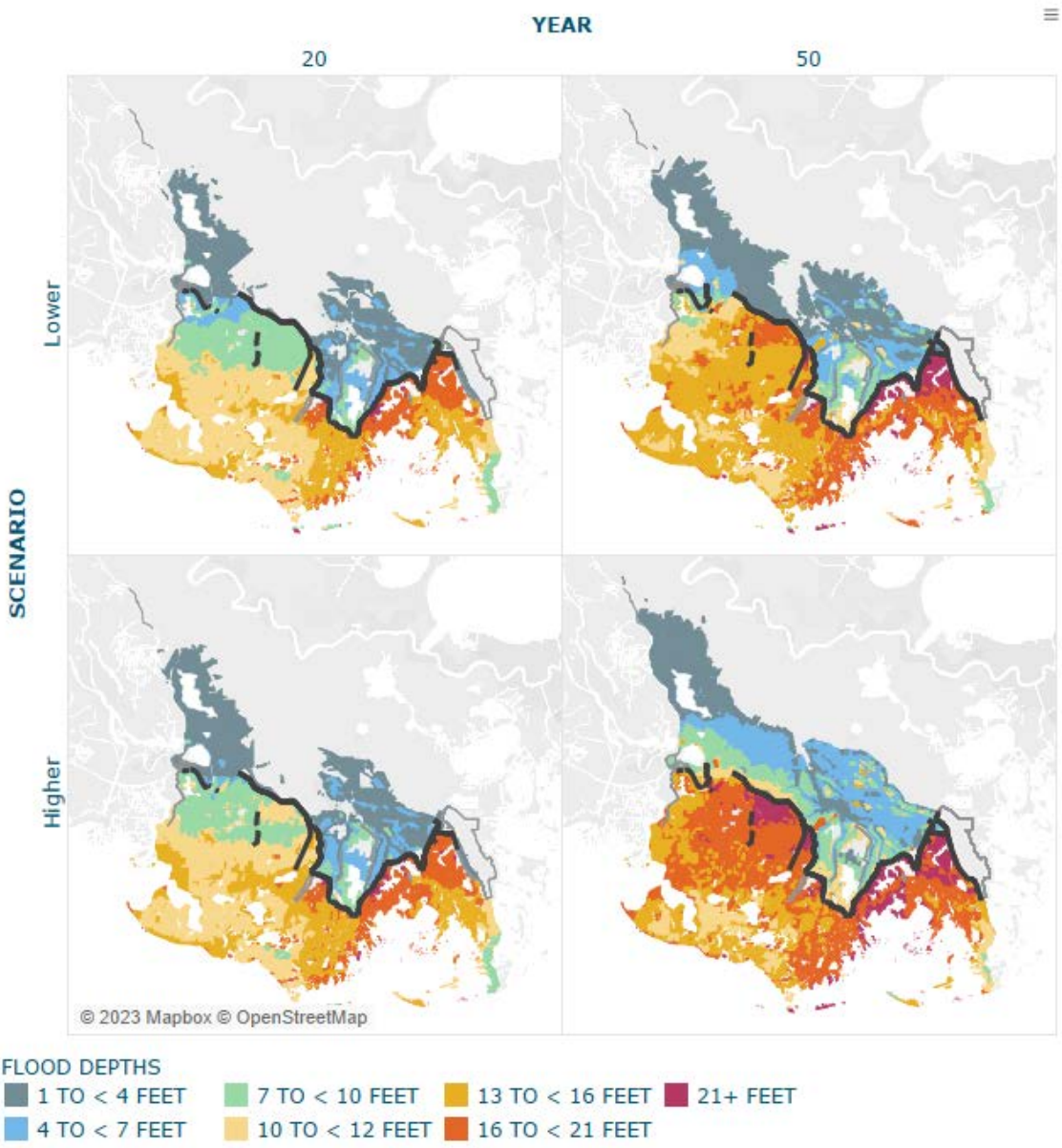

Figure 22. Risk Reduction Only Projects 1% (1 in 100-year) AEP flood depths in Years 20 and 50 in the Terrebonne region — IPET fragility, 50% pumping scenario, 50th percentile.

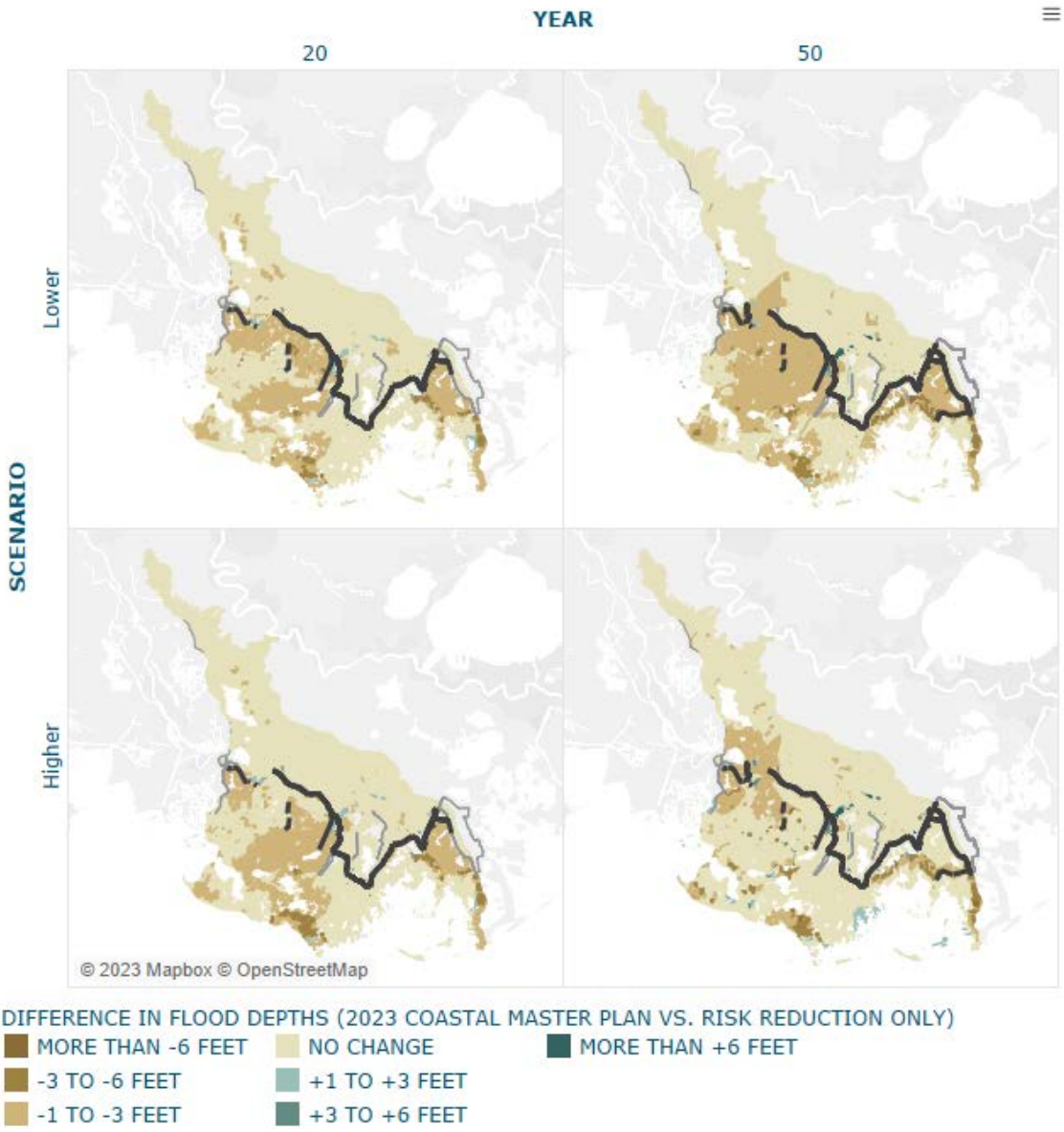

Figure 23. Difference in 2023 Coastal Master Plan and Risk Reduction Only Projects 10% (1 in 10-year) AEP flood depths in Years 20 and 50 in the Terrebonne region — IPET fragility, 50% pumping scenario, 50th percentile.

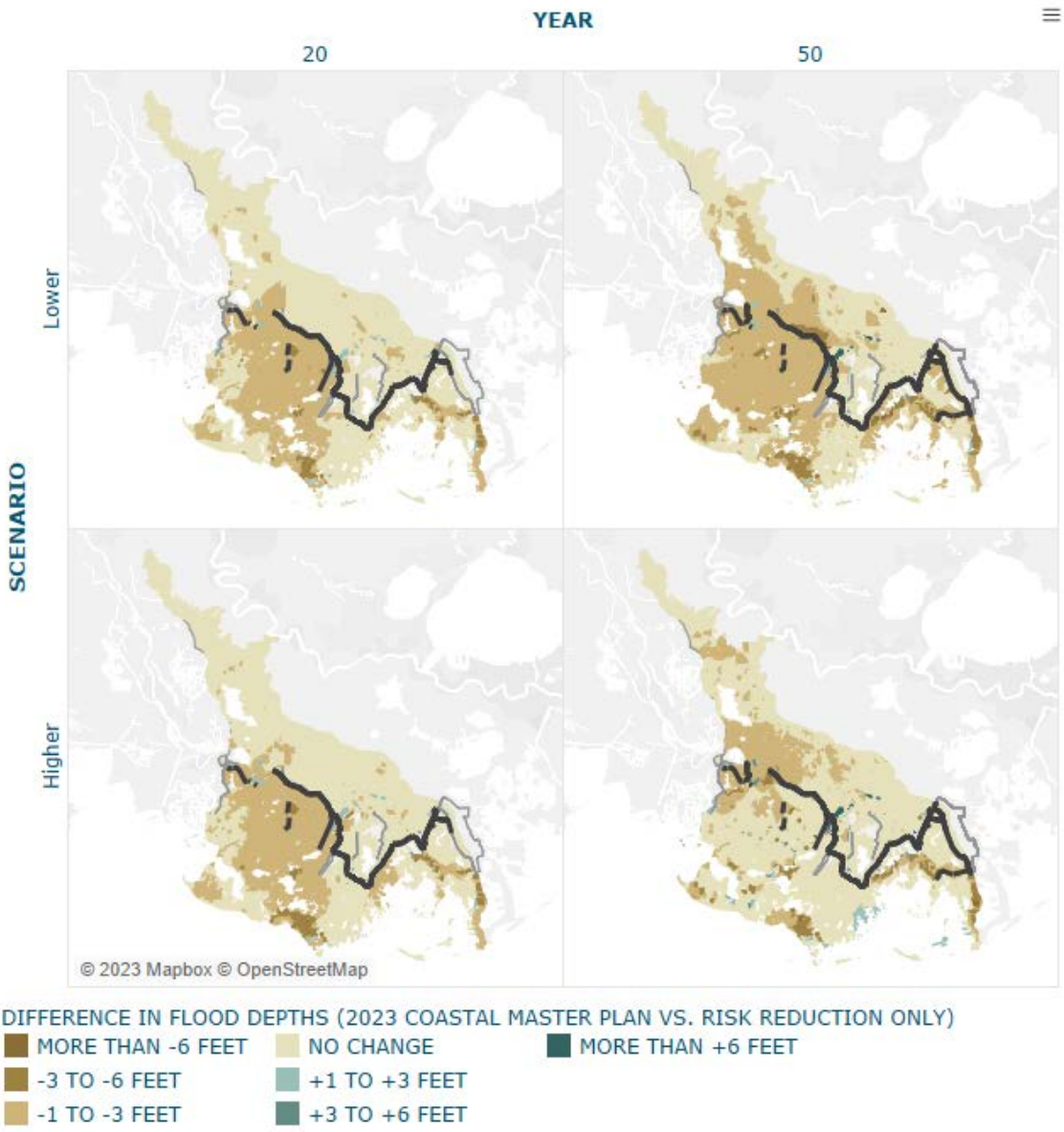

Figure 24. Difference in 2023 Coastal Master Plan and Risk Reduction Only Projects 1% (1 in 100-year) AEP flood depths in Years 20 and 50 in the Terrebonne region — IPET fragility, 50% pumping scenario, 50th percentile.

4.4 FLOOD DAMAGE IMPACTS

Across the entire Terrebonne region, Year 50 EADD in a FWOA case is approximately $5.7 billion in the lower scenario and $9.6 billion in the higher (Figure 25). The MTTG project and other structural risk reduction efforts are projected to reduce about 62% of that risk in the lower scenario and 52% in the higher scenario. The selected coastal restoration projects add a marginal 1.2% of risk reduction ($70 million) on top of that in the lower scenario, with that figure being 0.5% or $52 million in the higher scenario. Similar percentage reductions in EASD are estimated to occur in both the FWRO and FWMP cases, attributable to protection and restoration projects, respectively.

The geographic distribution of benefits is complex. The MTTG project in particular provides the large majority of the aggregate risk reduction from Figure 25, but restoration projects' addition has a mixed marginal impact (Figure 26). In Year 20, selected areas south of the new levee project see additional EADD reduction in both scenarios. By Year 50, however, restoration projects increase EADD to communities lower in the basin but behind MTTG; this includes not just communities like Houma, Bayou Blue, and Dulac, but also some along the Terrebonne Ridge like Raceland and Lockport. However, by Year 50 risk is reduced further inland to communities such as Amelia, Bayou Cane, and Thibodaux.

Exposure to flooding is substantially reduced by the master plan's risk reduction projects, with over twice as many single family residences not exposed to flooding at the 2% AEP level in both FWRO scenarios (Figure 27). In Terrebonne, restoration projects do have a net effect of shifting several thousand additional homes into the Not Exposed category, reinforcing that the benefits of restoration in this region are felt across a range of return periods.

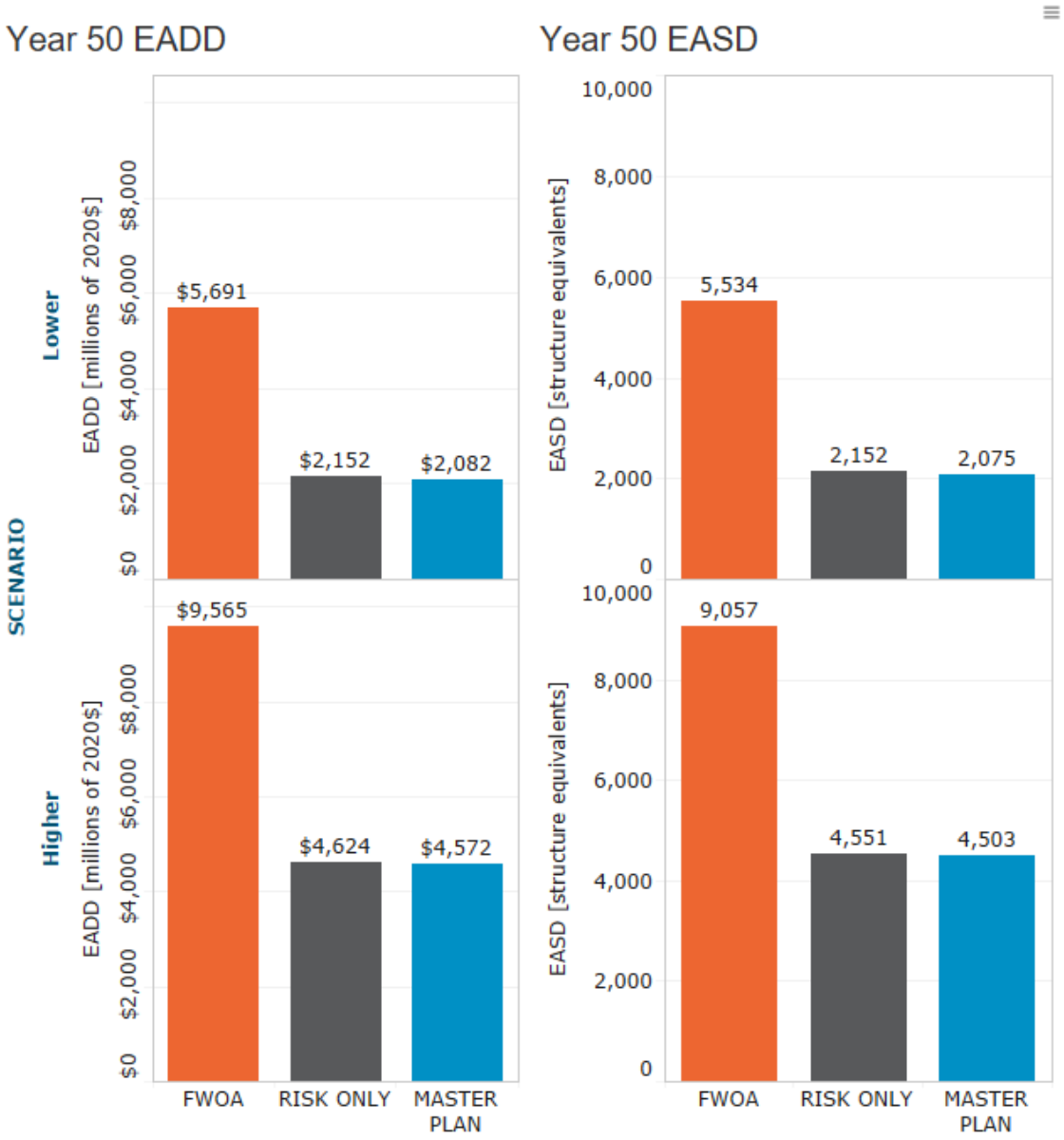

Figure 25. EADD and EASD comparison in Year 50 in the Terrebonne region — IPET fragility, 50% pumping scenario, 50th percentile.

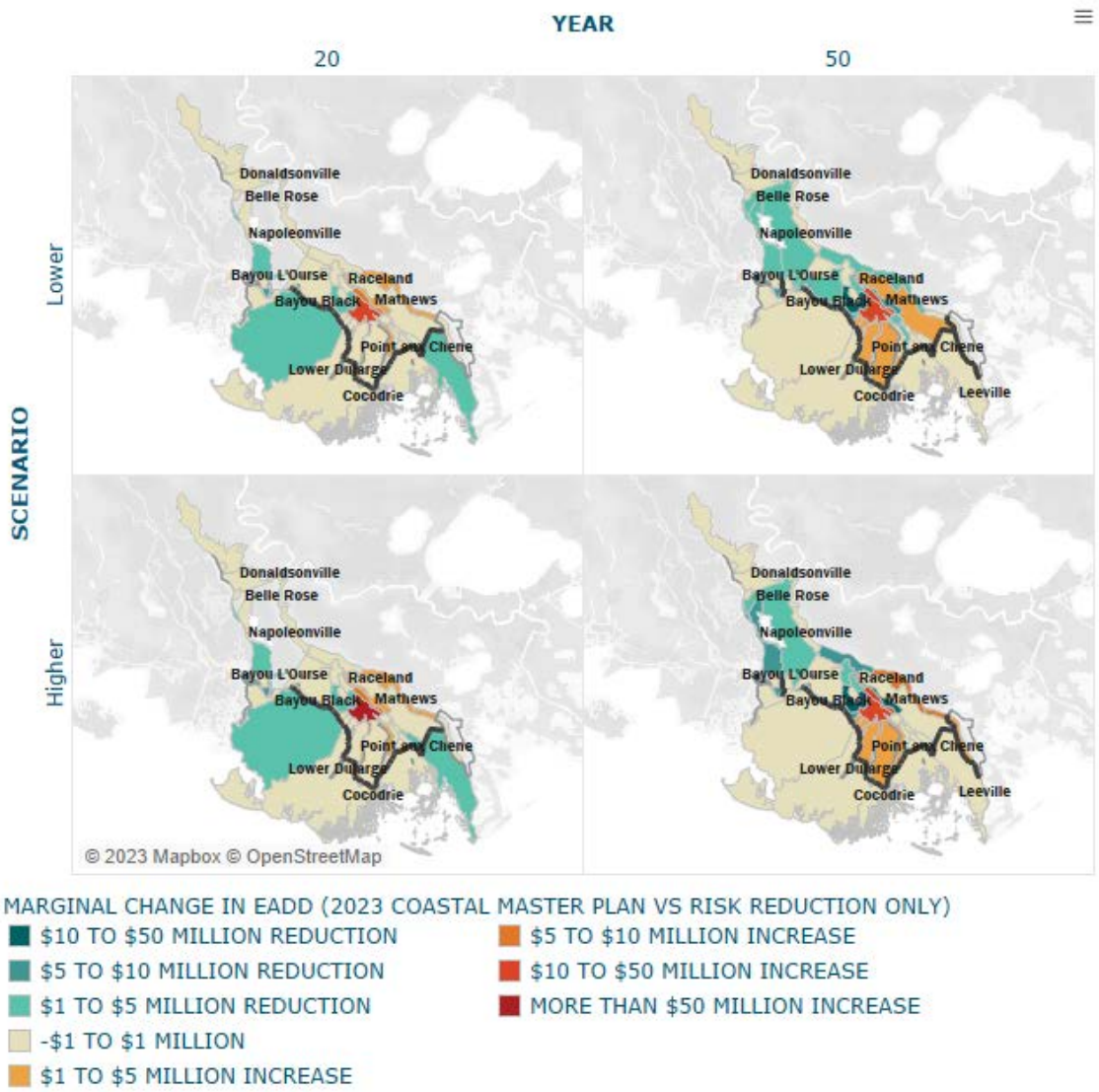

Figure 26. Difference in EADD Between 2023 Coastal Master Plan and Risk Reduction Only Projects in the Terrebonne region — IPET fragility, 50% pumping scenario, 50th percentile.

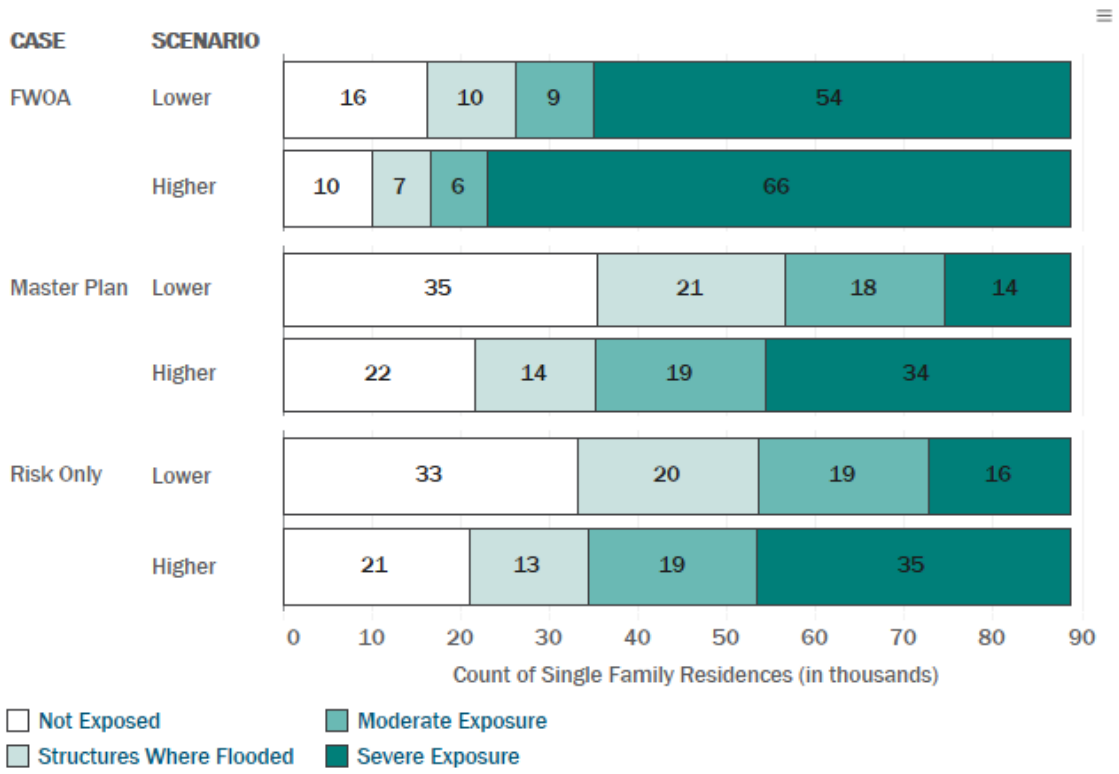

Figure 27. Single family residence structure exposure comparison by scenario in Year 50 in the Terrebonne region — IPET fragility, 50% pumping scenario, 50th percentile.

5.0 CENTRAL COAST

The Central Coast region is bounded on the west by Freshwater Bayou and the Freshwater Bayou Canal, from Abbeville to the Gulf. To the east, the region is bounded by Bayou Shaffer and the bank of the Lower Atchafalaya River to its mouth, then following the shoreline around Atchafalaya Bay to Point au Fer. The region contains extensive coastal marshland, natural ridges, forests, and agricultural land. The Atchafalaya Basin is unique among Louisiana's coastal basins in that it has a growing delta system with nearly stable wetlands.

Several federally authorized levees and water control structures in the Atchafalaya Basin provide flood protection and include 10 pump stations, Calumet Floodgate East and West, Charenton Floodgate, Bayou Chene, and multiple barge gates at existing navigation channels. Flood risk reduction systems in the basin include a combination of protection levees, river levees, and ring levees. These include Southern West Atchafalaya River Levee, Southern West Atchafalaya Basin Protection Levee, Southern East Atchafalaya River Levee, levees west of Berwick, Bayou Sale levees, Avoca Island Levee, the Morgan City Back Levee and floodwall, and the Southern Pacific Railroad Levee.

5.1 2023 COASTAL MASTER PLAN PROJECTS

For the 2023 Coastal Master Plan, eight projects were selected for the Central Coast region (Figure 28). These projects include several large-scale marsh creation projects from West Rainey Marsh and across Marsh Island to Point au Fer. Several originally submitted project concepts were revised to avoid overlap and to focus on regional priorities, such as maintaining regionally important landforms. Structural risk reduction projects were also selected for the region that, in conjunction with nonstructural risk reduction measures, would reduce risk and damage from storm surge-based flooding in communities across the Central Coast.

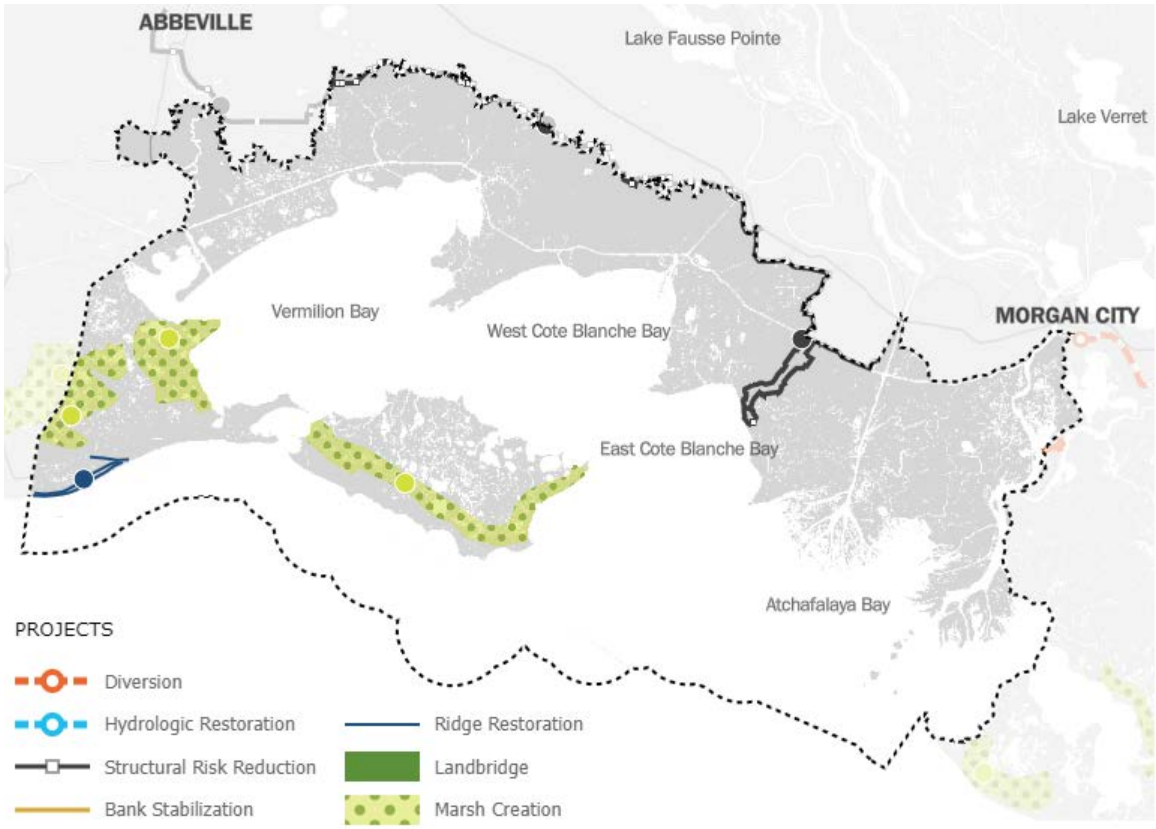

Figure 28. 2023 Coastal Master Plan projects located in the Central Coast region.

5.2 IMPACTS ON LANDSCAPE ELEVATIONS

By Year 50, the Marsh Island Barrier marsh creation project increases topographic elevations by approximately 1 foot in the lower scenario (Figure 29). Elevations increase more in the higher scenario, up to 4 feet in some grid cells, but the extent of increased topography is in a narrower band across the island. In the lower scenario, the West Rainey and East Rainey marsh creation projects also contribute about 1 foot of additional land elevation relative to the FWOA case, with more height being generated in the West Rainey area. In the higher scenario, some grid cells see 4 feet of increased elevation, but some areas south of the West Rainey project experience decreases of up to 2 feet. The Point au Fer marsh creation project also is projected to increase topobathy elevations by approximately 1 foot, although this does not translate into appreciable reductions in flood hazard.

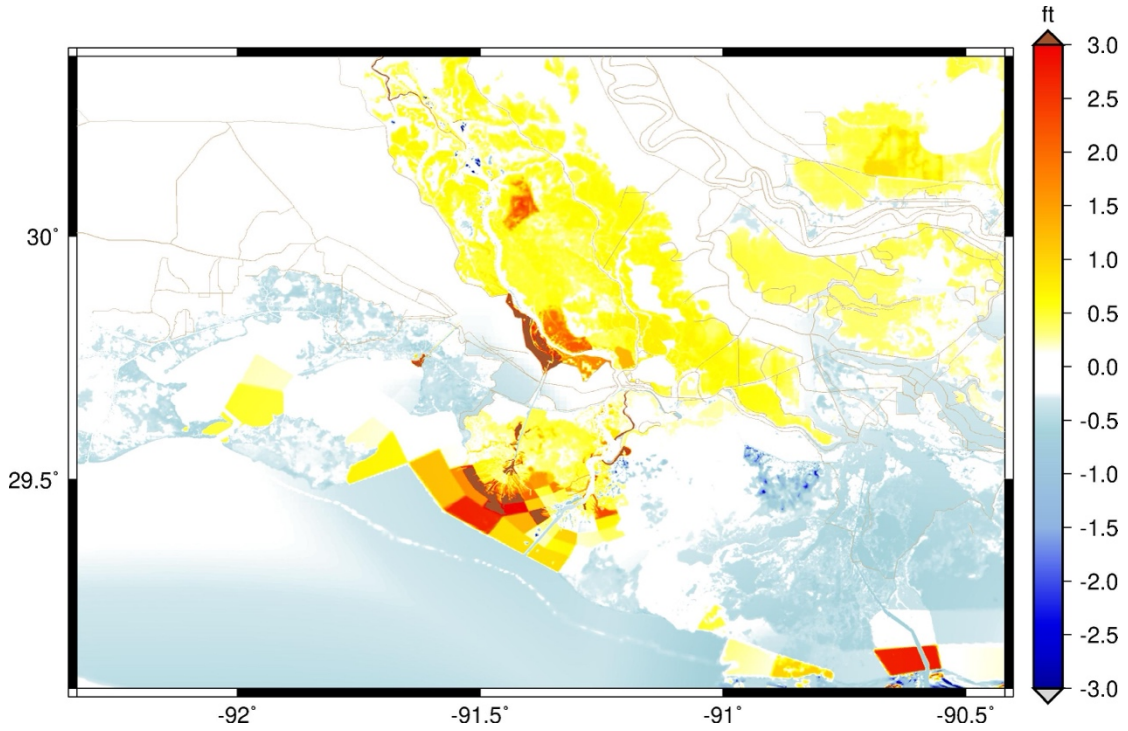

Figure 29. Change in topographic elevation in the higher scenario in Year 20.

5.3 FLOOD DEPTH IMPACTS

Figure 30 and Figure 31 show the 10% and 1% AEP flood depths, respectively, in the FWRO scenario in which only structural risk reduction projects are implemented. Simulations show increases in both the extent and depth of flooding from Year 20 to Year 50. The areas around Vermilion Bay, West Cote Blanche Bay, and Marsh Island always have larger flood depths than other areas in the Central Coast region. Much of this area is unpopulated and unprotected, but it is notable that flood depths are expected to encroach northward to farmlands and populated communities along Bayou Teche, such as New Iberia and Erath. These communities see the greatest increase of flood depths over time across a range of return periods.

In the protected areas of the Atchafalaya Basin, including areas around Morgan City, CLARA simulations find lower flood depths than other parts of the region under both environmental scenarios. Other protected areas, both to the north and south of Morgan City protected by the Bayou Benoit Levee are similarly not expected to experience a large amount of flooding, even under the higher environmental scenario. With the Iberia/St. Mary Upland Levee in place, 1% AEP flooding is eliminated in Year 20 north of U.S. 90, except for 1 to 3 feet of flooding near Baldwin. Inundation of 1 to 5 feet along the back side of the levee in Year 20 appears to primarily be driven by overtopping rather than surge running around the western terminus of the project, as evidenced by nearly identical patterns of

inundation with other master plan projects implemented, including the Abbeville and Vicinity project which is scheduled for implementation starting in Year 27. Implementation of structural risk reduction projects introduces the potential for modest induced surge in front of protection elements, with some developed areas like Glencoe and the Avery Island salt dome seeing increased hazard.

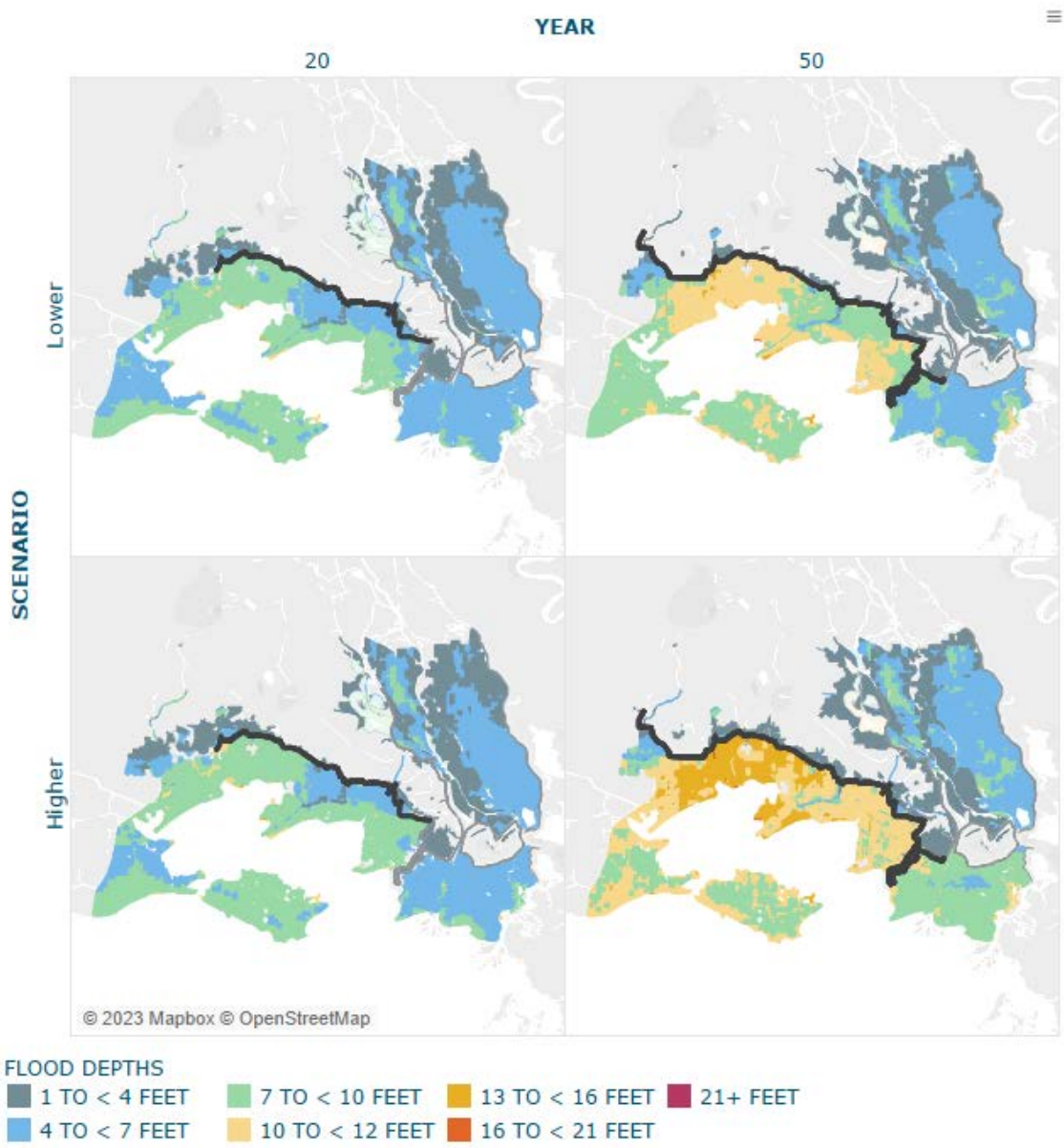

Figure 30. Risk Reduction Only Projects 10% (1 in 10-year) AEP flood depths in Years 20 and 50 in the Central Coast region — IPET fragility, 50% pumping scenario, 50th percentile.

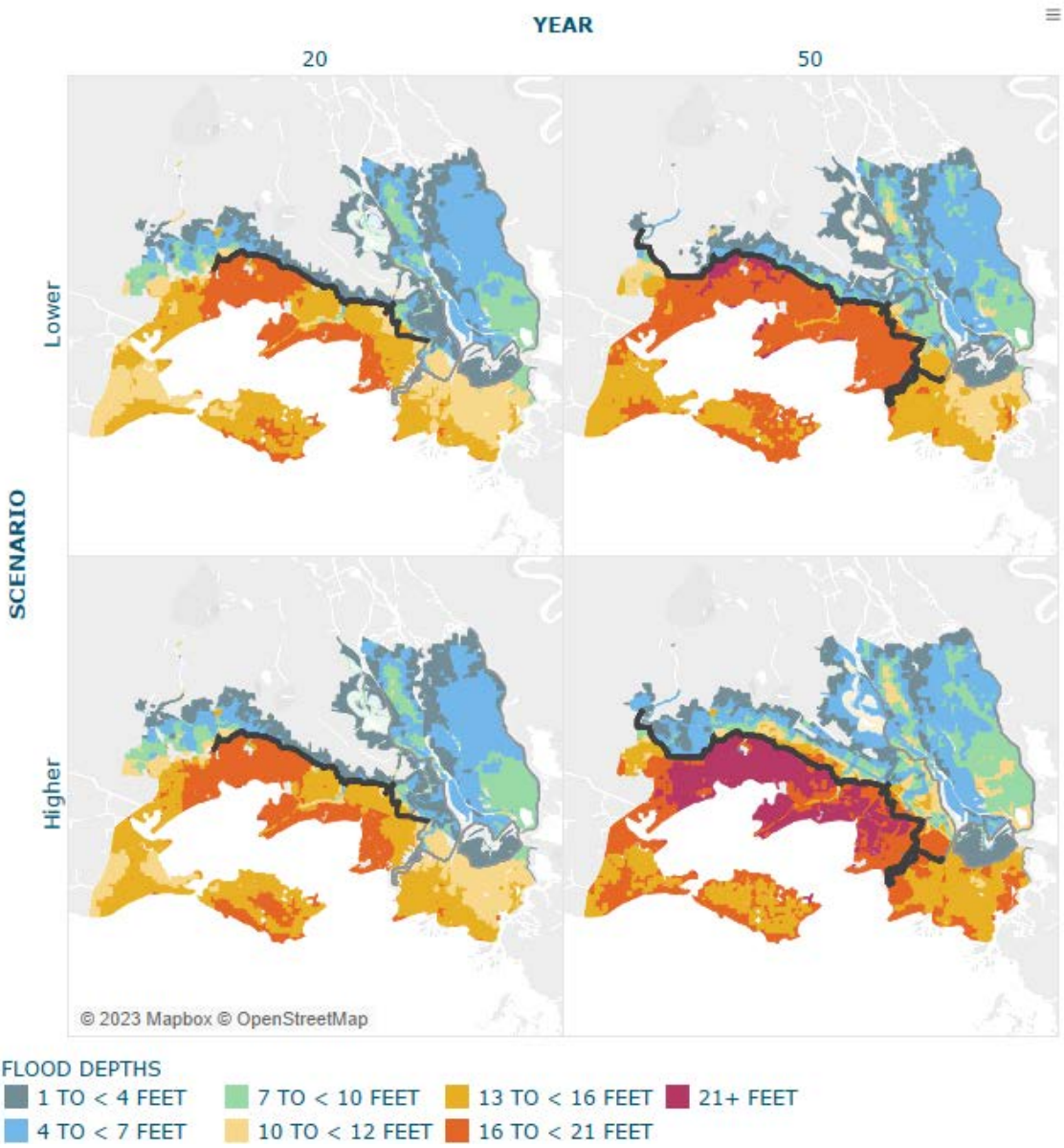

Figure 31. Risk Reduction Only Projects 1% (1 in 100-year) AEP flood depths in Years 20 and 50 in the Central Coast region — IPET fragility, 50% pumping scenario, 50th percentile.

Differences between the FWMP and FWRO 10% AEP flood depths, however, are 1 to 3 feet across years and scenarios where restoration projects build substantial land (Figure 32). Differences do not extend much beyond the Marsh Island Barrier, West Rainey, and East Rainey marsh creation projects. The flood hazard around the Point au Fer marsh creation project is approximately unchanged.

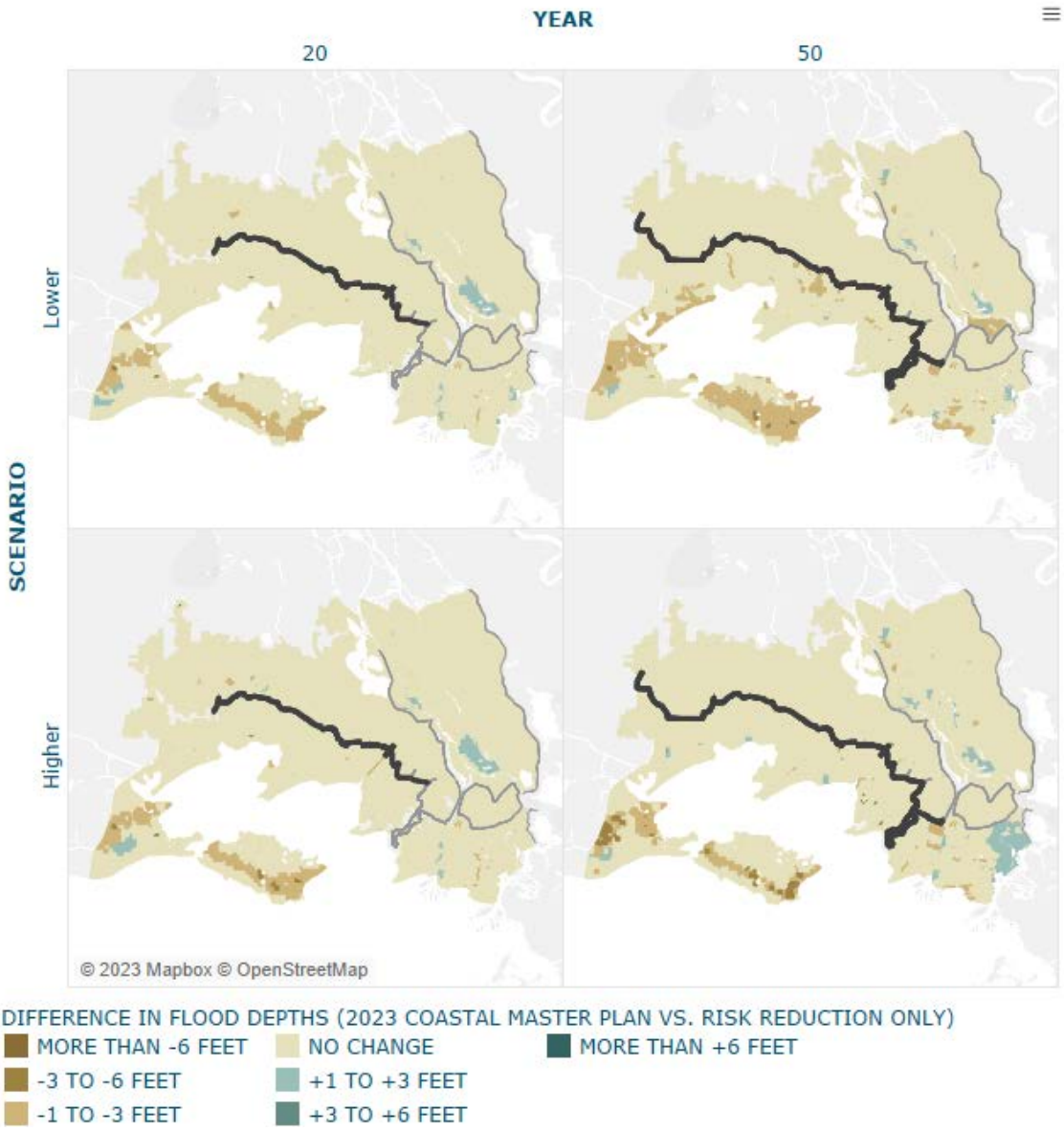

Figure 32. Difference in 2023 Coastal Master Plan and Risk Reduction Only Projects 10% (1 in 10-year) AEP flood depths in Years 20 and 50 in the Central Coast region — IPET fragility, 50% pumping scenario, 50th percentile.

The change in 1% AEP flood depths in the Central Coast is very similar to the changes in 10% AEP flood depths for both scenarios in Year 20 as well as the higher scenario in Year 50 (Figure 33). At Year 20, the land built by marsh creation projects directly reduces 100-year flood depths on the project footprints where topographic elevations increase, but not enough land is built to have an

appreciable impact on the hydrodynamics beyond the footprints.

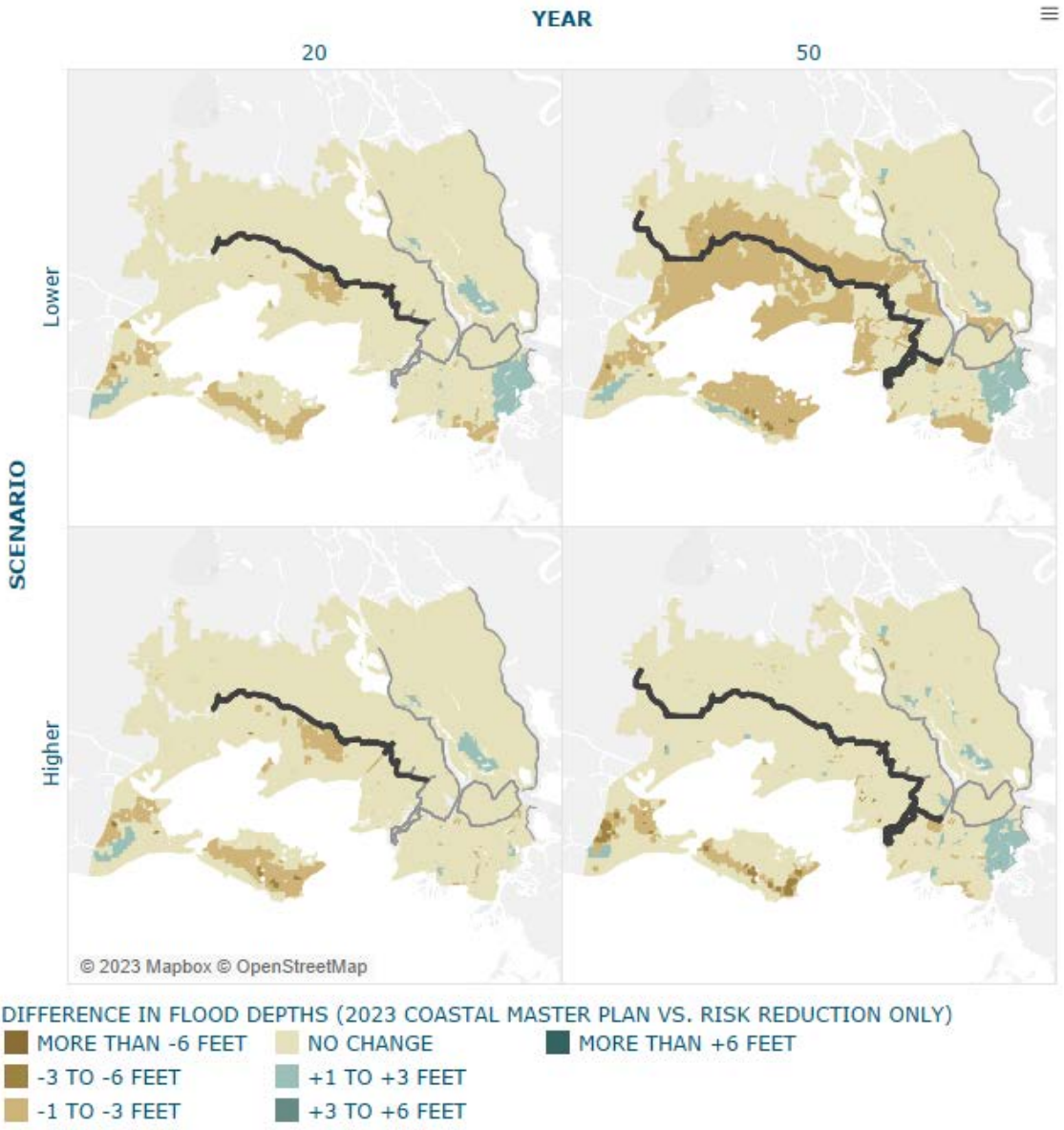

Figure 33. Difference in 2023 Coastal Master Plan and Risk Reduction Only Projects 1% (1 in 100-year) AEP flood depths in Years 20 and 50 in the Central Coast region — IPET fragility, 50% pumping scenario, 50th percentile.

In Year 50 of the higher scenario, sea levels rise and storm intensity increases to the point where impacts of the land building are overwhelmed by increasing hazard. This leads to a similar pattern where impacts are limited to the marsh creation project footprints. However, in Year 50 of the lower scenario, the increase in 1% AEP surge and waves gulfward of the projects is small enough that marsh

creation, particularly the Marsh Island Barrier project, effectively attenuates surge and wave propagation into Vermilion Bay and beyond. Flood depths are reduced by 1 to 3 feet over a wide area, even extending north of the Iberia/St. Mary Upland levee project.

5.4 FLOOD DAMAGE IMPACTS

When viewed over the entire Central Coast region, the risk of economic damage is very similar between the FWMP and FWRO cases (Figure 34). In the lower scenario, the marginal risk reduction provided by implementation of the master plan's restoration projects is only 2% of the risk reduction provided by structural protection projects (as measured by both EADD and EASD). In the higher scenario, the restoration projects actually increase risk on net, albeit by a small amount (0.2% for EADD, 0.3% for EASD).

The greatest reductions in risk are in the Iberia community benefiting from the reductions in overtopping of the Iberia/St. Mary Upland levee associated with the marsh creation projects to the south (Figure 35). Modest reductions are also seen in the Abbeville and Charenton communities, while the increase in the higher scenario is attributable to the Franklin area. Exposure of single family residences in the region to inundation at the 2% AEP are very similar with and without the master plan's coastal restoration projects (Figure 36).

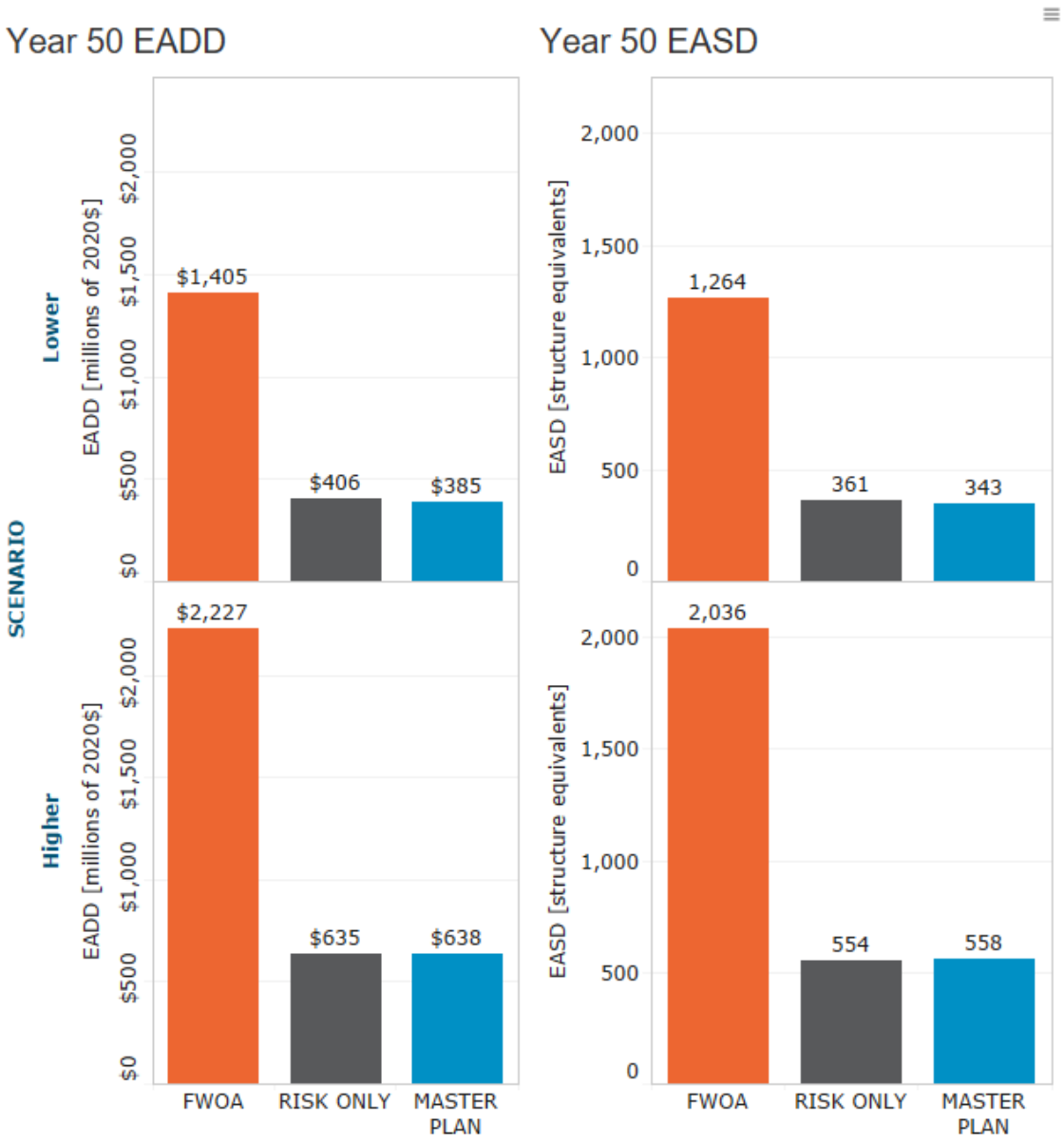

Figure 34. EADD and EASD comparison in Year 50 in the Central Coast region — IPET fragility, 50% pumping scenario, 50th percentile.

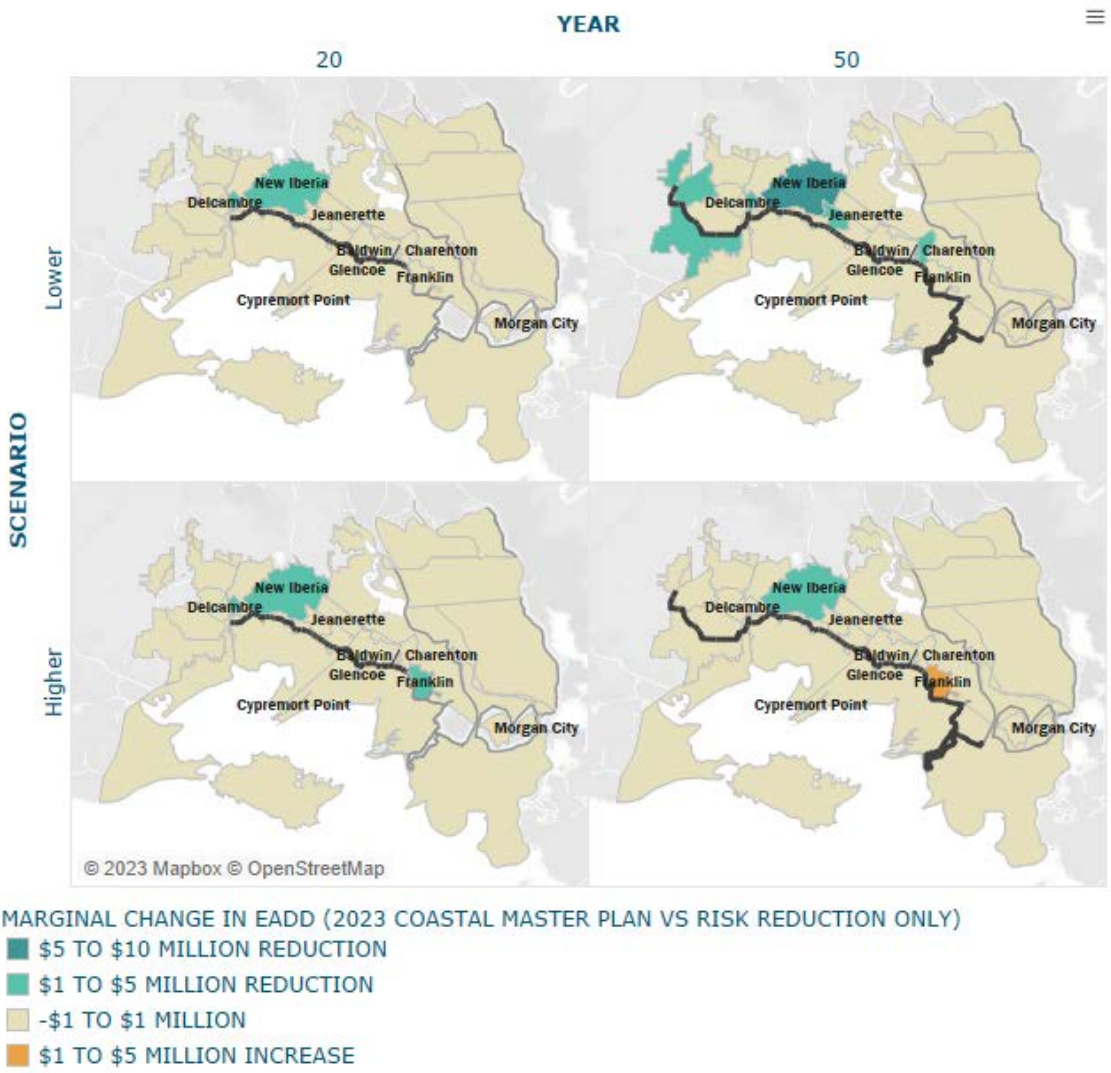

Figure 35. Difference in EADD Between 2023 Coastal Master Plan and Risk Reduction Only Projects in Years 20 and 50 in the Central Coast region — IPET fragility, 50% pumping scenario, 50th percentile.

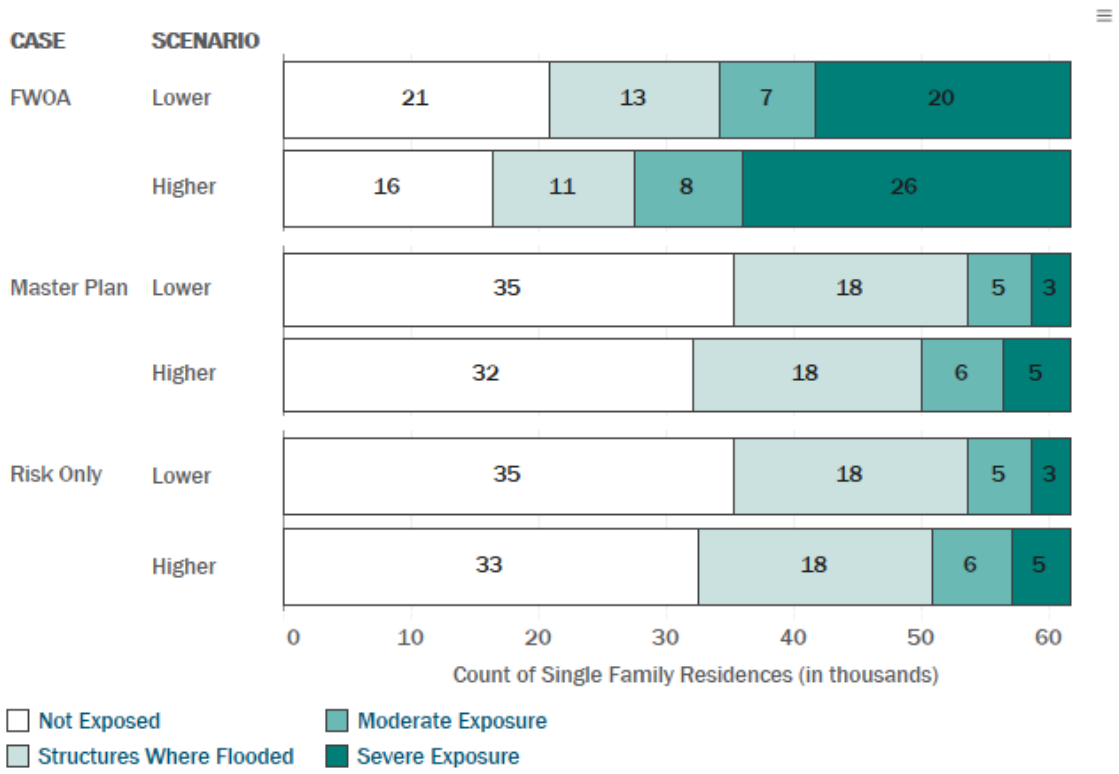

Figure 36. Single family residence structure exposure comparison by scenario in Year 50 in the Central Coast region — IPET fragility, 50% pumping scenario, 50th percentile.

6.0 CHENIER PLAIN

The Chenier Plain is densely populated with lake and marsh ecosystems, including the White Lake Wetlands Conservation Area; the Rockefeller Wildlife Refuge; and the Lacassine, Cameron Prairie, and Sabine National Wildlife Refuges. Development is centered on the north end of the region around Lake Charles and Sulphur. The region experiences some of the highest rates of erosion in coastal Louisiana and has been severely impacted by hurricanes over the past two decades. Its hydrology is highly managed with a variety of control structures and an extensive web of navigation canals, ditches, and culverts.

6.1 2023 COASTAL MASTER PLAN PROJECTS

The 2023 Coastal Master Plan selected 16 projects for the Chenier Plain region, none of which provides structural risk reduction (Figure 37). As such, the FWRO case is very similar to FWOA, with the exception of minor impacts on flood depths induced by the Abbeville and Vicinity structural protection project in the Central Coast region. Conversely, this implies that nearly all of the risk reduction in the Chenier Plain in the FWMP can be attributed to coastal restoration projects.

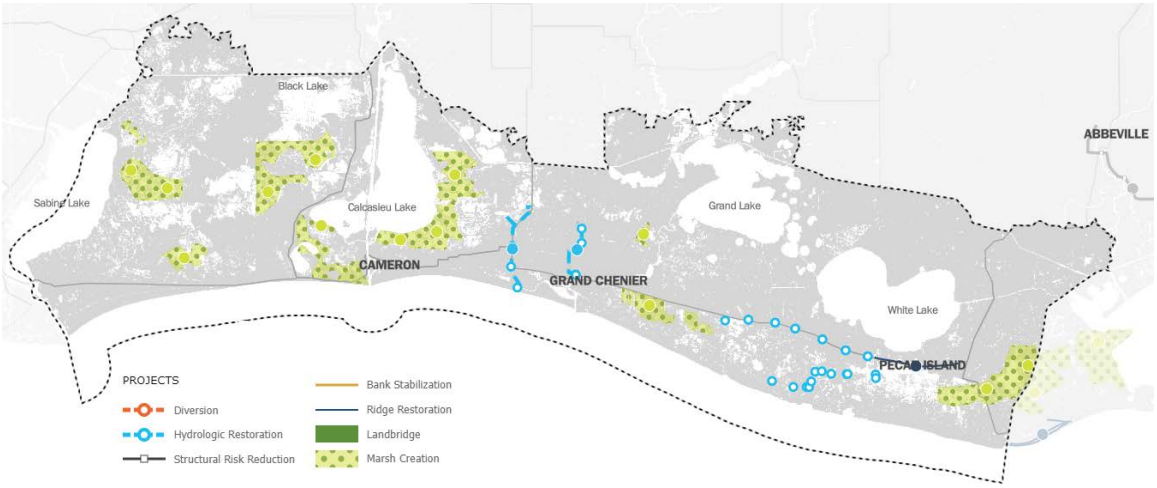

Figure 37. 2023 Coastal Master Plan projects located in the Chenier Plain region.

As seen in Figure 37, master plan projects in the Chenier Plain are primarily marsh creation that is distributed throughout the region. Besides these, the Cameron-Creole to the Gulf hydrologic restoration project aims to increase drainage through the Creole Canal southeast of Calcasieu Lake, and the Mermentau Basin hydrologic restoration project involves a geographically dispersed set of improvements such as channel dredging, road crossings, and flap gated culverts. The Pecan Island ridge restoration project is designed to restore natural hydrology and provide storm surge and wave attenuation south of White Lake.

6.2 IMPACTS ON LANDSCAPE ELEVATIONS

ICM results show that the region's many restoration projects have a mixed impact on topobathy. The greatest impact on topographic elevations is from the East Pecan Island and Freshwater Bayou North marsh creation projects on the eastern boundary of the Chenier Plain, with increases of up to 4 feet in parts of the project footprints. Effects are more modest over other marsh creation projects, with some areas seeing increases from 0.5 to 2 feet. However, this is interspersed with decreases in elevation in other areas between marsh creation projects; these declines mostly involve conversion of land to open water, though topographic elevations see decreases in some areas that are predominantly less than 0.5 feet.

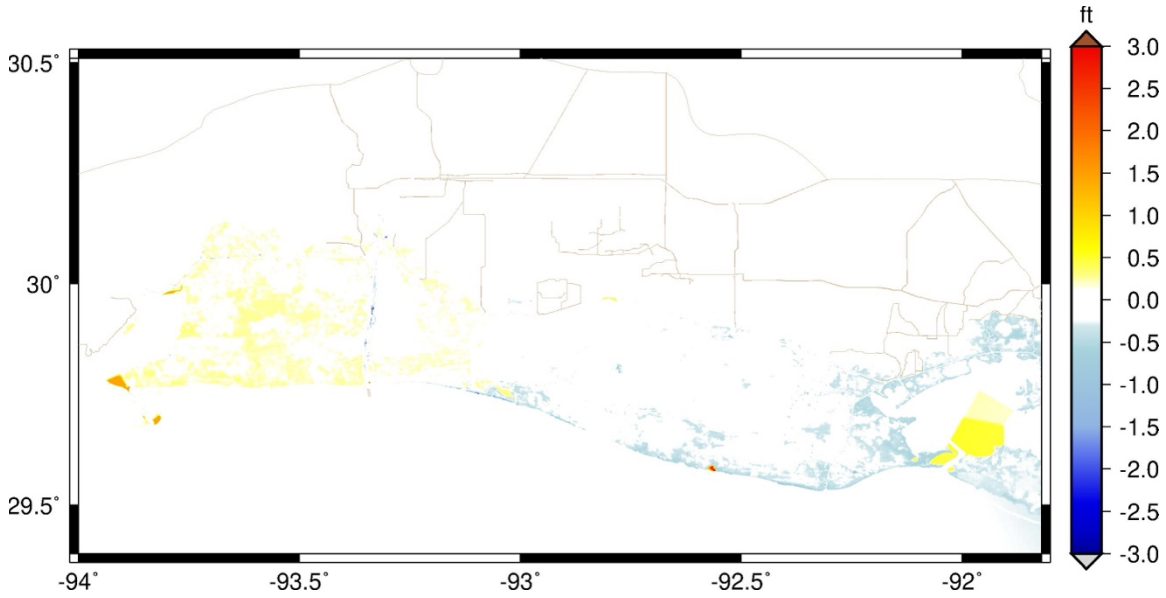

Figure 38. Change in topographic elevation in the higher scenario in Year 20.

6.3 FLOOD DEPTH IMPACTS

Figure 39 and Figure 40 show 10% and 1% AEP flood depths, respectively, in the FWRO scenario that is, as previously noted, essentially the FWOA case. The extent and magnitude of flooding over the 50-year period of analysis are expected to substantially increase under both environmental scenarios, primarily driven by SLR resulting in deeper and more widespread flooding. Simulations find that flooding tends to be concentrated in areas along the basins' estuarine lakes, especially to the north of White Lake, in the southeastern corner of the region. Over time, however, FWRO results show the floodplain steadily extending further inland to the east of Sabine Lake and the north of Calcasieu Lake, encroaching on populated communities such as Hackberry and Grand Lake, and even as far inland as Lake Charles. In the higher scenario, this expansion is faster and ranges more widely.

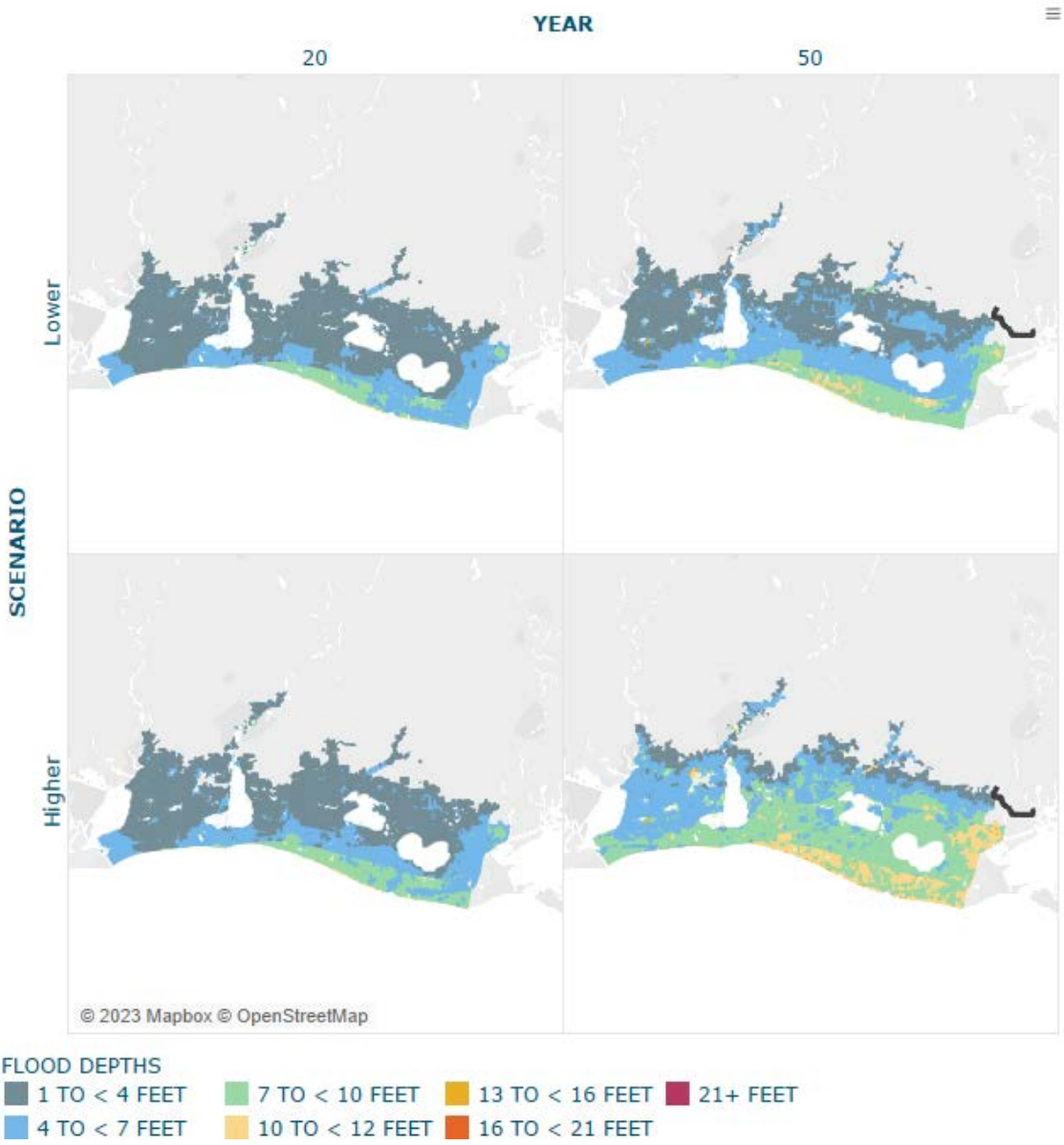

Figure 39. Risk Reduction Only Projects 10% (1 in 10-year) AEP flood depths in Years 20 and 50 in the Chenier Plain region — IPET fragility, 50% pumping scenario, 50th percentile.

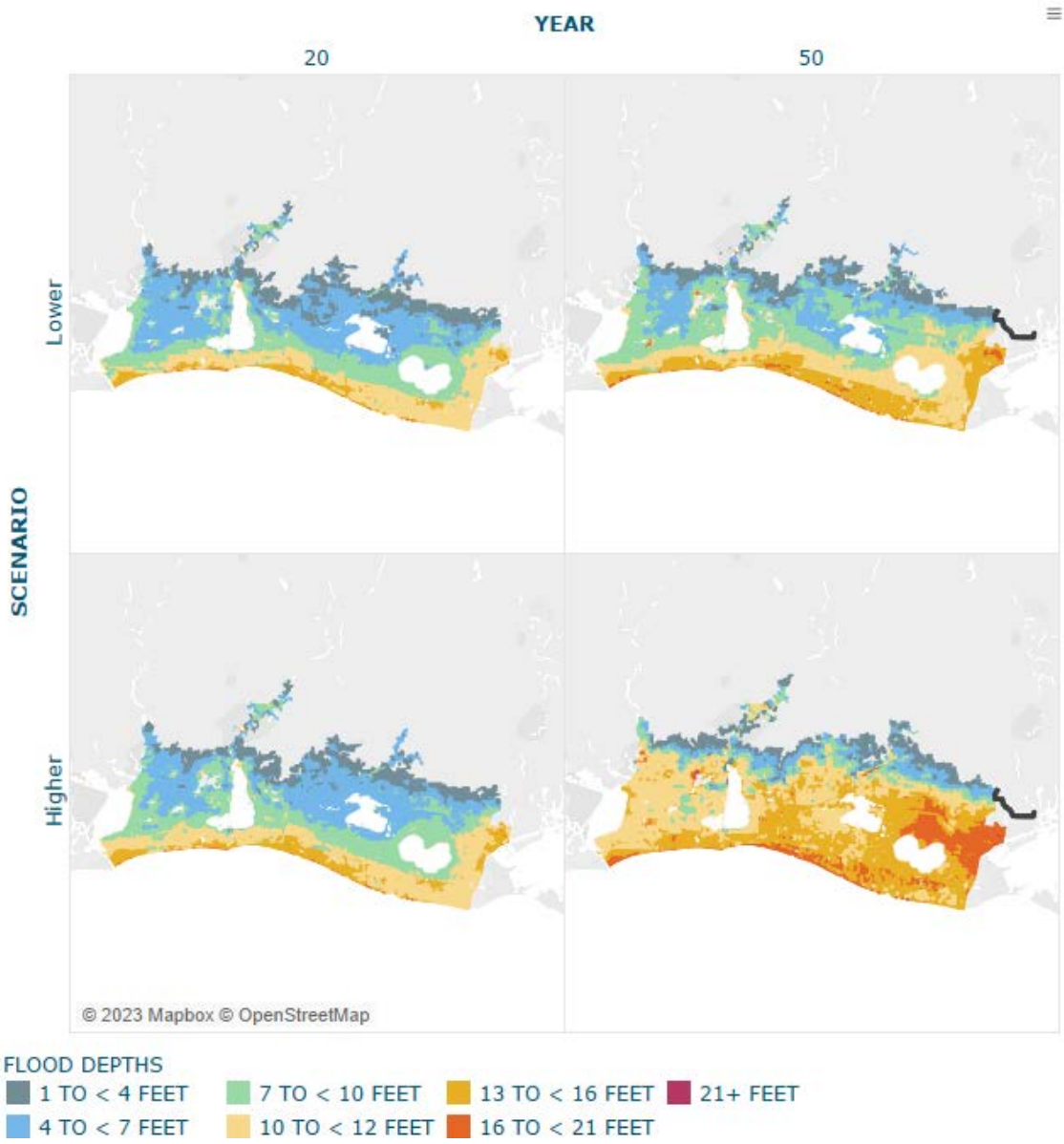

Figure 40. Risk Reduction Only Projects 1% (1 in 100-year) AEP flood depths in Years 20 and 50 in the Chenier Plain region — IPET fragility, 50% pumping scenario, 50th percentile.

Flood depths at the 10-year return period are virtually unaffected by the master plan's restoration projects in Year 20, and this is largely also the case in Year 50 (Figure 41). 10% AEP depths are reduced by 1 to 3 feet east of Sabine Lake and around the Mermentau Basin hydrologic restoration project in Year 50 of the lower scenario, but these impacts are smaller in the higher scenario, which

also sees some induced 10-year flooding southeast of Calcasieu Lake, between the Calcasieu Lake marsh creation projects and the Cameron-Creole to the Gulf hydrologic restoration project.

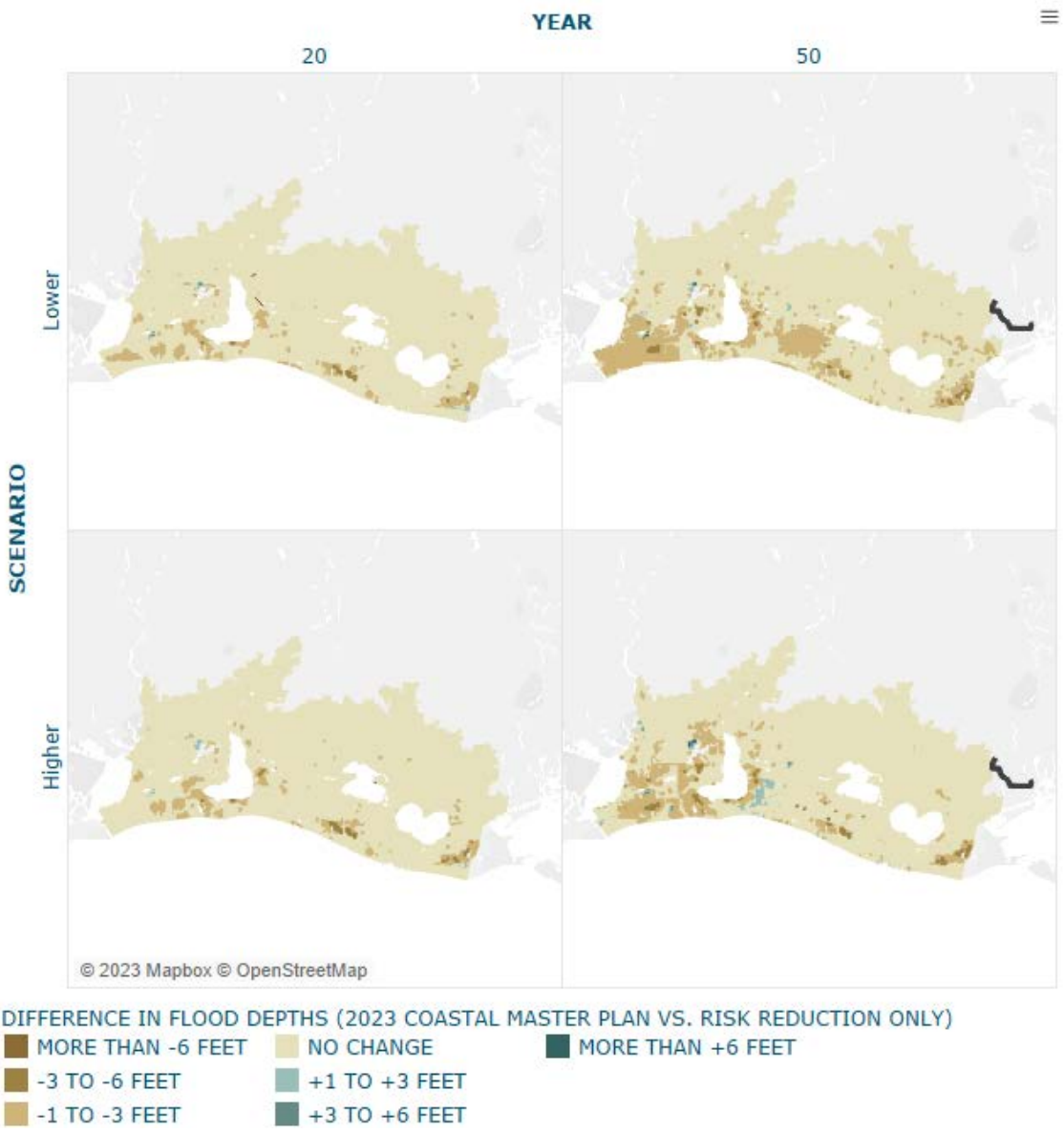

Figure 41. Difference in 2023 Coastal Master Plan and Risk Reduction Only Projects 10% (1 in 10-year) AEP flood depths in Years 20 and 50 in the Central Coast region — IPET fragility, 50% pumping scenario, 50th percentile.

Flood hazard benefits from coastal restoration projects in the Chenier Plain are more widespread at the 1% AEP level (Figure 42). This is particularly true in Year 50 of the lower scenario, which sees 1 to

3 feet of reduced 100-year flooding in large extents between Sabine and Calcasieu lakes, between Calcasieu and Grand lakes, and north of White Lake. In Year 50 of the higher scenario, reductions of 1 to 3 feet are seen west of Calcasieu Lake and in the Lake Charles area, while some induced flood depths of 1 to 3 feet are projected southeast of Calcasieu Lake and just north of the Cameron-Creole to the Gulf hydrologic restoration project.

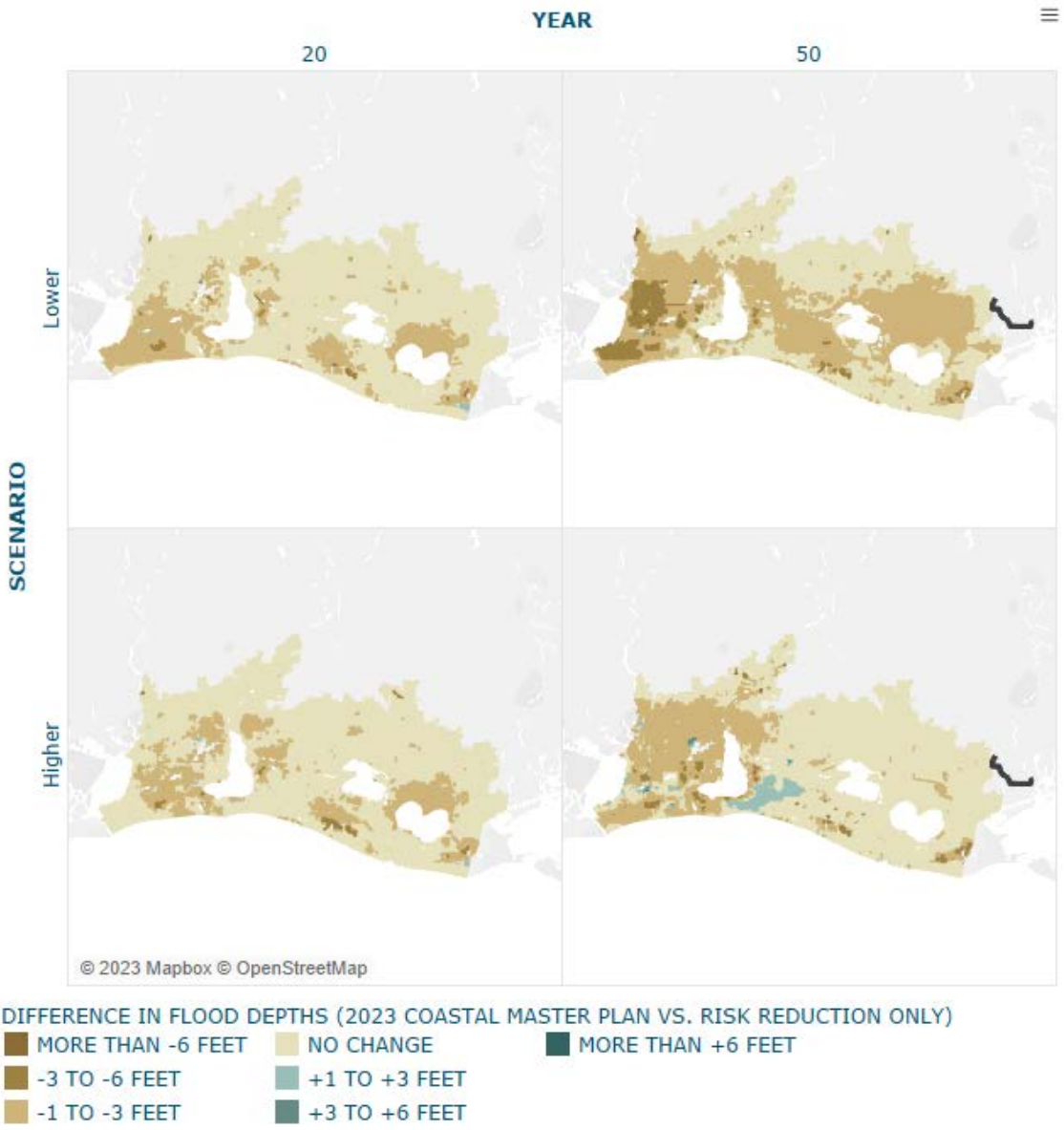

Figure 42. 2023 Coastal Master Plan and Risk Reduction Only Projects 1% (1 in 100-year) AEP flood depths in Years 20 and 50 in the Chenier Plain region — IPET fragility, 50% pumping scenario, 50th percentile.

6.4 FLOOD DAMAGE IMPACTS

EADD and EASD in the higher scenario is approximately double that in the lower scenario, indicating that the Chenier Plain is highly sensitive to changes in sea level and other environmental forcings (Figure 43). As noted earlier, the region lacks any additional structural protection projects in the master plan. This results in the FWRO case being nearly identical to FWOA, with the exception being a slight increase in risk from surge induced by the nearby Abbeville and Vicinity project at the northeastern edge of the region.

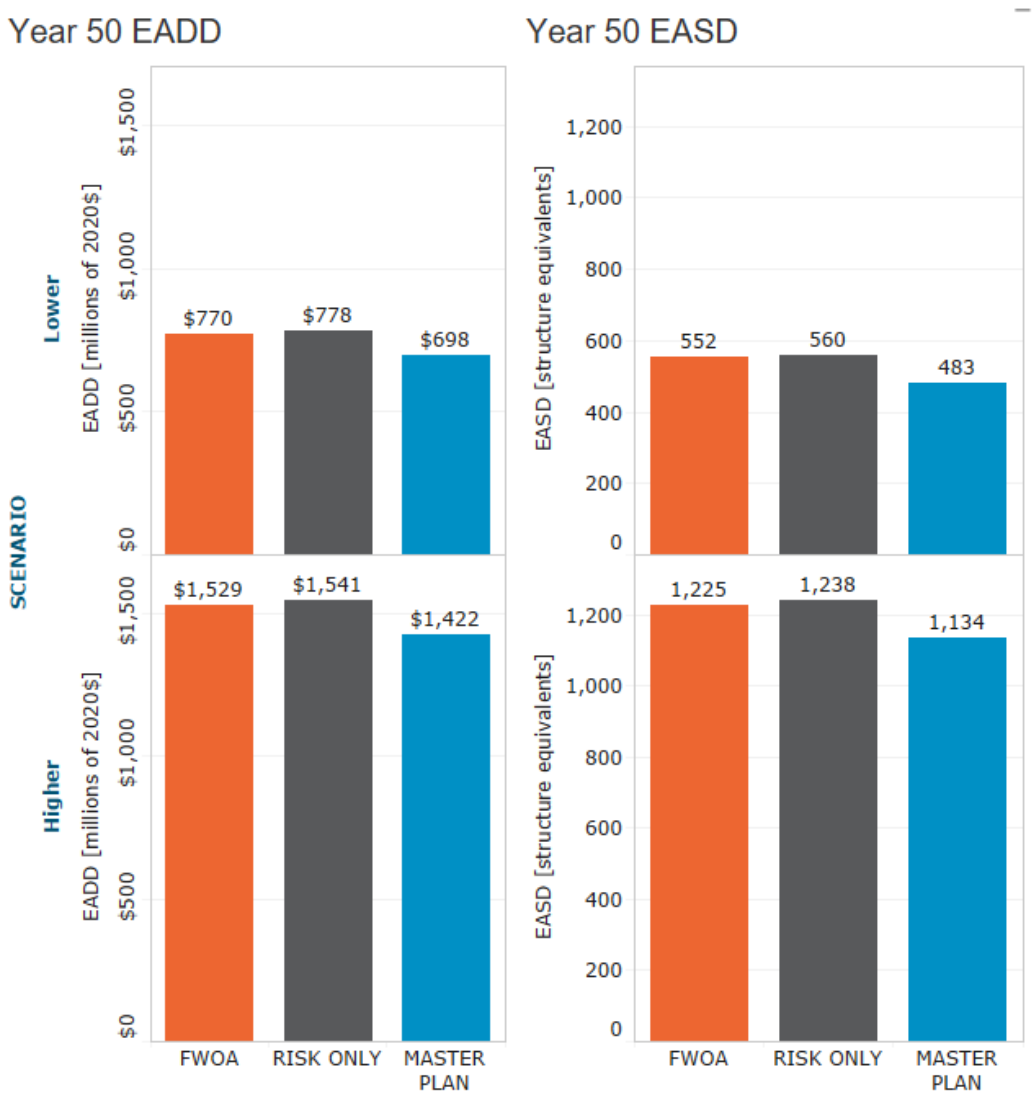

Figure 43. EADD and EASD comparison in Year 50 in the Chenier Plain region — IPET fragility, 50% pumping scenario, 50th percentile.

With the addition of the master plan's coastal restoration projects, risk is ultimately reduced in the Chenier Plain through their surge and wave attenuation impacts. This reduction is more modest than in other regions in absolute terms; however, the marginal risk reduction from restoration is larger here in relative terms, approximately 10% EADD and 14% EASD in the lower scenario, with 8% EADD and EASD in the higher scenario. These benefits are largest in Lake Charles and surrounding inland communities, as well as Vermilion-UNC, where the induced risk from the FWRO case is further reduced (Figure 44).

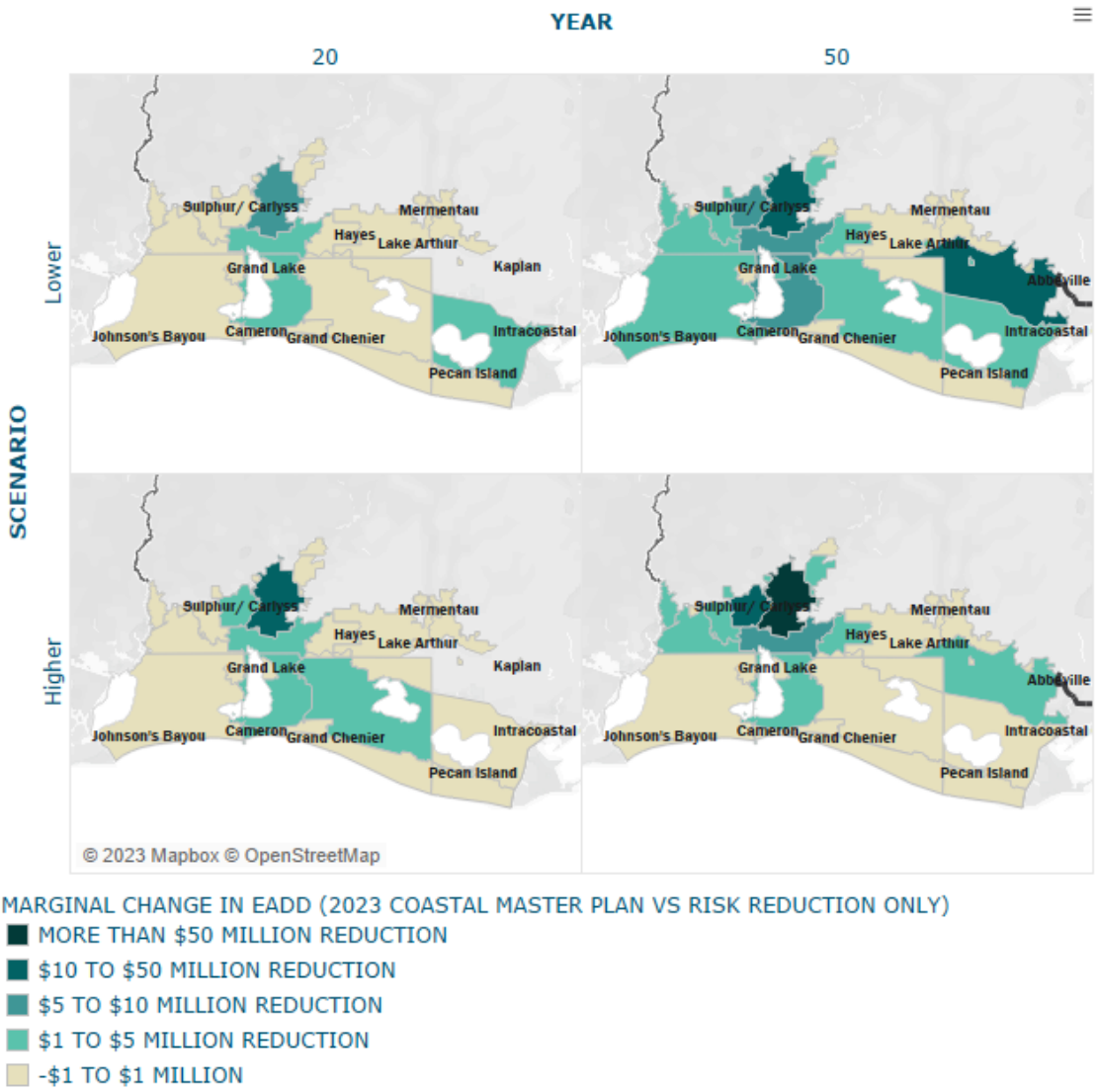

Figure 44. Difference in EADD Between 2023 Coastal Master Plan and Risk Reduction Only Projects in Years 20 and 50 in the Chenier Plain region — IPET fragility, 50% pumping scenario, 50th percentile.

Single family residential exposure to flooding at the 2% AEP level is very similar across all three compared cases, with the full master plan shifting approximately 2,000 marginal structures to not being exposed from some degree of exposure in the FWOA and FWRO cases (Figure 45).

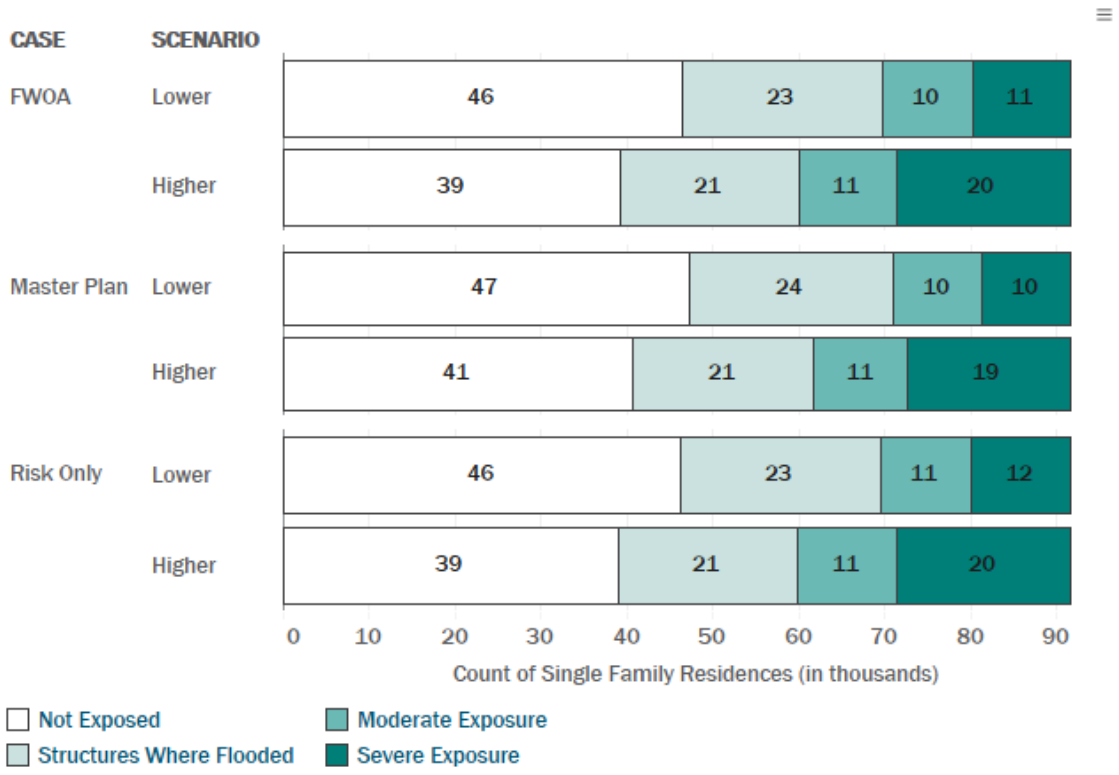

Figure 45. Single family residence structure exposure comparison by scenario in Year 50 in the Chenier Plain region — IPET fragility, 50% pumping scenario, 50th percentile.

7.0 CONCLUSION

This report described the simulation modeling results projecting coastal flood risk and damage in the year 2070. The document presented an analysis of interactions between structural risk reduction projects and coastal restoration projects. This is based on comparisons between the FWOA landscape, the FWMP landscape, and a landscape in which only the 2023 Coastal Master Plan's structural risk reduction projects have been implemented (FWRO). No restoration projects are present in the latter case, but protection projects are assumed to be implemented in keeping with the Coastal Master Plan's recommended implementation schedule.

Coastwide, the master plan's structural risk reduction projects are projected to reduce both EADD and EASD in Year 50 by 41% in the higher scenario and 49% in the lower scenario, relative to a FWOA landscape. The addition of the master plan's coastal restoration projects yields marginal risk reduction of 2.1-2.5% for both metrics and scenarios. This varies regionally, however, with up to 14% EASD reduction for the Chenier Plain in the lower scenario.

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