Financing resilient communities and coastlines

How environmental impact bonds can accelerate wetland restoration in Louisiana and beyond

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Financing resilient communities and coastlines

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Environmental Defense Fund
Qualified Ventures

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Project Team

Environmental Defense Fund
A leading international nonprofit organization, EDF creates transformational solutions to the most serious environmental problems. EDF links science, economics, law and innovative private-sector partnerships. EDF has been on the ground in the Gulf for more than four decades, working to restore coastal ecosystems to create more sustainable, resilient coasts. EDF has extensive experience creating and shaping markets to protect and restore natural resources, developing value-added business partnerships and crafting policies and financing mechanisms designed to engage private capital around environmental initiatives. EDF, together with its Restore the Mississippi River Delta coalition partners, is seeking ways to increase funding for Louisiana coastal restoration. EDF's environmental impact bond (EIB) project team draws expertise across its Ecosystems, EDF+Business and Climate and Energy programs.

Quantified Ventures
Quantified Ventures (QV) is an impact investment intermediary firm that helps coordinate outcomes-based financing approaches across the environmental and health sectors. At the time this project was launched, only one EIB for the provision of environmental services had been transacted — the District of Columbia Water Authority's EIB for green infrastructure for reducing stormwater runoff. Quantified Ventures played a key role in coordinating the DC Water EIB, and is currently involved in designing EIB transactions to address environmental challenges across the United States.

Additional parties included RAND Corporation (Rand), which provided a targeted analysis of Louisiana Coastal Master Plan (CMP) restoration projects' impacts on flooding risk and associated damages, and Upstream Tech (Upstream), which explored means to use machine learning, real-time environmental datasets, and satellite imagery to determine the achievement of performance outcomes over time. Staff from the Louisiana Coastal Protection and Restoration Authority (CPRA) provided valuable guidance and input to the EIB project team over the course of the project.

This project is being funded by NatureVest, the conservation investing unit of The Nature Conservancy, through its Conservation Investment Accelerator Grant, which aims to find and support the best talent and most meaningful work in the field of conservation investment.

Acknowledgements
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Table of contents

Executive summary

Louisiana is facing a land loss crisis that has already begun impacting communities and the national economy. Every 100 minutes, over 1.3 acres of land, an area of the size of a football field, is lost as wetlands turn into open water.[1] Since the 1930s, the state has lost an area of land the size of Delaware, and over the next 50 years, without action, Louisiana will lose an area nearly the size of Connecticut.[2] As this coastal land disappears, so does the storm surge protection it provides communities and businesses, posing significant challenges and putting people and industries at risk.

To combat this crisis, Louisiana's Coastal Protection and Restoration Authority (CPRA) developed an ambitious and innovative 50-year, $50-billion Coastal Master Plan (CMP) to protect and restore the state's coastal areas and sustain the livelihoods of its inhabitants. If fully implemented, the plan would reduce current rates of land loss to realize a self-sustaining, smaller, more resilient Mississippi River Delta that continues to support vibrant communities, a quarter of the nation's waterborne commerce, thriving fisheries, and national energy infrastructure. Diverse stakeholder groups from coastal communities to non-governmental organizations to business leadership support the CMP, and it has enjoyed unanimous support from the state legislature.

While the vision is in place and some projects are underway or completed, the challenge is finding the financial resources to make the entire plan a reality. CPRA has identified $9.16 billion to $11.76 billion in coastal restoration funds,[3] but is short of the funding needed to fully implement the plan.[4] Identified funding sources include billions of dollars in dedicated criminal and civil penalties associated with the 2010 Deepwater Horizon oil spill, which will be deployed over the next 15 years, as well as annual revenues from oil and gas production from offshore Louisiana. Failure to find the remaining capital will slow the state's progress and leave assets increasingly vulnerable to sea level rise and damaging storms.

At the same time, coastal restoration projects will become more expensive over time as CPRA must wait for funds to construct them and continued land loss causes projects to require more sediment and engineering in the future as land continues to erode into the Gulf.

[1] Couvillion, B.R., Beck, Holly, Schoolmaster, Donald, and Fischer, Michelle (2017). Land area change in coastal Louisiana 1932 to 2016: U.S. Geological Survey Scientific Investigations Map 3381, 16 p. pamphlet, https://doi.org/10.3133/ sim3381.

[2] Coastal Protection and Restoration Authority. (2017). Coastal Master Plan. Retrieved from: http://coastal.la.gov/our-plan/2017-coastal-master-plan/.

[3] Sutcliffe, C.M. (2018). CPRA Funding Summary. Presentation at 2018 State of the Coast. Retrieved from: http://stateofthecoast.org/images/SOC18Presentations/2/4-Sutcliffe.pdf.

[4] That gap may be greater than it appears; one study, calculating the costs of the $50 billion 2012 CMP with inflation over its 50 year implementation, found that by 2062 the total price tag could be $94.7 billion. Davis, M.S., Driscoll, John, and Vorhoff, Harry (2014). "Financing the Future: Turning Coastal Restoration and Protection Plans Into Realities: The Cost of Comprehensive Coastal Restoration and Protection". Tulane Institute on Water Resources Law & Policy.

Overview: Louisiana's coastal master plan

Louisiana's CMP is the state's blueprint for creating a more sustainable coast. Updated every six years, the plan uses the best available science to drive coastal protection and restoration efforts to reduce coastal flood risk to communities, promote sustainable ecosystems, provide habitat for a variety of commercial and recreational activities, and support regionally and nationally important industries. The plan includes structural and shoreline protection projects as well a host of nature-based features, such as marsh creation, barrier island restoration, ridge restoration, oyster barrier reefs, sediment diversions and hydrologic restoration projects. Completion of the 2017 CMP would add or maintain 802 square miles of land and reduce expected hurricane storm surge damage by $150 billion over the next 50 years, as compared to a future without action. Each update of the CMP has been unanimously approved by the state legislature, and the Fiscal Year 2019 Coastal Annual Plan — the annual funding vehicle for the CMP — dedicates $600 million in projects, demonstrating continued support for the CMP.

Filling the gap: environmental impact bonds

There is no one solution to addressing this financing gap: the state will have to take a "both-and" approach of using existing funds as efficiently as possible, while simultaneously identifying new funding sources and financing approaches to build out the range of possible financing tools. One key opportunity for CPRA and the Coastal Protection and Restoration Financing Corporation (CPR FC) is to bond against the future annual settlement revenues from the Deepwater Horizon spill — similar to the approach Louisiana took with the Tobacco Settlement Financing Corporation, bonding against settlement revenues from tobacco companies to support health investments in the state.

"Traditional" municipal bonds — be they general obligation bonds backed by the full faith and credit of the issuer or revenue bonds backed by project revenue streams — allow issuers to quickly access capital markets to finance critical public projects. These same "traditional" municipal bonds structures can be reconfigured and structured to allow for repayment not from project revenue streams but from future, dedicated sources of revenue.

Environmental impact bonds (EIBs) incorporate yet another innovative feature — project performance incentives — and represent a promising tool that the state could add to its coastal restoration financing toolkit. EIBs are a form of pay-for-success debt financing in which investors purchase a bond, and repayment to the investors by a "payor" (here, CPRA and/or other interested parties) is linked to and potentially augmented by the achievement of a desired environmental outcome. In practice, most EIBs function similarly to more traditional bonds or other debt, with a fixed interest rate and term, except with an additional "performance payment" made to investors if projects achieve greater-than-expected performance ("over-performance"). [5]

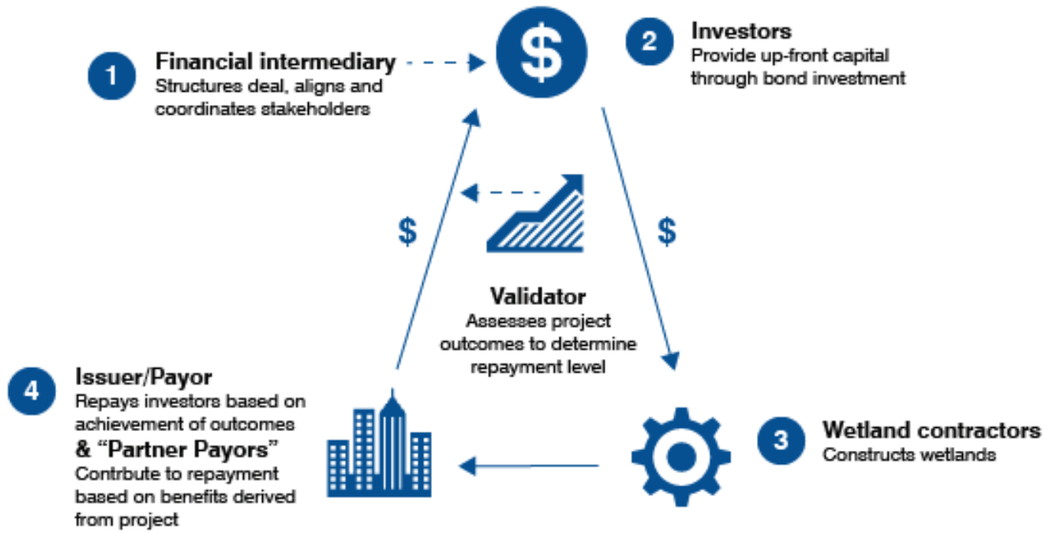
[5] In some cases there is an under-performance payment from investors back to the issuer if the projects do not perform.

Because payments are based on outcomes rather than just the projects themselves, EIBs offer a number of attractive features, including the following:

- **Transferring risk of performance to investors**, conserving public funds and making their spending more efficient based on what actually works
- **Engaging additional "partner-payors,"** private or public entities that benefit from project outcomes but would not have previously contributed to projects, to share in project financing based on the level of benefits they realize from them.
- **Attracting new investors** with a mandate or desire to align their financial returns with positive environmental impact, a growing sentiment in the broader investment community.
- **Building an evidence base for outcomes** through the evaluation that is integrated as a fundamental component of the EIB to validate outcomes, informing future planning.
- **Showcasing innovation** to catalyze greater internal and external support.

FIGURE ES-1

Environmental impact bond structure overview



In the context of coastal restoration in Louisiana, an EIB transaction could be structured to help the state of Louisiana construct wetland restoration projects sooner at a reduced cost; attract the financial involvement of parties who stand to derive the most benefit from accelerated restoration, avoided land loss and reduced storm damages; and quantify the value of the environmental and economic impacts of investing in wetland restoration.

EIBs vs. "traditional" municipal bonds

"Traditional" municipal bonds — be they general obligation bonds backed by the full faith and credit of the issuer or revenue bonds backed by project revenue streams — allow issuers to quickly access capital markets to finance critical public projects. These same "traditional" municipal bonds structures can be reconfigured and structured to allow for repayment not from project revenue streams but from future, dedicated sources of revenue. EIBs incorporate another unique and innovative feature, specifically project performance incentives that allow an issuer, such as CPRA, to leverage additional capital from local asset owners, as "partner-payors," who share an interest in coastal restoration because these projects provide critical protection to property and business operations.

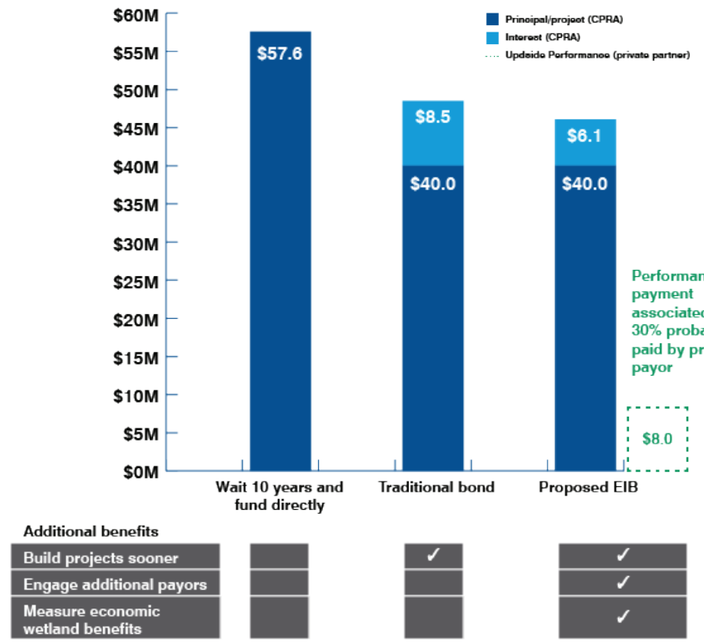
EIBs can provide incentives for sustainable wetland construction by creating a "performance payment" that is shared with wetland restoration contractors if the wetland achieves desired outcomes. This ensures that all parties are aligned toward creating and maintaining sustainable wetlands that provide desired land loss avoidance and flood risk reduction benefits over time.

Finally, EIBs also provide an important means of quantifying the impacts of investing in wetland restoration, by demonstrating the value of restoration efforts to stakeholders across the state and laying the groundwork for future capital contributions from asset owners to restoration projects.

An EIB could accelerate and augment CPRA's effectiveness and impact by restoring wetlands that contribute to protecting communities and stabilizing local economies, jumpstarting job creation through coastal restoration and preserving the tax base through avoided land loss and lowered flood risk. By demonstrating how the private sector can partner with government to implement coastal resilience projects while generating a financial return for investors, Louisiana can lead the way to a new era of private investment in coastal resilience. EIBs can be replicated to support coastal restoration throughout coastal Louisiana, in other Gulf states, and beyond to help regions across the U.S. and the globe cope with sea level rise, land loss and damaging storms.

FIGURE ES-2

Illustrative comparison of CPRA costs of waiting to fund projects, issuing a traditional bond and pursuing the proposed EIB[6]



[6] Notes on calculations: The project evaluated in this report is estimated to be built at the end of CMP Implementation Period I (years 1-10), so the "wait and fund directly" estimate includes a 10-year delay in construction in the absence of bonding. The estimates for interest rates are based on high-level bond pricing; specific costs and details would be determined in transaction structuring and bond issuance process. The performance threshold to trigger the performance payment — how likely "over-performance" would be to occur — would also be determined during transaction structuring and is estimated at 30 percent for the illustrative purposes.

Project scope

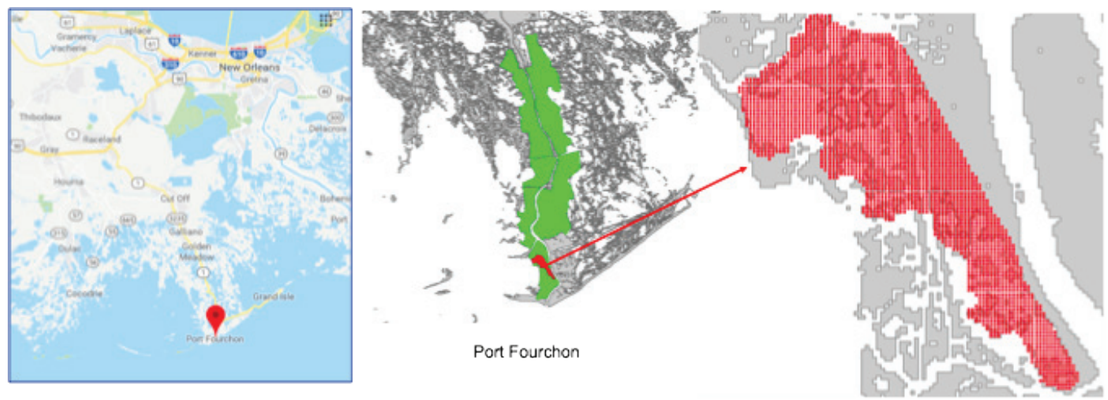
To help address this financing challenge, Environmental Defense Fund (EDF), together with Quantified Ventures, and with input from Louisiana's CPRA, evaluated the feasibility of an EIB to support wetland restoration in Louisiana — and to create a blueprint for financing other natural infrastructure projects that build coastal resiliency across the Gulf and beyond. This project was funded by NatureVest, the conservation investing unit of The Nature Conservancy, through its Conservation Investment Accelerator Grant.

Proposed environmental impact bond transaction: Belle Pass-Golden Meadow marsh creation

This study focuses on a potential $40 million investment in the CMP's Belle Pass-Golden Meadow area adjacent to Port Fourchon, due to the port's economic significance in facilitating offshore oil and gas production. The economic importance of this site also makes it an ideal candidate for exploring a "multi-payor" transaction, leveraging local asset owners to contribute

FIGURE ES-3

Proposed transaction site (red area, far right): Belle Pass-Golden Meadow site (green area) adjacent to Port Fourchon (red pin, far left)



to repayment of the bond upon validation of land loss avoidance benefits provided by wetland restoration.

A simple two-tier EIB transaction is proposed for the Belle Pass-Golden Meadow Marsh Creation project to demonstrate the EIB concept for wetland restoration and begin to gather performance data. **Table ES-1** and **Figure ES-4** summarize the key aspects of the proposed transaction.

The model proposed here is relatively simple: The EIB is a bond with a bonus performance payment for "over-performance" of the wetland. The CPR FC issues a $40 million bond and is responsible for principal and interest payments to investors. A "partner-payor", such as a local asset owner, guarantees a performance payment "bonus" to investors and wetland contractors if wetland restoration surpasses a mutually agreed upon threshold for avoided land loss. This avoided land loss represents, by extension, a reduction in potential flood damages to nearby building and infrastructure assets; the opportunity to help this project get built earlier than planned generates benefits to the partner as the protection benefits start to accrue sooner.

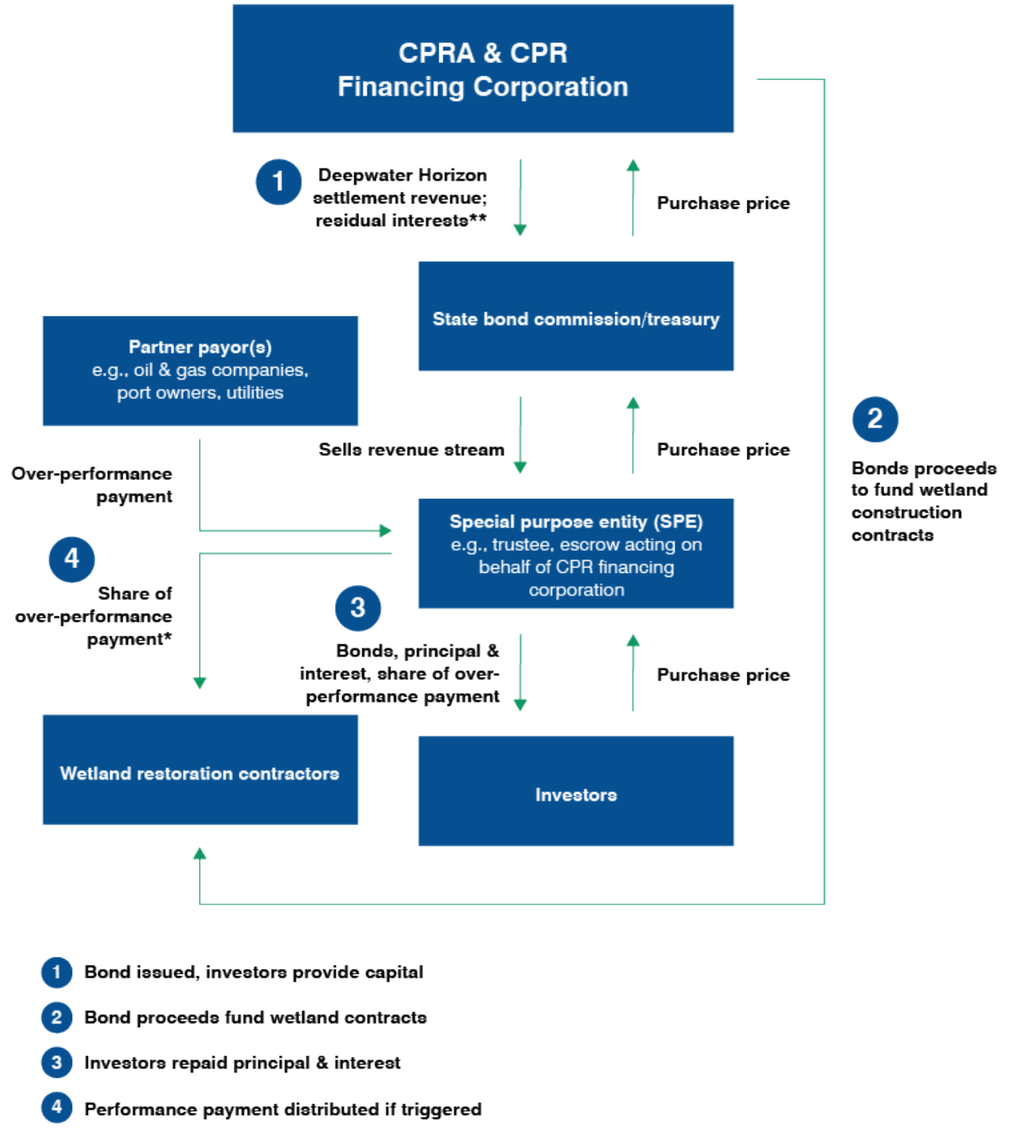
TABLE ES-1

Proposed EIB transaction details (to be finalized in transaction structuring process)

EIB structure	2-tiered (base and over-performance)
Transaction size	$40 million
Denomination	$5 million
Upside performance payment	$3.5 million to $8 million ($1 million to contractors, remainder to investors)
Tenor	10-15 years
Interest rate	1.82-4.73%
Issuer	CPR Financing Corporation
Bond type	Asset-backed bond against future Deepwater Horizon spill settlement revenues
Bond tax status	To be determined
Potential repayment sources - principal	Deepwater Horizon oil spill revenues (CPRA)
Potential repayment source - interest	Coastal Protection and Restoration Trust Fund (CPRA)
Potential performance payment source	Local private asset owner (e.g., oil and gas company)
Project location	Belle Pass-Golden Meadow marsh creation, west of Port Fourchon
Acres of wetland restored	585-835 acres
Performance outcome of interest	Flood risk reduction
Proxy performance metric for measurement	Avoided land loss (vs. expected land loss, and against a similar site where restoration has not occurred)

FIGURE ES-4

Proposed Louisiana EIB transaction structure



* The amount of over-performance payment, if any, is contingent upon achievement of a to-be-determined measurement of flood risk reduction.
** According to CPR Financing Corporation's enabling legislation La. R.S. 39:99:25 to 99.100, residual interests are " the income of the coporation, and bond proceeds, if any, not previously paid to the state, that are in excess of the corporation's requirements to pay its operating expenses, debt service, sinking fund and other redemption requirement, reserve fund requirements, and any other contractual obligations to the holders or that may be incurred in connection with the issuance or repayment of the bonds.

Benefits of using an environmental impact bond

Overall, this approach aligns the incentives of the state, investors, wetland contractors and local asset owners as each works together to ensure a stable economic and environmental future for Louisiana.

For "partner-payors": From the "partner-payor's" perspective, participation in repayment of an EIB means they can secure earlier implementation of wetland restoration adjacent to their assets, to reduce their vulnerability to flood damage and lessen costly business disruptions. Their voluntary investment in wetland restoration will therefore improve the long-term economic stability of the region in which they operate. Finally, the EIB may be set up in a way to provide them with tax benefits for that investment.

For investors: A coastal wetland restoration EIB can be designed to be attractive to investors, especially those with environmental and social investment goals. These "impact investors" are seeking to deploy capital toward projects that benefit ecosystems and communities, while generating a return. In this case, investors receive a share of the performance payment if the wetland over-performs, aligning their interests with the state and wetland contractors.

For contractors: The idea of an outcomes-based approach in wetland construction is already an interest for CPRA. CPRA is evaluating performance-based contracts (PBCs) to implement the CMP, and this EIB provides a similar set of incentives by rewarding wetland contractors for creating sustainable wetlands. The EIB could be used to finance traditional CPRA contracts, or it could be used to finance PBCs. If combined with a PBC, the investors in the EIB could potentially take on some of the risk of wetland sustainability and performance over a longer period of time than the performance contract, and thereby reduce contract costs since wetland contractors would not be responsible for performance for as many years.

FIGURE ES-5

Benefits of the proposed multi-payor EIB

Entity	Benefits
CPRA	• Start projects sooner • Attract additional payors • Incentivize sustainable wetland construction
Asset owner "partner payors"	• Benefit sooner from protections to assets provided by wetlands • Reduce business disruptions • Reduce long-term vulnerability • Use philanthropic dollars effectively
Investors	• Invest in projects that support communities and coastlines • View measurable impact of investments • Receive a bonus performance payment if project over-performs
Wetland contractors	• Receive compensation for sustainable wetland construction
Communities	• Reduce economic impacts from coastal land loss • Protect jobs linked to critical on-shore and off-shore assets & activities

Moving to transaction execution

This report concludes that CPRA would benefit from an EIB because it would help the state use capital more efficiently, build projects sooner, engage local asset owners, attract new investors to Louisiana and build an evidence base for the value of wetlands for flood risk reduction. Moreover, it suggests that CPRA can become a global trailblazer in how to finance coastal resilience and restoration efforts and outlines critical next steps for CPRA and the CPR FC to take to move forward with launching the EIB concept. The first step is activating the CPR FC's bonding authority, which will require a legal analysis of how to navigate any restrictions related to bonding against Deepwater Horizon settlement revenues. In tandem, CPRA and the CPR FC can finalize the site selection and scope of this transaction, and move forward with transaction structuring toward ultimately issuing the environmental impact bond. CPRA and the CPR will also have to engage with investors to evaluate real and perceived risks of the transaction, including land rights, tax status of the bond, and clarifying how and when performance payments would be made.

Conclusion

Louisiana's coastal land loss crisis is daunting. But CPRA and its partners have developed a clear vision of what investments need to be made, as outlined in the CMP. The critical next step for the state is not what to invest in, but how to pay for it — and in the most cost-effective manner possible. The state will need to draw on a range of financial approaches and tools to help make the full vision of the CMP a reality and to address the significant funding gaps identified.

The EIB outlined in this report serves as a template not just for Louisiana but for other coastal investments around the world. Implementing an EIB represents an opportunity for Louisiana to become a world leader in coastal resilience financing. A pilot EIB would demonstrate the power of impact investing to address one of the greatest challenges of our time — building coastal resilience in the face of climate change and sea level rise — while generating a financial return for investors. It can help the state accelerate Louisiana's investment in its coasts and communities, engage and involve asset owners who benefit from restoration efforts and provide a model for future larger investments not just in Louisiana but in coastal areas across the country.

CHAPTER 1

Project overview and objectives

Avoiding land loss is critical to the future of Louisiana's economy, citizens and environment. Coastal Louisiana is losing land to subsidence and sea level rise at a rate about one football field every 100 minutes, posing a direct risk to as much as $3.6 billion in assets that support $7.6 billion in economic activity each year.[7] In addition to direct economic losses, land loss also makes the coast more vulnerable to storms. Without action to restore or protect the coast, by 2067, continued land loss is expected to increase the direct potential damage from a single storm by as much as $138 billion and cause an additional $53 billion in losses from business disruptions to the U.S. economy.[8] Beyond pure economics, coastal Louisiana is home to 2 million people who are at risk from flooding. With sea level rise by 2050, the 100-year coastal floodplain will increase in size by 30% and an additional 260,000 are expected to be at risk.[9] Therefore, the future of Louisiana's coastal communities depends on investing in coastal restoration.

To address these growing land loss and storm impact concerns from Hurricane Katrina and subsequent storms, Louisiana's Coastal Protection and Restoration Authority (CPRA) developed a robust $50 billion Coastal Master Plan (CMP), last updated in 2017, that guides actions to sustain the state's coastal ecosystem, safeguard coastal populations, and protect vital economic and cultural resources.[10] However, to date, only $9.16 billion to $11.76 billion in publicly available funding has been identified to support the plan.[11] While billions of dollars from Deepwater Horizon oil spill settlements are flowing to Louisiana for restoration over the next 15 years, additional funding sources must be secured to fully implement the plan, and all of these funds need to be used as efficiently as possible to maximize their effect.[12]

[7] In 2015 dollars.
[8] Barnes, S.R. &Virgets, S. (2017). Regional impacts of Coastal Land Loss and Louisiana's Opportunity for Growth. LSU Economics & Policy Research Group.Retrieved from: https://www.edf.org/sites/default/files/LSU-EPRG-Regional-Economic-Land-Loss-Risks-and-Opportunities-2017.pdf
[9] Climate Central & ICF International. (n.d.). States at Risk: America's Preparedness Report Card. Retrieved from: http://assets.statesatrisk.org/summaries/Louisiana_report.pdf.
[10] The cost to implement the CMP may be higher; one study calculated the costs of the $50 billion 2012 CMP considering inflation over its 50 year implementation and found that by 2062 the total price tag could be $94.7 billion. Davis, M.S., Driscoll, John, and Vorhoff, Harry (2014). "Financing the Future: Turning Coastal Restoration and Protection Plans Into Realities: The Cost of Comprehensive Coastal Restoration and Protection". Tulane Institute on Water Resources Law & Policy.
[11] Sutcliffe, C.M. (2018). CPRA Funding Summary. Presentation at 2018 State of the Coast. Retrieved from: http://stateofthecoast.org/images/SOC18Presentations/2/4-Sutcliffe.pdf.
[12] Davis, M., & Boyer, N.D. (2017). Financing the Future III: Financing Options for Coastal Protection and Restoration in Louisiana. Retrieved from: http://media.wix.com/ugd/32079b_333bc8956d9d4d56ae8b76253c8270ef.pdf.

To help close the CMP funding gap and ensure existing funds are used as efficiently as possible, Environmental Defense Fund (EDF) and Quantified Ventures (QV), with support from CPRA, have explored how an environmental impact bond (EIB) could be designed to help deliver critical infusions of private capital and engage new classes of investors and payors in support of restoration efforts in coastal Louisiana. While the CMP includes different types of restoration projects, the project team focused on wetland and marsh creation (hereafter "wetland restoration"), the largest restoration category in the CMP at $18 billion, as the target intervention for the EIB. Strategically siting wetland restoration in areas that have historically experienced the greatest asset damages may be one of the most cost-effective methods of coastal protection in the Gulf of Mexico.[13] Restored wetlands will also provide numerous additional benefits through ecosystem services. This study focuses exclusively on EIB opportunities for financing wetland restoration, though the model could be applied to other CMP projects as well.

Environmental impact bond overview

The goal of this effort was to evaluate a $30 million to $50 million pilot investment transaction to demonstrate the feasibility of an EIB for financing wetland restoration. This report focuses on evaluating this potential investment, though the approach is illustrative and could be applied to other sites and geographies along the Louisiana coastline, as well as for natural infrastructure projects generally across coastal geographies.

An EIB is a form of pay-for-success financing where investors provide capital to the issuer of the bond for the construction of environmental projects and are repaid, generally, by that public sector issuer (also referred to as a "payor"). The payments are based on the extent to which desired environmental outcomes are achieved. In practice, it is similar to a traditional bond issuance, but with an additional "performance payment" mechanism beyond principal and interest payments. The performance payment is triggered based on outcomes that are measured and validated over time by a third-party validator. Therefore, EIBs present a novel structure to align the incentives of issuers and investors toward environmental impact wherein the issuers' costs are based on how successfully beneficial outcomes are achieved, and investors' financial returns are tied to impact returns.

In 2017, the District of Columbia Water and Sewage Authority (DC Water) issued the first-ever EIB to finance 20 acres of green infrastructure projects for stormwater management. This $25 million bond issuance, which was bought by Goldman Sachs and Calvert Impact Capital, provided a template for outcomes-based investments in environmental projects. QV, a partner on this project, helped coordinate the DC Water transaction and is now evaluating possible EIB transactions across the United States.[14]

EIBs can provide several key benefits beyond a more "traditional' bond issuance to the bond issuer:

1. **Sharing risk with investors:** Because payments to investors are tied to the achievement of desired outcomes on the project, EIBs can allow issuers to transfer some risk of project performance to investors, helping leverage scarce public funds towards more efficient spending. This feature also incentivizes issuers to experiment with innovative or impactful projects whose performance may be considered risky or uncertain. The

[13] Reguero, B.G., Beck, M.W., Bresch, D.N., Calil, J., and Meliane, I. (2018). Comparing the cost effectiveness of nature-based and coastal adaptation: A case study from the Gulf Coast of the United States. PLoS ONE 13(4): e0192132. Retrieved from: https://doi.org/10.1371/journal.pone.0192132.
[14] For more detail on the DC Water transaction, see: http://www.quantifiedventures.com/dc-water.

performance payment mechanism can be structured in different ways. For instance, DC Water's EIB utilizes a three-tiered structure focused on sharing risk of project failure with investors:

- "As-expected performance" of green infrastructure projects: No performance payment is made between issuer and investors.
- "Over-performance": Issuer makes a performance payment to investors, in addition to regular interest payments, in the case of over-performance where higher than expected performance is achieved.
- "Under-performance": Investors make performance payment to the issuer in the case of under-performance, allowing the issuer to recoup and redeploy some of the investment into other projects.

Other environmental and social impact bonds utilize a two-tiered structure where performance payments are only made by issuers to investors in the case of over- or as-expected performance. In this case, the potential over-performance payment serves to make the investment more attractive by creating more potential reward for investors.

Regardless of the performance payment structure, private investors assume much if not all of the performance risk. Also, the structure aligns the incentives of all stakeholders in the transaction toward achieving desired outcomes.

2. **Engaging additional "partner-payors" (e.g., local asset owners):** EIBs are structured to measure and quantify the benefits associated with project outcomes. Often, these benefits accrue to multiple entities beyond the primary issuer responsible for project implementation. Because payments in an EIB structure are made based on outcomes and not just on completing the projects themselves, they serve as a way to link these positive externalities to multiple payors,[15] thus benefiting the primary issuer through cost-sharing for financing and repayment.

   For instance, wetland restoration projects not only help CPRA meet its commitments — they also help private asset owners or commercial operators in the region achieve the outcomes they care about, such as avoided land loss and flood risk reduction, which in turn reduce business interruptions and property damage. These asset owners would contribute in part out of a desire to accelerate the construction of beneficial wetland projects adjacent to their property and assets. Tying the involvement of these "partner-payors" to the realized achievement of outcomes may make them more comfortable to participate and can lay the groundwork for future involvement in projects that provide flood risk reduction benefits to their property and business operations.

3. **Attracting new investors:** Because of their focus on innovative environmental investments, EIBs can attract so-called "impact investors" who are seeking not just financial returns but also environmental and social returns. These investors, who might not have otherwise participated in a bond issuance in a given geographic location or with a given issuer, can now represent a new and growing class of investors for issuers to diversify their capital sources — an effort which could be valuable to CPRA as the organization embarks on a broader bonding agenda.

[15] Note: For the purposes of this report, the terms "partner" and "payor" are both used to describe additional parties who contribute to repayment of the environmental impact bond.

4. **Building an evidence base for outcomes:** As repayment in an EIB is linked to outcomes, the bonds necessitate monitoring and quantification of how, and the extent to which, the projects generate these outcomes. The EIBs therefore help issuers create an empirical database for projects, informing future adaptive management strategies, planning decisions, and incentivizing development of novel and cost-effective methodologies for future monitoring.

   This EIB's focus on measuring wetland performance would help CPRA better document how natural infrastructure can build resilience by reducing vulnerability to land loss or flooding, and can potentially inform coastal program management across the state and country. As discussed in **Box 1**, EIBs can also cover more nuanced or longer-term outcomes than other forms of outcomes-based financing, like PBCs, potentially saving time or costs in those contracts.

5. **Showcasing innovation:** As a novel financing approach focused on measuring environmental outcomes, EIBs allow issuers to showcase their appetite for innovation and leadership in exploring new, beneficial and efficient uses of public funds for environmental projects. Further, much like green bonds,[16] using EIBs to finance environmental projects can send a signal to the investment market that environmental sustainability and risk management are priorities for the state.[17]

[16] Morgan Stanley Institute for Sustainable Investing (2018). Sustainable Value: Sustainable Bond Issuance as an Investor Signal. Retrieved from: https://www.morganstanley.com/pub/content/dam/msdotcom/ideas/gender-equality-bond/Sustainable_Bond_Issuance_as_an_Investor_Signal.pdf.
[17] Morgan Stanley Institute for Sustainable Investing (2018). Sustainable Value: Sustainable Bond Issuance as an Investor Signal. Retrieved from: https://www.morganstanley.com/pub/content/dam/msdotcom/ideas/gender-equality-bond/Sustainable_Bond_Issuance_as_an_Investor_Signal.pdf.

Environmental Impact Bonds and Performance-Based Contracting: What's the link?

EIBs and PBCs both help issuers pay for outcomes ("performance") rather than just process (e.g., construction). In 2017, Louisiana's legislature authorized the use of outcome-based performance contracting for coastal protection projects. CPRA is initiating its first PBC pilot for wetlands restoration, in which contractors would provide their own project financing and be repaid by CPRA according to the achievement of milestones. The project site proposed here falls just outside CPRA's proposed PBC pilot area (on the Terrebonne Basin side rather than the Barataria Basin side of Bayou Lafourche).

For projects that would use PBCs, though, the two mechanisms could work well together. "Performance" in CPRA's PBC definition would be defined by such factors as area of land built and elevation of land pursuant to CPRA's wetland engineering and design guidelines, borrowed from national standards set for compensatory wetland mitigation and wetland mitigation banking.

However, in practice, it may be difficult for contractors to control for more nuanced or external factors driving outcomes, as compared to simpler project outputs. For example, in the context of wetland restoration, contractors are accustomed to being responsible for meeting a certain amount of acreage, species composition or land elevation. Yet even with the best possible construction or design, they may not be able to fully control factors such as accretion or continued erosion of sediment around the wetland. Therefore, those more nuanced factors driving outcomes of avoided land loss or flood risk reduction may be more suited to the risk transfer mechanism of an EIB than through a PBC.

In addition, there is also an element of timing differentiating PBCs and EIBs. Typically, wetland restoration contracts cover performance over 5-10 years, whereas EIBs can set an evaluation period informed by what makes the most sense for particular project outcomes or by investor preferences, up to the maturity of the bond. Because coastal stabilization and resilience outcomes from wetland restoration occur on longer timeframes, EIBs may be able to cover more years of performance related to even simple outcomes, such as wetland area or elevation, than PBCs.

In speaking to wetland contractors through the development of this report, the project team found there was common interest among these firms to take on less years of performance or less complicated outcomes through the performance contracts. Contractors also expressed that they would charge higher rates for longer or more complex performance contracts. EIBs can help shift some of these performance outcomes from contractors to investors, potentially at lower costs to issuers (depending on the size of the performance payment). Issuers also benefit from outcomes-based financing that is oriented more toward the end results issuers ultimately care about (i.e., by accounting for performance on longer timeframes or for factors outside the control of contractors).

However, the team recognizes that responsibility for outcomes should not fall solely to investors, as it is still important to properly incentivize and hold contractors accountable for optimal wetland design and construction. Where PBCs are used, EIBs can be layered on to share responsibility for outcomes and incentivize contractors. Even without a PBC, however, EIBs can also include a small portion of the performance payment going to contractors, as in the transaction structure proposed here, to achieve this shared incentivization toward success.

CHAPTER 2

Assessment of transaction design elements

In order to assess the feasibility of an environmental impact bond to support wetland restoration in Louisiana, the project team conducted an analysis of the investment context in order to:

1. **Establish the value of bonding** as a financing approach and possible sources of bond repayment.
2. **Determine a possible pilot site and size** within CPRA's suggested $30 million to $50 million transaction amount.
3. **Evaluate how best to value and measure wetland performance**, and what outcomes should be tied to repayment of the EIB.
4. **Weigh various possible transaction design features** to settle on a proposed transaction structure.
5. **Engage and evaluate possible partners** who can assist in repayment of the EIB.

The goal of this project is to demonstrate the potential of an EIB for financing wetland restoration and focuses on evaluating one possible investment scenario. The approach is illustrative and could be applied to other sites and geographies along the Louisiana coastline.

Proposed transaction: overview

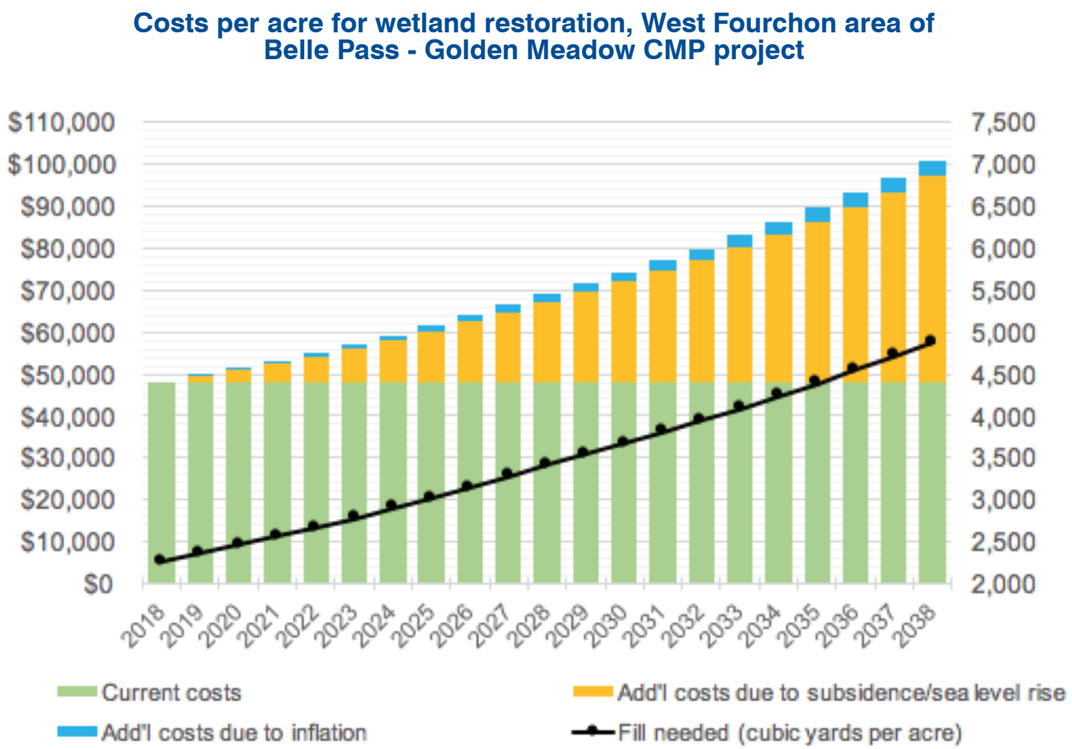
This analysis led to the selection of $40-million, 835-acre pilot project area in the larger Belle Pass-Golden Meadow Marsh Creation CMP project, adjacent to Port Fourchon. The proposed transaction ties financial payment to reduced rates of land loss over time due to wetland restoration, which can serve as a proxy for flood risk reduction benefits provided to local asset owners. Given the focus on illustrating these economic benefits to asset owners, the proposed structure focuses on engaging these entities as potential partners to contribute to repayment of the bond once desired outcomes of the wetland are achieved. This section of the report outlines the process followed to arrive at this transaction structure, and the transaction is subsequently presented in greater detail.

2.1 The value to CPRA of bonding and sources of repayment

Fundamentally, wetland restoration projects will be less expensive constructed now than in the future. A 2016 study by The Water Institute of the Gulf modeled these effects on future restoration costs for a representative sample of sites across different parts of the coast.[18] For this report, the project team updated the calculation of sediment required for restoration at different points in time with data and design inputs from CPRA for potential EIB candidate sites. Based on these calculations, the costs of restoration are expected to more than double over the next 20 years in representative sites, as illustrated in Figure 1 below.

FIGURE 1

Estimated restoration costs per acre over time, West Fourchon[19]



[18] Reed, D.J. (2016). Future Costs of Marsh Creation Projects in Coastal Louisiana. The Water Institute of the Gulf. Retrieved from: https://thewaterinstitute.org/reports/future-costs-of-marsh-creation-projects-in-coastal-louisiana.

[19] Assumes 2% average annual inflation. Costs due to subsidence and sea level rise also include inflationary costs on additional, but not current, sediment required.

Because subsidence and sea level rise continue to occur, restoration projects — particularly wetland restoration — get more expensive over time, not just due to inflation-related cost increases but also as more sediment is required to achieve the same level of restoration. Further, there is the possibility for additional flood-related damages and erosion to occur in the interim period between now and when the wetlands are constructed.

The increasing costs over time make a strong case for bonding as a general approach, to allow CPRA to access capital now to construct wetland restoration projects. The Coastal Protection and Restoration Financing Corporation (CPR FC) has authority to bond, per its enabling legislation.[20]

In addition to overall comparative costs of course, the key question for CPRA and investors alike is what revenue sources could be used to repay a bond over time. As discussed above, CPRA has identified $9.16 billion to $11.76 billion in funds to support the $50-billion CMP. For wetland restoration projects, most of the funding sources identified by CPRA are revenue streams that will be realized on an ongoing, annual basis. That funding is derived primarily from settlement funds related to the 2010 Deepwater Horizon oil spill and from a share of revenues from oil and gas production in federal waters off the coast of Louisiana pursuant to the Gulf of Mexico Energy Security Act (GOMESA). Because these revenues are projected to come in over time, the CMP outlines a staged approach to investment in wetland restoration, demarcating projects for completion in three implementation periods: years 1-10, 11-30 and 31-50. These sources of funding are outlined in **Table 1** below. **Box 2** provides a general overview of funding available through funds associated with the Deepwater Horizon oil spill.

TABLE 1

Available funding sources for bond repayment

Revenue source	Current estimates	Timeline	Repayment potential	Notes
Deepwater horizon oil spill funds				
Natural resource damage assessment (NRDA)	$319 million	Annual until 2031	Principal	Project plans must be approved in advance
RESTORE Act (Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act)	$55.9 million	Annual until 2031	Principal	Project plans must be approved in advance
Oil & gas production revenues				
Gulf of Mexico energy security act (GOMESA)	$66 million	Annual	Principal	Dependent on oil prices, maximum of $140 million per year to Louisiana. Projected to be $65 million to $75 million for the next 5 years
Oil and gas revenues – state mineral revenues	$15 million	Annual	Interest and performance payments	Tied to state oil and gas production and dependent on oil and gas prices; held in Coastal Protection and Restoration Trust Fund

[20] Louisiana Revised Statute (2017, 6 July). R.S. § 39:99.26

A deeper dive: Deepwater Horizon settlement funds

Two separate sets of funds related to the Deepwater Horizon oil spill are available to fund wetland restoration in Louisiana (and other Gulf states affected by the spill).

The Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act (RESTORE Act of 2012) dedicated 80 percent of all administrative and civil penalties related to the Deepwater Horizon spill to a Gulf Coast Restoration Trust Fund (Trust Fund) which is now overseen by the **Gulf Coast Ecosystem Restoration Council** (RESTORE Council).

The Oil Pollution Act authorizes evaluation of oil spill impacts and the planning and execution of restoration efforts. After the Deepwater Horizon oil spill, the **Deepwater Horizon Natural Resource Damage Assessment Trustee Council** formed for this purpose. Each Council has established standard operating procedures for administration and expenditure of their funds.

The **Louisiana Trustee Implementation Group** (LA TIG), which includes representation from state and federal agencies, makes decisions regarding which are suitable projects to fund, guided by specific criteria and in compliance with applicable federal and state laws, and, to the extent possible, consistent with Louisiana's CMP.

The state must request authorization for specific restoration projects from one of these two sources. While the State of Louisiana is represented on both the RESTORE Council and the LA TIG, the state cannot assume funding will be approved. If and when either the Council or LA TIG (depending on to whom the application was made) approves the project, funding is also authorized. If a project is funded through the RESTORE Council, the state submits a grant application and is reimbursed for its authorized expenses. If a project is funded through the LA TIG, the state submits a funding resolution and if approved, monies are released for the planned and authorized expenses.

Therefore in the context of an EIB, where either of these two sources of revenue for the state are involved, a bond would most likely be issued once a project has been authorized for repayment by the Council or the LA TIG. Repayment to investors would subsequently occur.

As outlined in Section 6: Conclusions and Next Steps, additional legal analysis will be required to determine the specifications around which of these revenue sources could be employed for bond repayment. While the CPR FC has the authority to bond against these revenues per the entity's enabling legislation,[21] the allocation of Deepwater Horizon settlement revenues requires federal approval.

[21] Louisiana Revised Statute. R.S. § 39:99.25-100.

The tobacco settlement financing corporation as a template

Louisiana's Tobacco Settlement Financing Corporation provides the template for the CPR FC, and therefore serves as a model for how CPRA and the CPR FC could utilize its bonding authority. In 1998, Louisiana entered into a settlement agreement with 45 other states to receive compensation from tobacco manufacturers to address the health costs associated with tobacco usage. These funds were allocated into health, education and tobacco enforcement uses in the state. The state has received $2.6 billion in settlement revenues since 1999. The Tobacco Settlement Financing Corporation has issued bonds against future settlement revenues that provide current assets for the state, starting with a securitization of 60 percent of the state's settlement revenues in a $1.2 billion bond issuance in 2001 (which was refunded in 2013). This model was successful in attracting investors, demonstrates to the state and to investors that a bond issuance is feasible, and can provide a roadmap for pursuing legal clarity on how the CPR FC can exercise its bonding authority.

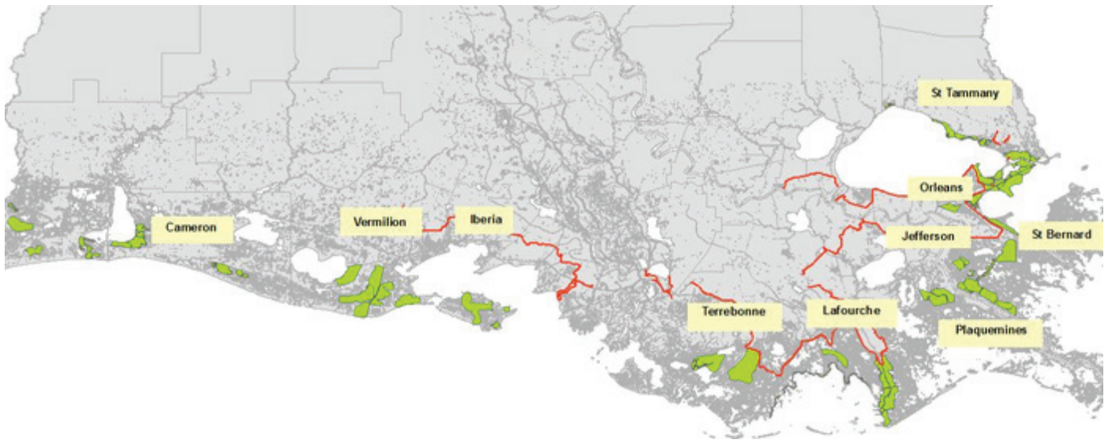
2.2 Selecting pilot project site and size

The project team worked with the CPRA to define criteria for narrowing the list of potential project areas that could be financed with an EIB to conduct an in-depth feasibility analysis. One key parameter was choosing a project that would benefit from an accelerated construction timeline. The project team evaluated the 31 currently unfunded 2017 CMP marsh creation projects scheduled for the latter end of Implementation Period 1 (years 1-10) and Implementation Period 2 (years 11-30).

FIGURE 2

Marsh creation projects included in implementation period

1 (years 1-10) and 2 (years 11-30) of Louisiana's 2017 CMP (green). Structural projects, i.e., levee construction or improvements, are shown with red.



The project team evaluated the sites to ensure that baseline criteria for an EIB would be met, including:

- **Avoided costs:** The project could realize avoided costs of further land subsidence through earlier construction.
- **Sufficient transaction size:** CPRA identified a range of $30 million to $50 million for a pilot transaction, ensuring that sufficient wetland area could be restored to warrant the time and effort involved in designing an EIB transaction and attracting investors.
- **Viable repayment:** A source of revenue could be identified for repayment of an EIB; in this case, each project could be eligible for Deepwater Horizon oil spill funds.
- **Measurable outcomes:** The project must have measurable environmental improvements or outcomes to which payments can be tied.

To generate a shortlist of sites and ultimately select a pilot site, the team evaluated these 31 sites across a range of criteria to identify those with characteristics especially well-suited for financing with an EIB, such as:

- **Multiple stakeholder beneficiaries:** Ideally, the wetland restoration project should have potential to generate land loss avoidance, flood risk reduction and/or other benefits which could attract additional "partner-payors". These potential benefits include:
  - Reduced damages to public and private assets.
  - Reduced business interruption to major industries.
  - Lower costs for levee operations and maintenance.
  - Protection of navigation channels such as the Gulf Intracoastal Waterway.
- **Potential for performance risk and incentives to be shared:** There is some uncertainty regarding outcomes of the wetland restoration project, and the issuer could be seeking to reduce or share these risks with investors, or to incentivize good performance.

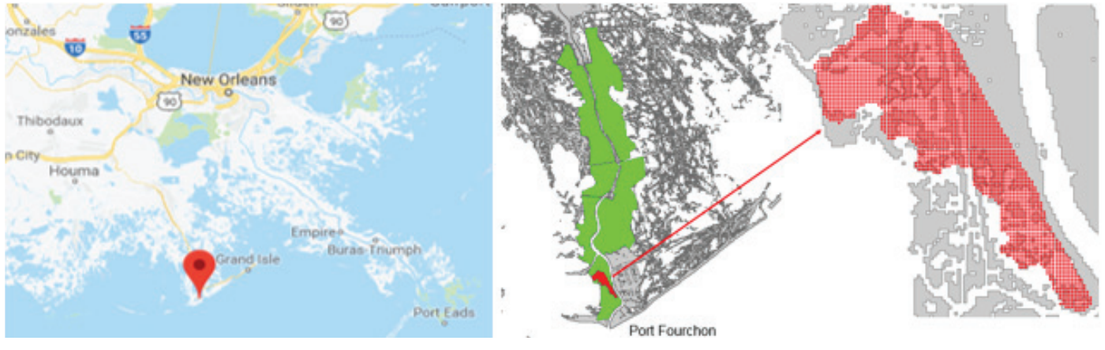
More detail on this analysis is provided in **Appendix B**.

The project team chose the Belle Pass-Golden Meadow project area (Figure 3) as the most appropriate site due to the concentration and vulnerability of economically valuable assets in the area. Further, the state is considering parts of Belle Pass-Golden Meadow for its pilot with PBCs, which could help the state compare actual cost savings from PBCs and EIBs.

The Belle Pass-Golden Meadow Marsh Creation project is one of the largest wetland restoration projects in the 2017 CMP, comprised of 23,000 acres in the southern tip of Lafourche Parish, along either side of Bayou Lafourche. Potential beneficiaries of restoration in this area include the port itself, navigation and energy industries, users of Highway 1 which runs through the project area, the South Lafourche Levee District that maintains the levees directly to the north of this area, and nearby communities. RAND's analysis of the impacts of restoration on

FIGURE 3

Belle Pass-Golden Meadow marsh creation project (green) and proposed EIB pilot area (red).



damages from storm surge suggests that wetland restoration projects could reduce direct damages to industrial assets in Lafourche Parish by an average of $3.1 million annually through 2065, or roughly $155 million in total by 2065.[22,23]

Due to the constraints of the pilot size ($30 million to $50 million), the EIB would only fund a portion of the Belle Pass-Golden Meadow Marsh Creation project, focusing on the southern portion of the site adjacent to Port Fourchon.

Port Fourchon

Port Fourchon has strategic and economic importance to Lafourche Parish, the Houma-Thibodaux Metropolitan Statistical Area, Gulf Coast region and the nation. The port is a critical provider of jobs and tax revenues in Lafourche Parish and is an economic driver for the state of Louisiana. The port is central to oil and gas production, storage and distribution for the nation, servicing over 90 percent of the Gulf of Mexico's offshore oil production.[24] Business disruptions from storms are costly at the local, state and national levels. A 2014 study commissioned by Port Fourchon estimates that for every hour the port is out of operation, the U.S. economy suffers by $22 million.[25] The vital importance of this port to the regional and national economy is outlined in further detail in **Appendix C**.

The economic importance of Port Fourchon presents an interesting opportunity to explore the value of wetland restoration projects to local asset owners, thereby creating the potential for a multi-payor transaction in which asset owners who benefit from wetland restoration projects could contribute to repayment of those projects as "partner-payors."

[22] Results for the high environmental scenario in the 2017 CMP, which considers the highest levels of sea-level rise, subsidence and storm intensity analyzed for planning purposes.
[23] The RAND analysis did not include direct benefits to levees (such as reduced operations and maintenance costs from wave attenuation by wetlands), reduced tidal or nuisance flooding damages, or the costs of avoided business disruption, making this a conservative estimate.
[24] Greater Lafourche Port Commission. (n.d.) Port Facts. Retrieved from: http://portfourchon.com/seaport/port-facts.
[25] Loren C. Scott & Associates, Inc. (2014). The economic impact of Port Fourchon: an update. Retrieved from: http://www.lorenscottassociates.com/Reports/PortFourchonImpact2014.pdf.

2.3 Valuing wetlands and determining outcomes for measuring wetland performance

The value of wetlands

In any EIB, the performance payment mechanism is driven by an economic logic that issuers should be paying for projects based on the successful generation of environmental benefits and thus provide issuers with economic value. Therefore, the greater the benefits and outcomes achieved, the more the issuer should be willing to pay for it. Likewise, the less successfully an outcome is achieved, the less the issuer should pay for it.

Wetlands provide a ripe opportunity for the EIB model since wetlands create a range of quantifiable benefits that accrue to a diverse range of stakeholders. Louisiana contains about 40 percent of the highly valuable wetlands in terms of habitat and ecosystem services of the lower 48 United States — but this value is under threat, as the state also experiences 90 percent of the annual coastal marsh loss in the nation.[26,27] The project team considered a range of wetland benefits to help inform what kind of outcome and definition of "performance" might be most meaningful to CPRA and the EIB.

Overall ecosystem services

The Mississippi River Delta's fresh water and habitats influence the ecological health of the entire region. In 2010, a report on coastal Louisiana's provision of ecosystem services stated that the delta generates at least $12 billion to $47 billion (2007 dollars) in ecosystem benefits — including water supply and quality mitigation, recreation, food production and storm protection — to people each year. If this natural capital were treated like an economic asset, its total value to the nation would be $330 billion to $1.3 trillion (assuming a 3.5 percent discount rate).[28]

Economic benefits

In addition, over 1 million people in Louisiana depend on the coast for their livelihoods as of 2012, and the region is home to a majority (57 percent) of the state's jobs.[29] Large-scale wetland restoration in coastal Louisiana presents a significant opportunity to stabilize these jobs and to protect existing infrastructure, industry and resources of national importance. The delta supports infrastructure that supplies 90 percent of the nation's outer continental oil and gas, 20 percent of the annual waterborne commerce (five of the nation's 15 largest shipping ports by cargo volume are located in the delta) and 26 percent (by weight) of continental U.S. commercial fisheries landings.[30]

Investing in wetland restoration will also create new jobs by adding to the state's sizeable and growing water management industry. Coastal protection and restoration activities and their associated benefits are estimated to add and sustain 78,000 to 105,000 jobs over the next 10 years and create $17.27 of total economic output for every $1 spent.[31]

Land loss mitigation

It is estimated that the coastal region of Louisiana is home to around $500 billion in capital assets, including residences, commercial and industrial infrastructure, transport networks, etc.[25] Continued land loss alone, apart from the additional impact from storms, is expected to put $3.6 billion of these assets at risk over the next 50 years and cause another $7.6 billion in disruption of economic activity if no protection or restoration action is taken.[27] Wetlands help abate this risk both directly through the creation of wetlands themselves, and indirectly as points of accretion for more sediment to fill in.

Flood risk reduction

Reducing land loss mitigates exposure of coastal assets to storms and floods, and wetlands also help diffuse the force of wind and storm surges. Wave attenuation services of marsh vegetation, as measured by reductions in wave height per unit distance across a wetland, have been documented across a number of studies.[32,33] One study of southern Louisiana shows that wetland continuity and vegetation roughness can be effective in reducing hurricane storm surge levels and, by extension, property damage.[34] Additionally, maintaining property values could improve the stability of the tax base in the regions benefiting from protection.

Investments in wetland restoration have been highlighted as one of the most cost effective measures for risk reduction along the Gulf Coast.[35] A study comparing the costs and benefits of 10 adaptation measures, including nature-based measures, traditionally engineered or "gray" infrastructure and policy measures, shows high benefit-to-cost ratios of wetland restoration particularly in high risk areas — including Lafourche and St. Tammany parishes in Louisiana, two of the regions considered for the EIB pilot in this analysis.

[26] Dahl, T.E. & Johnson, C.E. (1991). Status and trends of wetlands in the conterminous United States, mid-1970's to mid-1980's. US Department of the Interior, Fish and Wildlife Service. Retrieved from: https://www.fws.gov/wetlands/documents/Wetlands-Status-and-Trends-in-the-Conterminous-United-States-Mid-1970s-to-Mid-1980s.pdf.

[27] Stedman, S. & Dahl, T.E. (2008). Status and trends of wetlands in the coastal watersheds of the eastern United States, 1998 to 2004. National Oceanic and Atmospheric Administration, National Marine Fisheries Service & US Department of the Interior, Fish and Wildlife Service: Retrieved from: https://www.fws.gov/wetlands/documents/Status-and-Trends-of-Wetlands-in-the-Coastal-Watersheds-of-the-Eastern-United-States-1998-to-2004.pdf.

[28] Batker, D., de Torre, I., Costanza, R., Swedeen, P., Day, J.W., Boumans, R., & Bagstad, K.. (2010). Gaining ground: wetlands, hurricanes and the economy: the value of restoring the Mississippi River delta. Earth Economics. Retrieved from: https://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=1038&context=iss_pub.

[29] Barnes, S.R. & Virgets, S. (2017). Regional impacts of Coastal Land Loss and Louisiana's Opportunity for Growth. LSU Economics & Policy Research Group. Retrieved from: https://www.edf.org/sites/default/files/LSU-EPRG-Regional-Economic-Land-Loss-Risks-and-Opportunities-2017.pdf.

[30] Coastal Protection and Restoration Authority. (2017). Coastal Master Plan. Retrieved from: http://coastal.la.gov/our-plan/2017-coastal-master-plan/.

[31] Barnes, S.R. & Virgets, S. (2017). Regional impacts of Coastal Land Loss and Louisiana's Opportunity for Growth. LSU Economics & Policy Research Group. Retrieved from: https://www.edf.org/sites/default/files/LSU-EPRG-Regional-Economic-Land-Loss-Risks-and-Opportunities-2017.pdf.

[32] Gedan, K.B., Kirwan, M.L, Wolanski, E., Barbier, E.B. & Silliman, B.R.. (2010). The present and future role of coastal vegetation in protecting shorelines: answering recent challenges to the paradigm. Climatic Change 106(1): 7–29. Retrieved from: https://www.researchgate.net/publication/226141366_The_Present_and_Future_Role_of_Coastal_Wetland_Vegetation_in_Protecting_Shorelines_Answering_Recent_Challenges_to_the_Paradigm.

[33] Shepard, C.C., Crain, C.M. & Beck, M.W. (2012). The protective role of coastal marshes: a systematic review and meta-analysis. PLoS ONE 6(11): e27374. doi:10.1371/journal.pone.0027374. Retrieved from: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0027374.

[34] Barbier, E.B., Georgiou, I.Y., Enchelmeyer, B., & Reed, D.J.. (2013). The value of wetlands in protecting southeast Louisiana from hurricane storm surges. PLoS ONE 8(3): e58715. doi: 10.1371/journal.pone.0058715. Retrieved from: http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0058715.

[35] Reguero, B.G., Beck, M.W., Bresch, D.N., Calil, J., and Meliane, I. (2018). Comparing the cost effectiveness of nature-based and coastal adaptation: A case study from the Gulf Coast of the United States. PLoS ONE 13(4): e0192132. Retrieved from: https://doi.org/10.1371/journal.pone.0192132.

Habitat creation and carbon sequestration

In the preparation of Louisiana's CMP, other wetland ecosystem benefits were considered in the selection of marsh creation sites, including direct benefits to species such as alligator, crawfish, oysters, shrimp, saltwater fisheries, and freshwater fisheries, all of which support the seafood and tourism industries.

Carbon sequestration from marshes and coastal ecosystems represents another service that could be supported by investments in restoration. Investing in coastal restoration helps enhance sequestration and prevent carbon releases that occur as wetlands convert to open water. A carbon offset, defined as a metric ton reduction in emissions of carbon dioxide, compensates, or offsets, an emission made elsewhere. An analysis of Louisiana demonstrated that allowing entities to invest in wetland restoration projects to offset greenhouse gas emissions elsewhere holds promise as a new carbon offset sector and could bring between $540 million and almost $1.6 billion over the next 50 years to assist with wetland restoration in the Mississippi River Delta.[36]

Determining outcomes: defining "success" of a wetland

Given all of these sources of value provided by wetlands, the project team sought to identify a performance outcome that represented the benefit most valued by stakeholders, and a metric that could be established as a proxy for that outcome and easily measured. The team settled on a metric of avoided land loss as the primary metric to evaluate. The logic for this decision is described below.

In addition to the payors' priorities in terms of how they view impact and economic value, the selection of a particular outcome and associated metric to assess the performance payment must also be based on logistical considerations for its cost-effective and reliable measurement and validation. Therefore, the project team considered the following criteria when selecting potential performance metrics for the EIB pilot:

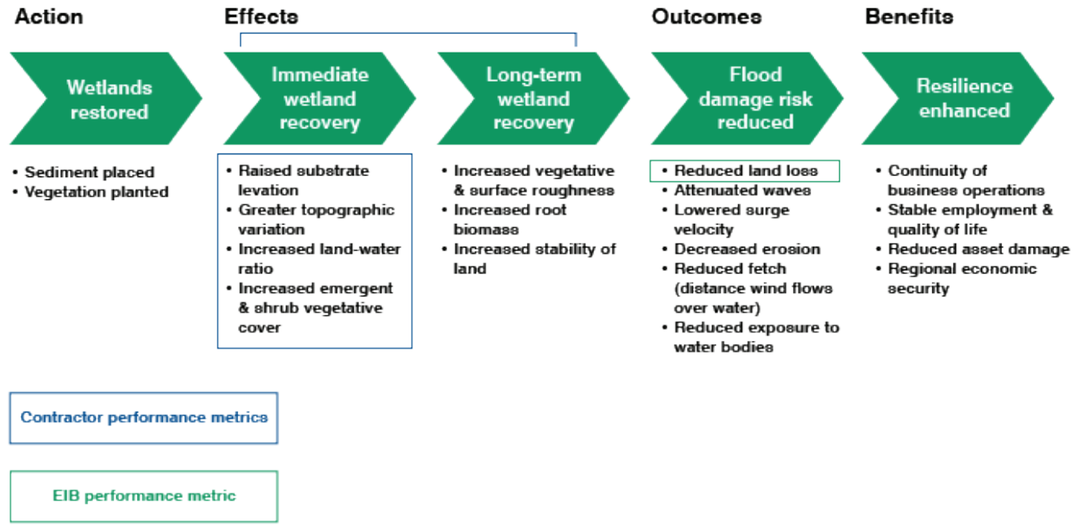
- Readily measurable and verifiable in a cost-effective manner.
- Can be attributed to the performance of the project.
- Compelling to CPRA and other potential payors and beneficiaries.
- Risk probabilities fit investors' appetite.
- Time horizon of outcome's achievement fits payors' planning window.
- Time horizon of validation fits investors' appetite.
- Not easily addressed through service provider contracts or insurance mechanisms.

The team's analysis (detailed in **Appendix D**) determined that flood risk reduction was the outcome most valuable to local asset owners, and avoided land loss is the best proxy metric around which to structure the EIB performance payment. This means that if the wetland restoration project "over-performs" in terms of expected avoided land loss over time, this would trigger a performance payment to investors.

[36] Mack, S.K., Yankel, C., Lane, R.R., Day, J.W., Kempka, D., Mack, J.S. … LeBlanc, D.. (2014). Carbon market opportunities for Louisiana's coastal wetlands. Tierra Resources. Retrieved from: https://climatetrust.org/wp-content/uploads/2015/03/Carbon-Market-Opportunities-for-Louisiana%E2%80%99s-Coastal-Wetlands-150305-CS-FNL.pdf.

FIGURE 4

Outcome logic chain: measuring "performance" for a wetland



Measuring and validating outcomes

As noted above, the ability to measure and validate achievement of outcomes is key to the environmental impact bond.

Ideally, the EIB could provide the opportunity to directly measure the outcome of interest: flood risk reduction benefits from the wetland restoration projects. However, the necessary detailed high resolution risk modeling would be expensive, thereby increasing transaction costs to such an extent that it could reduce the appeal of this financing approach to CPRA. Furthermore, the relatively small size of the pilot EIB wetland restoration would limit the geographical extent of the project and, by extension, the amount of benefits that could be reasonably attributed to the project. Flood depths in the area could be tracked with remote sensing, but such is not the same as determining the wetland's full flood risk reduction potential. Measurement of other wetland characteristics, such as land-water ratio and vegetation density, would also help to establish that the project exhibits flood buffering characteristics and could be expected to generate flood risk reduction benefits.

As a result, the team focused on avoided land loss as a proxy metric for flood risk reduction, and developed a proposed approach for a measurement methodology. Fundamentally, the net effect of the project on wetland creation (land created minus land lost) would be measured throughout the monitoring period within the project area as well as adjacent parcels. These project impacts would be compared to a counterfactual scenario (i.e., land loss without restoration based on comparable reference sites). **Appendix D** describes an approach to measuring these "counterfactual outcomes" as well as defining expected levels of avoided land loss.

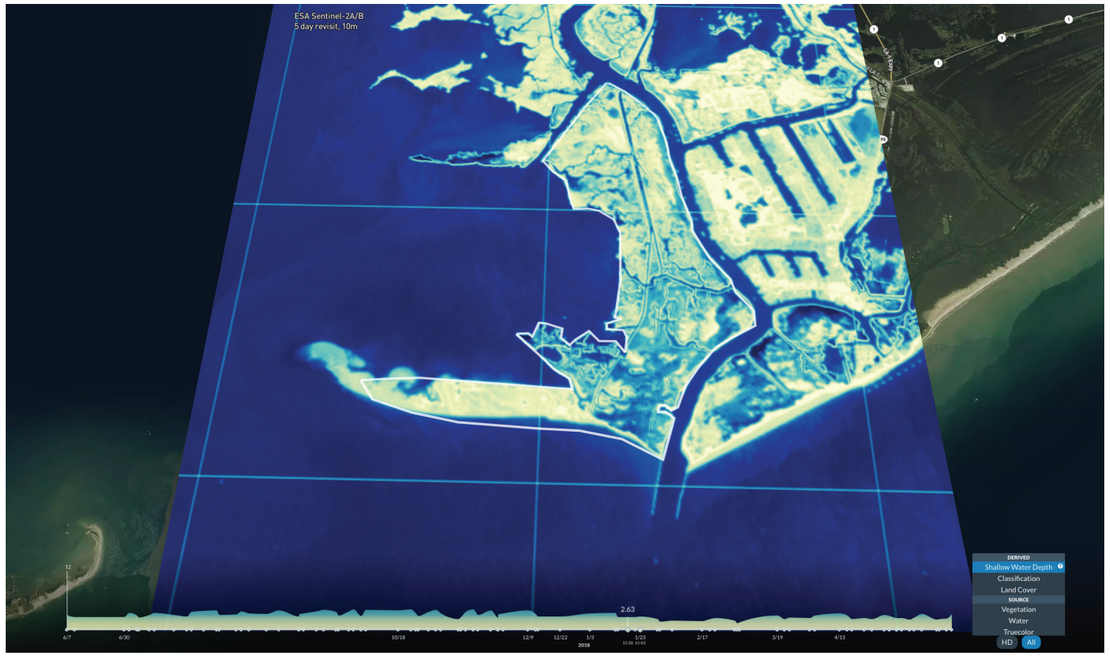
Measurement and validation also entails costs to the issuer, so the team evaluated potential options for conducting measurement and validation through a low-cost, technology-enabled approach. The team engaged with the technology company Upstream to develop a methodology for low-cost, near real-time monitoring of avoided land loss and other project metrics through satellite imagery and machine learning, cross-referenced with observational

data from the Coastwide Reference Monitoring System (CRMS) and United States Geological Survey (USGS) field stations. **Figure 5** is an illustrative screenshot of water depth in the Port Fourchon area from Upstream's platform, demonstrating how the platform could generate visualized data on the performance of the wetland over time.

Ultimately, the project team concluded that measuring avoided land loss can serve as a valuable proxy for flood risk reduction benefits to stakeholders, therefore linking repayment of the bond to an economically valuable concept.

FIGURE 5

Port Fourchon water depth, as generated by upstream satellite imagery and analysis



2.4 Evaluating possible transaction design options

With a pilot site and the outcome and metric identified, the project team evaluated how to design a financial transaction in a manner that would be most beneficial to CPRA. Three primary design concepts were explored:

- Engaging "partner-payors" based on reducing risk to local assets:
  - Wetland restoration projects that are constructed near valuable assets can provide flood risk reduction benefits. Local asset owners would participate in repayment of the bond based on the observable achievement of wetland restoration outcomes. They would be able to see that the wetland was providing benefits to their assets and thereby helping the asset owner avoid future costs related to storm and flooding damage.
- Engaging private stakeholders based on beneficial use of dredged materials:
  - Port Fourchon is evaluating the possibility of a port deepening project to 50 feet near the mouth of Bayou Lafourche to allow for a deepwater rig repair and refurbishment facility. This effort would produce 20 million cubic yards of sediment from the initial dredging process as well as an estimated 75 million to 80 million cubic yards generated by regular operations & maintenance (O&M) dredging over the lifespan of the project.[37] The port expects that it will require 12 million cubic yards for compensatory mitigation from the project, leaving an excess of at least eight million cubic yards that it must find another use for or dispose of. This transaction could make beneficial use of those dredged materials for wetland restoration nearby. The viability of this beneficial use is being evaluated through a project being led by The Water Institute of the Gulf. Section 3.1 of this report evaluates this multiple benefit opportunity of using port sediment in greater detail.
- Extending performance risk coverage of a PBC:
  - As discussed in **Box 1**, above, in areas where wetland restoration work would be completed through a PBC, the EIB could provide additional risk coverage for outer years of performance in terms of area, elevation, and vegetative cover. In this model, it is possible that if the investors were willing to take on more of the performance risk of the wetlands, — by agreeing to accept a lower return if the wetland outcome metrics were not achieved, because there could be a higher return if wetlands "over-perform" — then CPRA may be able to secure contractors under a PBC contract that would be less expensive, as the contractor would be taking less performance risk on themselves.

[37] Estimates provided by Port Fourchon.

To determine the most appealing and feasible of these design considerations, the project team discussed ideas and options with CPRA, potential "partner-payors," and potential investors. These conversations led to a decision to focus on a transaction grounded in:

- Demonstrating value of wetlands for reducing land loss rates (and therefore reducing flood risks for asset owners);
- Leveraging outside capital from investors and partners to accelerate and reduce implementation costs of CPRA projects;
- Creating incentives for wetland contractors to focus on long-term project sustainability; and,
- Providing a model for future coastal restoration investments that draws on local resources via partnerships with local asset owners.

TABLE 2

Possible candidates to participate in repayment

Organization	Interest in Port Fourchon area and wetland restoration
Port Fourchon	Port Fourchon is a quasi-public agency that owns and operates a port supporting central Gulf of Mexico oil and gas activities and the Louisiana Offshore Oil Port. Port Fourchon receives the majority of its revenues from leases and has a clear interest in protecting the area's surrounding infrastructure from storm and flooding disruption. The port has expressed understanding of the value of large swaths of healthy wetlands and coastal habitat adjacent to its facilities and is exploring the beneficial placement of materials dredged from the port to aid the state's wetland restoration plans. Port representatives have stated that the $300 million in restoration under the CMP in the vicinity of the port has been critical to its demonstrating its continued sustainability to potential clients. In choosing its wetland mitigation sites, the port has publicly indicated it strategically selected locations that provide protective services to the port and its infrastructure.
Oil & gas companies	A number of large multinational oil & gas companies are lessees at Port Fourchon, including Shell and Chevron among others, and ConocoPhillips owns land adjacent to the port. These companies have significant interest in the ongoing and uninterrupted operation of Port Fourchon. Some of these companies have in the past provided philanthropic support for wetland restoration efforts. For instance, Shell has previously demonstrated its commitment to wetland restoration through by supporting projects like the Forest Ridge Project in partnership with the port and the Audubon Society.
Utility (e.g., entergy)	Entergy is the utility that provides power to Port Fourchon and surrounding communities across the coast. Entergy has a significant interest in avoiding power supply disruption to its customers in the area, as demonstrated by a recent $300 million investment in upgrading the electricity wiring that runs south to the port.
Other clients of Port Fourchon	The port has a range of additional lessees and partners that utilize the port for operations, and these entities who benefit from wetland restoration efforts may be interested in participating in the transaction.

2.5 Identifying possible transaction "partner-payors"

The project team conducted initial discussions with representatives of some local asset owners and corporate entities to develop understanding of potential interests in wetland restoration and the EIB mechanism. **Table 2** provides an illustrative overview of the types of entities that could serve as transaction partners with CPRA.

The table above is not exhaustive nor does it express any form of expressed interest nor commitment from these entities to participate. There are many other asset owners that could have interest in participating in repayment of the EIB; **Box 4** presents an overview of flood insurance and the evolving role of the insurance industry. A key next step will be to identify one or multiple "partner-payors" and to secure their interest in signing a Memorandum of Understanding that indicates their interest in working with CPRA to pursue an EIB issuance. This next step and others are summarized in Section 6, Conclusion & Next Steps, of this report.

Exploring a future role for insurance companies in the EIB

Floods are the nation's most common natural disaster. On the face of things, it would seem that the insurance industry, including reinsurers, might be interested in joining a project that aims to reduce damages to insured properties due to rising seas and storm-related floods. Historically the private insurance industry limited their exposure by exiting a market (i.e., providing no insurance) and this was a key driver for Congress creating the National Flood Insurance Program (NFIP) in 1968.

Enrollment in the NFIP is required for all properties in high-risk areas to be eligible for federal or federally-related financial assistance for either purchasing a property (i.e., federally backed mortgages) or constructing a building. Despite these requirements and high coastal flood risks, market penetration of flood insurance is only 21 percent in Louisiana. Many large asset holders, like oil and gas companies, self-insure against flood damages, including business interruption.

Because most of those property owners that purchase flood insurance do so through the NFIP, private insurers have little incentive to invest in risk reduction. However, several factors could increase incentives for private insurers to take action to reduce their risk exposure. First, the NFIP only provides coverage for up to $250,000 for a structure and $100,000 for possessions, so private insurance is available for persons seeking additional insurance. Second, the Biggert-Waters Act of 2012 allowed federal agencies to accept private flood insurance in lieu of federal flood insurance when making property loans. Third, starting in 2016, the Federal Emergency Management Agency began to purchase reinsurance for the NFIP; therefore, insurance may become an increasingly important component of market-based solutions to lessen the exposure of taxpayers to flood risk.

It is also worth noting that examples are emerging of the insurance industry evaluating coastal restoration investments to mitigate potential storm damages, including approaches based on catastrophe and resilience bonds.

CHAPTER 3

Proposed environmental impact bond structure

The process described above resulted in the design of a simple two-tier multi-payor pilot transaction: fundamentally, a bond repaid as "normal" by CPRA along with a performance payment as a "bonus" if the wetland over-performs in terms of avoided land loss. There is no performance payment between parties if the project under-performs, though contractors would be subject to contractual obligations to CPRA regarding the construction quality of the wetland.

The CPR FC would issue the bond and be responsible for principal and interest payments based on Deepwater Horizon oil spill settlement revenues. An additional private sector partner would provide an "upside performance payment" shared between investors and wetland contractors if the project over-performs according to the extent to which the project reduces land loss in the area. Fundamentally, this "partner-payor" is providing a financial enhancement through the performance payment to investors that could lead to reduced borrowing costs for CPRA overall. CPRA would also benefit from measuring and quantifying wetland benefits to local stakeholders, in the ability to demonstrate how investments in restoration are benefiting communities and businesses.

This proposed transaction is summarized in **Table 3** below and described in greater detail in the section that follows. The goal of this analysis was to determine the feasibility of a transaction, and therefore in some cases, ranges are provided rather than specific numbers. The exact parameters of the transaction would be finalized and negotiated in the transaction structuring phase.

This project site in Belle Pass-Golden Meadow has already undergone some design and engineering work supported by Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) funding for a smaller 614-acre site, making the project relatively investment-ready, though the same approach and concept has potential to be applied in other parcels within Belle Pass-Golden Meadow and beyond. This section outlines in greater detail this transaction, including the structure, financial details, outcomes linked to performance payments and benefits to CPRA and other stakeholders.

TABLE 3

Proposed environmental impact bond details

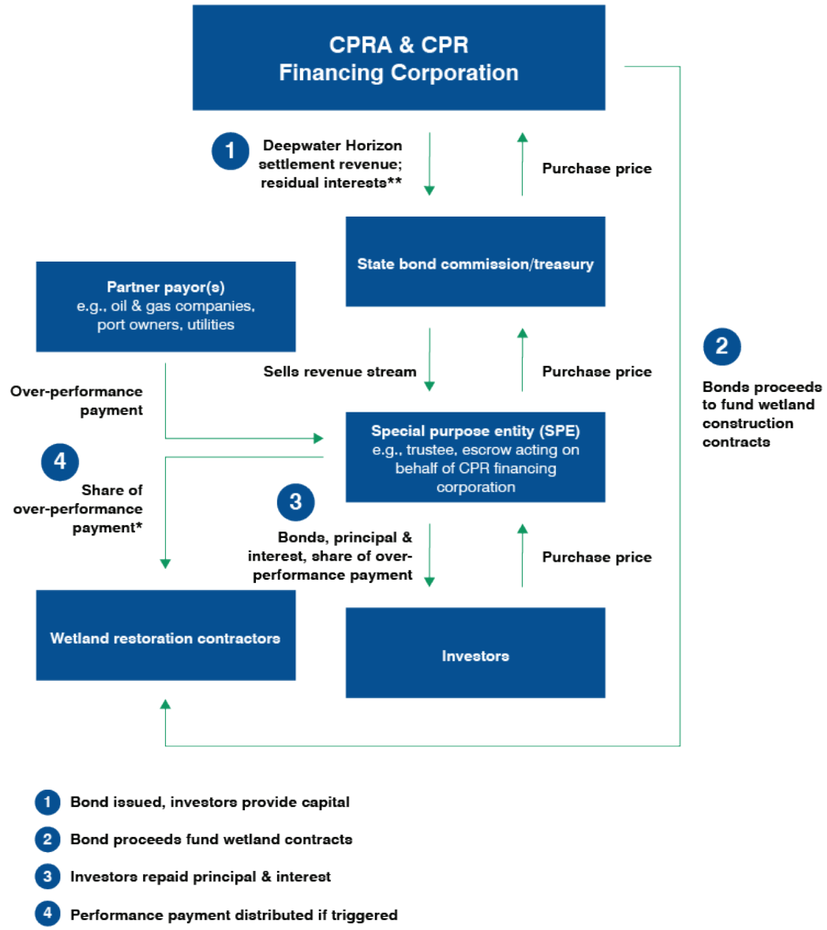
EIB structure	2-tiered (base and over-performance)
Transaction size	$40 million
Denomination	$5 million
Upside performance payment	$3.5 million to $8 million ($1 million to contractors, remainder to investors)
Tenor	10-15 years
Interest rate	1.82-4.73%
Issuer	CPR Financing Corporation
Bond type	Asset-backed bond against future Deepwater Horizon spill settlement revenues
Bond tax status	To be determined
Potential repayment sources - principal	Deepwater Horizon oil spill revenues (CPRA)
Potential repayment source - interest	Coastal Protection and Restoration Trust Fund (CPRA)
Potential performance payment source	Local private asset owner (e.g., oil and gas company)
Project location	Belle Pass-Golden Meadow Marsh Creation, west of Port Fourchon
Acres of wetland restored	585-835 acres
Performance outcome of interest	Flood risk reduction
Proxy performance metric for measurement	Avoided land loss (vs. expected land loss, and against a similar site where restoration has not occured)

3.1 Transaction structure

Figure 6 below outlines the potential flows of financial payments between transaction stakeholders. The Special Purpose Entity (SPE) would serve as an escrow or intermediary entity for the performance payment and would then channel these funds through to CPRA for disbursement to investors and wetland contractors in the event of over-performance. The funds would likely need to be channeled from the intermediary into a dedicated escrow account at CPRA in order to be able to track the funds.

FIGURE 6

Proposed multi-payor EIB transaction



* The amount of over-performance payment, if any, is contingent upon achievement of a to-be-determined measurement of flood risk reduction.
** According to CPR Financing Corporation's enabling legislation La. R.S. 39:99:25 to 99.100, residual interests are " the income of the coporation, and bond proceeds, if any, not previously paid to the state, that are in excess of the corporation's requirements to pay its operating expenses, debt service, sinking fund and other redemption requirement, reserve fund requirements, and any other contractual obligations to the holders or that may be incurred in connection with the issuance or repayment of the bonds.

Details regarding these financial flows would be finalized in the transaction structuring process. The Tobacco Settlement Financing Corporation, as outlined in **Box 3**, provides a starting point as a template for how this bond issuance could work in reality.

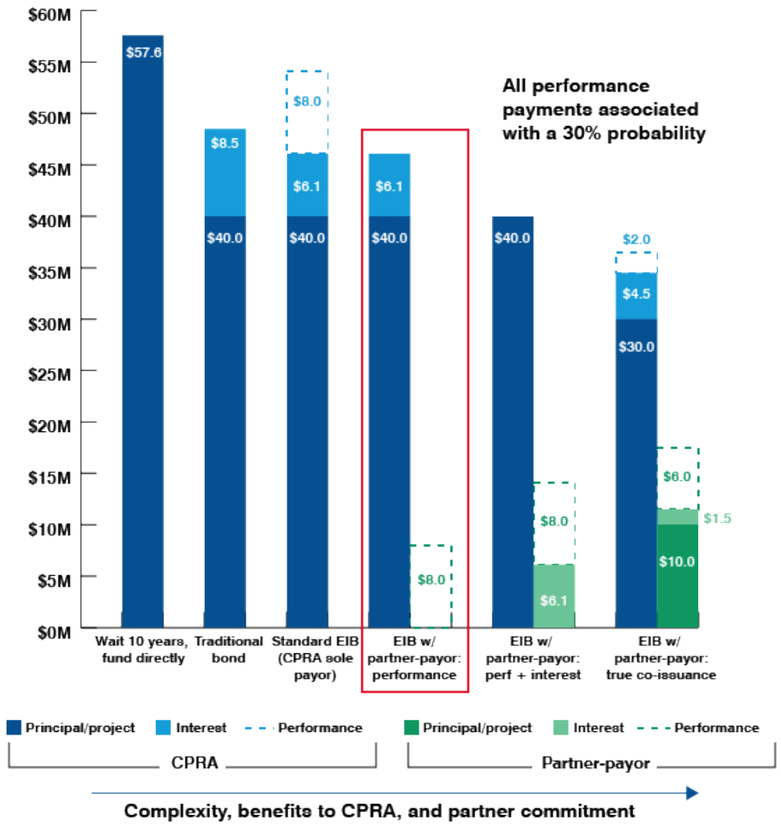
In this transaction, the CPR FC would be the bond's issuing entity. While CPRA would be responsible for the bulk of repayment, a "partner-payor" (or payors) would contribute to repayment based on the achievement of outcomes based on provision of the "upside" payment for over-performance.

There are various different approaches to sharing repayment between the CPR FC and one or more "partner-payors". **Figure 7** outlines some illustrative examples of how payment sharing could be arranged on a spectrum of increasing complexity and "skin in the game" for the "partner-payor", from simply providing the performance payment to a true co-issuance, with the "partner-payor" borrowing a portion of the total principal required and disbursing the proceeds toward the wetland restoration projects. The proposed transaction is outlined in red. Increasing partner engagement and cost-sharing in the transaction offers greater benefits to CPRA over a standard EIB where CPRA is the sole payor (but adds complexity), while EIBs in general offer benefits over "traditional" bonds (i.e., bonds with no performance component). For example, even without a "partner-payor" for performance, CPRA / CPR FC can benefit by issuing an EIB as a sole payor, as the EIB still would hedge performance risk, showcase innovation and build an evidence base of outcomes, in addition to accessing new sources of capital. Such an EIB transaction would need to consider evaluation costs and possible additional compensation to investors for taking on more risk. Either form of bond benefits CPRA compared to waiting to fund directly, due to increased sediment requirements and construction costs over time.

The team estimated an $8M estimate for the performance payment amount. This calculation is outlined in Section 3.6: Performance Payment Sizing. The final amount would be determined in transaction structuring, in collaboration with CPRA, the CPR FC, and the "partner-payor(s)".

FIGURE 7

Projected costs for various traditional and EIB financing options



Assumes a 15-year EIB or traditional bond with mortgage-style principal amortization and a 2.5% base interest rate. Does not reflect time value of money. Assumes 30% likelihood of over-performance case, and 25% principal-share with "partner-payor" in true co-issuance model. Likelihood of outperformance is hypothetical at this point - probability distribution of performance outcomes and valuation to be refined during transaction structuring.

Determining the extent of "partner-payor" involvement

As outlined in **Figure 7** above, the more the "partner-payor" has "skin in the game," meaning the extent to which they are responsible for repayment of the bond, the more complex the transaction becomes. Based on the need to balance simplicity of the deal with CPRA's interests in developing greater multi-stakeholder engagement to share in financing costs for restoration, the most desirable initial EIB structure would involve a single partner (or coalition of partners) to participate by providing a potential upside payment to investors, and possibly the wetland contractor, in the case of "over-performance" in terms of avoided land loss.

This approach could leverage funding from oil and gas companies who are already contributing financial resources to beneficial projects like wetland restoration along the coast, and the EIB's focus on measurement of wetland outcomes might encourage future participation in wetland restoration investment by demonstrating its benefits to local asset owners. In addition to engaging an oil and gas company or other private partner, CPRA could further realize savings by leveraging the excess sediment from the proposed deepening project at Port Fourchon, at a lower cost than they would have had to procure sediment themselves.

As described earlier, in a two-tiered EIB structure, issuers may benefit from a lower interest rate due to the potential of the upside performance payment. This compensatory lowering of the interest rate can be modeled through an expected value calculation based on both the size of the performance payment to investors and the expected likelihood of a payout (determined by predictive modeling of outcomes and where the threshold for over-performance is set). The interest rate is then set such that the overall expected value of the rate and return to investors (including both base and overperformance cases) remains the same as it would in a more traditional offering, informed by credit rating, term, underwriting revenue source, and other factors.

The sensitivity table below in **Table 4** illustrates how the greater the performance payment and the greater the probability it gets paid out, the more potential reduction in base interest rate CPRA could get in the issuance. The numbers in the chart indicate percent reductions below the market interest rate that CPRA might otherwise receive in a bond issuance. For example, if the performance payment is set at $8 million with $7 million going to investors, and the outcomes threshold for over-performance is set at a level that corresponds to a 30 percent likelihood, the interest rate could be reduced by up to 0.6 percent.

Note that these potential interest rates are illustrative and will also be informed by investors' risk pricing and preferences, as well as the credit rating of the issuer. The specific parameters of the transaction, including bond pricing, would be established in the transaction structuring phase.

TABLE 4

Interest rate adjustments to CPRA based on performance payment size and expected probability[38]

Expected Likelihood of Performance Payout \ Performance Payment Size	$3,000,000	$4,000,000	$5,000,000	$6,000,000	$7,000,000	$8,000,000	$9,000,000	$10,000,000
5%	-0.04%	-0.06%	-0.07%	-0.08%	-0.10%	-0.11%	-0.13%	-0.14%
10%	-0.08%	-0.11%	-0.14%	-0.17%	-0.20%	-0.23%	-0.25%	-0.28%
15%	-0.13%	-0.17%	-0.21%	-0.25%	-0.30%	-0.34%	-0.38%	-0.42%
20%	-0.17%	-0.23%	-0.28%	-0.34%	-0.40%	-0.45%	-0.51%	-0.57%
25%	-0.21%	-0.28%	-0.35%	-0.42%	-0.50%	-0.57%	-0.64%	-0.71%
30%	-0.25%	-0.34%	-0.42%	-0.51%	-0.60%	-0.68%	-0.77%	-0.86%
35%	-0.30%	-0.40%	-0.50%	-0.60%	-0.70%	-0.80%	-0.90%	-1.00%
40%	-0.34%	-0.45%	-0.57%	-0.68%	-0.80%	-0.91%	-1.03%	-1.15%
45%	-0.38%	-0.51%	-0.64%	-0.77%	-0.90%	-1.03%	-1.16%	-1.30%
50%	-0.42%	-0.57%	-0.71%	-0.86%	-1.00%	-1.15%	-1.30%	-1.44%

[38] Assumes a 15-year EIB, 2.5 percent base (non-adjusted) interest rate, 835 acres, $40 million in project costs and project construction beginning in 2018.

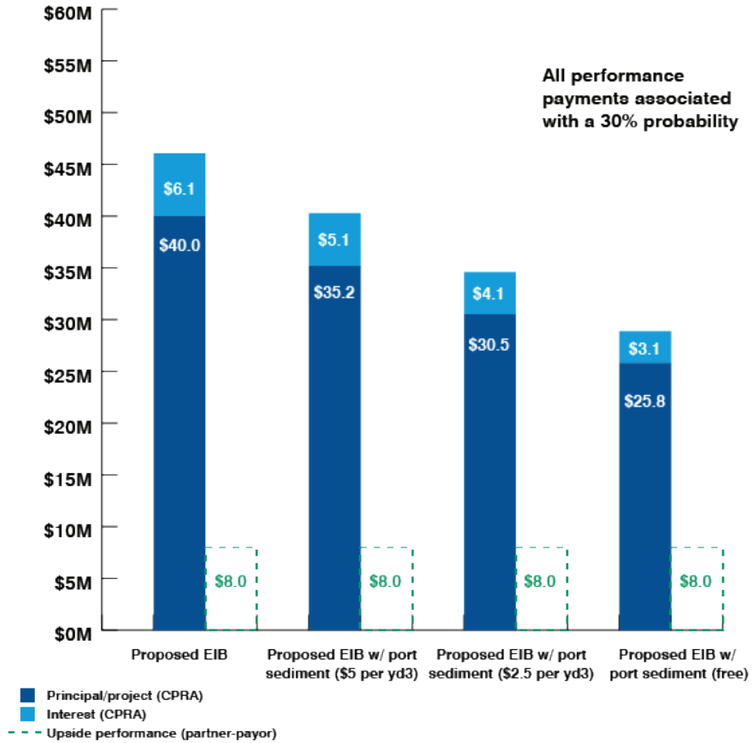
3.2 Acquiring Sediment from Port Fourchon

Building on this proposed structure that engages a private partner to participate in the EIB financing itself, the project team explored making the deal even more attractive to CPRA and investors through the beneficial use of dredged materials from Port Fourchon and its lessees. CPRA could further build the case for a multi-stakeholder approach to wetlands financing, and achieve cost savings, by engaging Port Fourchon to acquire sediment from its planned deepening project. The project team estimates the proposed wetland project in West Fourchon would require just under 1.9 million cubic yards if initiated in 2018, increasing to 4.1 million by 2038 — well less than the 8 million cubic yards excess that may be generated from the deepening project at Port Fourchon. Further, without the port's involvement, the team estimates CPRA's current sediment costs to be around $7.52 per cubic yard.

Therefore, if CPRA would be able to acquire sediment from the port at any lesser cost, it would lower the overall costs and issuance size required, while the port would benefit from acquiring a source for its excess sediment and from the resilience outcomes provided by the wetland, further supporting a synergistic multi-stakeholder model for wetlands financing. **Figure 8** below demonstrates the impacts of acquiring sediment from Port Fourchon at different cost points on the principal and interest required in the proposed EIB structure.

FIGURE 8

Projected costs for the proposed EIB without and with sediment acquisition from the Port Fourchon deepening project



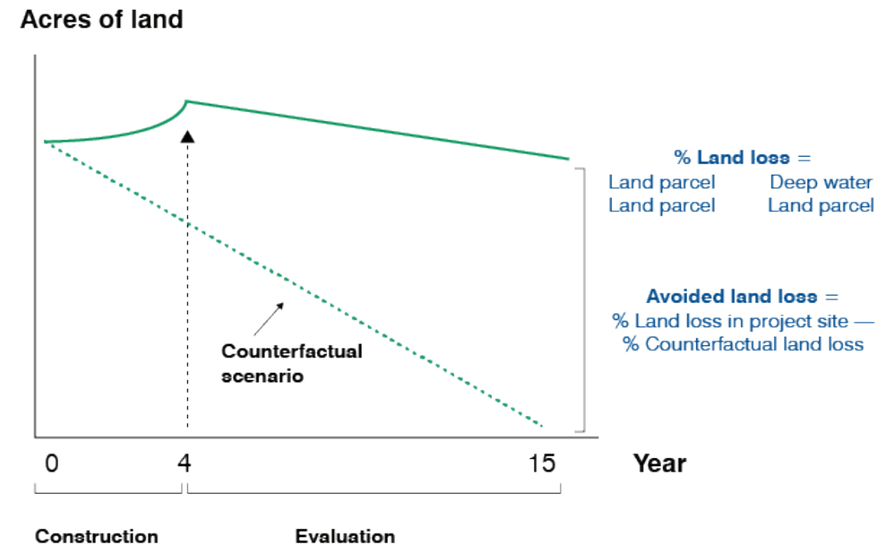
3.3 Outcomes, metrics and performance payments

As outlined in **Figure 4** above, this transaction would focus on an outcome of flood risk reduction benefits provided by wetlands, which would be measured via the proxy of avoided land loss. This metric, while a measure of physical and environmental changes, can be translated for "partner-payors" into avoided business disruption and other economic impacts from storm effects in the absence of wetland construction.

Avoided land loss is determined by wetland construction decisions but also by natural processes like sediment accretion and reduced exposure of adjacent lands to erosive forces. It is the net effect of the project on wetland creation (land created minus land lost) which would be measured throughout the monitoring period within the project area as well as adjacent parcels (**Figure 9**). These effects are compared to a counterfactual scenario (i.e., land loss without restoration based on comparable reference sites). This approach is outlined in greater detail in **Appendix D**.

FIGURE 9

Approach for measuring avoided land loss



The outcome metric, avoided land loss, is the difference in the percent land loss between the project site and the counterfactual scenario (i.e., a similar site where no project is constructed) after construction.

If the avoided land loss metrics are successfully achieved and additional metrics such as vegetation density and land-water ratio also improve, it would follow that wave attenuation benefits from wetland restoration that lower damages and business disruptions from flooding can be expected to accrue. Additional data can be collected during the monitoring period to construct proxies that indicate potential benefits. These secondary outcomes could also be measured in order to build knowledge and confidence regarding wetland restoration benefits, but would not be linked to financial repayment.

While not the focus on this transaction, the wetlands restored will ideally provide additional environmental outcomes, including improved Gulf fisheries, migratory bird and waterfowl habitat and, possibly, carbon sequestration benefits. These benefits could be explored as the transaction is structured to determine if there are additional possible value streams that could accrue to involved stakeholders.

3.4 Measurement methodology

A third party evaluator would validate performance thresholds related to avoided land loss that would trigger a performance payment to investors. **Appendix D** proposes a methodology for measuring outcomes linked to performance payments. One approach is to use machine learning and program evaluation methods to determine if the project had a statistically significant impact on avoided land loss at the end of the monitoring period, compared to reference sites that define a counterfactual scenario. Investors would receive a performance payment if the project in fact slowed down land loss compared to the baseline. An alternative would be to conduct an analysis of historical data and prior restoration projects to model and predict the expected avoided land loss from the project as well as confidence intervals. In this case, if the final project outcome exceeds the expected upper confidence interval investors would receive a performance payment.

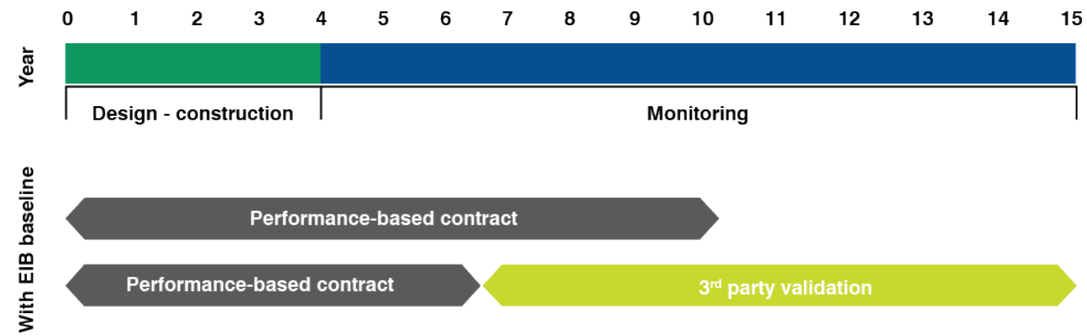
3.5 Timeframes for measurement and validation

The timeline for measurement and validation will depend on whether the bond proceeds are used to finance a Performance-Based Contract or a traditional CPRA wetland restoration contract wherein the state designs the restoration and a contractor executes on that design. The EIB concept will work for either scenario. This approach is explained in further detail in **Appendix D**. The performance payment would be made at the end of the bond's life cycle, which is currently modeled at 15 years.

Due to the fact that performance measurement responsibilities can shift, it is possible that an EIB could lower the costs of a PBC. For example, PBCs will likely have an extended performance measurement period involving detailed validation methods. With an EIB, the third party evaluator may be able to address longer-term monitoring, therefore reducing the time period for monitoring and corrective work obligations of the PBC. Under the EIB, this transfer of costs and risks to the investor may result in a lower cost PBC. **Figure 11** illustrates this possibility.

FIGURE 11

Illustrative example of how an EIB could reduce PBC monitoring timeline



3.6 Performance payment sizing

In any impact bond, there are several ways to determine an appropriate size for the performance payment:

- **Economic valuation of benefits:** Because the logic of the performance payment mechanism is based on sharing the value of additional benefits in the case of over-performance (or the negative value of reduced benefits in the case of under-performance), a fundamental way to calculate the payment size is as a fraction of the estimated economic value of benefits generated from the project going to investors or contractors, with the bulk of benefits remaining with the payors.
- **Avoided costs:** As an alternative to valuing positive outcomes, the performance payment size may also be selected based on avoided costs — for example of an alternative technology for the project, or if more successful projects require less ongoing maintenance or change orders.
- **Financial considerations:** Ultimately, the size of the performance payment will need to make financial sense to both payors and investors and be informed by, for example, target effective returns or capital availability.

The project team followed these three methods to arrive at a suggested performance payment size of $8 million (assuming a 15-year bond), which will be refined in transaction structuring with more specific data, a performance payor selected, and through negotiation among the parties to the EIB.

Economic valuation of benefits

Once a willing "partner-payor" is identified, the economic valuation must be conducted from their perspective — which specific benefits accrue to them and what is the associated value. In the context of this project, this valuation will be based on flooding and land loss located near the payor's particular assets, and the value of those assets at risk. In the absence of more granular data and without a particular payor determined yet, the team used recent regional studies from coastal Louisiana and the entire Gulf of Mexico on economic risk from land loss and storms, and the ability of wetlands to mitigate that risk,[39,40] to arrive at an expected value of these benefits scaled down and tied to the particular project in West Fourchon proposed here.

Based on this analysis, the team estimates the benefits generated from wetlands to be valued at $2,253 per acre on an annual basis for avoided land loss alone and $34,877 per acre annually for associated flood risk reduction. For the approximately 835-acre parcel proposed here, over the timeframe of a 15-year EIB (11 years post-construction),[41] and assuming a 2.5 percent discount rate, this is equivalent to $15.9 million present value in avoided land loss alone, which drives an additional $251.1 million in potential flood risk reduction. Because the EIB will be evaluated based on avoided land loss as a proxy for flood risk reduction, flood risk reduction benefits are more uncertain, and to err on the side of a more conservative valuation, the team suggests using the land loss value alone to inform the performance payment sizing rather than the flood risk reduction value. In future value at the end of the 15-year EIB (i.e., when the performance payment will be made), the $15.9 million in present-value avoided land loss benefits are equivalent to $23.1 million (again assuming a 2.5 percent discount rate). These figures are based on the expected value of performance, with greater avoided land loss or flood risk benefits (i.e., in an over-performance scenario) associated with greater incremental value.

Avoided costs

If wetlands are over-performing in terms of land loss mitigation, they will require less ongoing O&M and change orders to maintain or increase acreage. Based on estimates from wetlands restoration projects throughout the CMP, the project team determined that in an expected (base) performance case, annual O&M costs for these projects average around 2.7 percent of the initial planning, engineering, design, and construction costs. For the $40 million proposed project, over the timeframe of a 15-year EIB (11 years post-construction), and assuming a 2.5 percent discount rate, this is equivalent to around $9.3 million in total O&M costs in present value, or $13.4 million in future value at the end of the 15 years (i.e., when the performance payment will be made).

[39] Reguero, B.G., Beck, M.W., Bresch, D.N., Calil, J., and Meliane, I. (2018). Comparing the cost effectiveness of nature-based and coastal adaptation: A case study from the Gulf Coast of the United States. PLoS ONE 13(4): e0192132. Retrieved from: https://doi.org/10.1371/journal.pone.0192132.

[40] Barnes, S.R. & Virgets, S. (2017). Regional impacts of Coastal Land Loss and Louisiana's Opportunity for Growth. LSU Economics & Policy Research Group. Retrieved from: https://www.edf.org/sites/default/files/LSU-EPRG-Regional-Economic-Land-Loss-Risks-and-Opportunities-2017.pdf.

[41] The length of time used for the economic valuation also reflects a conservative approach, in that avoided land loss and flood risk reduction benefits will accrue into the future beyond the term of the EIB.

Financial considerations:

The project team expects that a reasonable premium for over-performance to investors in this EIB may be between 1.5 to 2.0 percent in additional effective return (assuming a base market rate of 2.5 percent), which corresponds to a performance payment in year 15 to investors of $6.8 to $9.5 million.

Putting all these considerations together, the team suggests $8 million to be a reasonable value for the over-performance payment, which is about $1 million less than half the average of the avoided land loss and O&M cost valuations, representing a less than 50 percent share of benefits going to investors and contractors at the performance threshold. With $1 million going to contractors, a $7 million payment at the end of year 15 corresponds to an over-performance premium to investors of 1.54 percent, within the reasonable expected range. Further analysis will be required through the transaction structuring phase of the EIB to link the benefits valuation to the particular payor and better understand how this value and avoided costs scale with increasing performance. Ultimately, however, the final performance payment size will be selected as a point of negotiation between the parties to the EIB (CPRA, the "partner-payor" payor, investors, and contractors).

CHAPTER 4

Aligning incentives: how this transaction benefits all stakeholders

An EIB can help to align the interests of different stakeholders through a transaction structure in which the asset owners, or "partners," contribute to repayment of the EIB to some degree. This EIB is intentionally designed to realize benefits for all of the key parties involved with the transaction: CPRA, additional partner(s), investors, and wetland restoration contractors.

4.1 CPRA Incentives

The proposed transaction holds significant benefits for CPRA, as outlined in **Table 5**.

TABLE 5

EIB benefits to CPRA

Benefits to CPRA	Description
Capital Access	
1. Access to project capital "up-front" via bonding	The costs for wetland restoration will increase over time as coastal erosion and land subsidence continue to occur, meaning more sediment will be required to complete the same project in the future. As a result, constructing projects now instead of waiting 10 years (for projects scheduled toward the end of CMP Implementation Period I and beginning of Period II) can save CPRA significant costs, amounting to an expected $17.6 million savings for a $40 million project in West Fourchon. Though financing introduces some additional cost to the project, these financing costs are still lower than the expected increases in project costs over that time period.
2. Access to a new and different source of capital	An EIB issuance could attract impact investors — institutional investors, banks and family offices/foundations — who seek environmental and social as well as financial returns on their investments. An EIB focused on wetland restoration allows CPRA and the state to highlight the state's environmental work and their leadership in doing so in a resource-efficient and cross-sector manner.
Sharing costs and engaging asset owners	
3. Cost-sharing with local asset owners as payors, guarantors, or investors	The EIB can allow CPRA to "crowd-in" private capital from local asset owners and other partners to reduce overall project costs. By engaging asset owners as "partner-payors" based on their receipt of wetland protection benefits at an earlier point in time than otherwise planned, this EIB mechanism can reduce costs of a specific project to CPRA and/or allow CPRA to share risks with these local parties.
4. Piloting multi-stakeholder transaction that could serve as a model for other CMP restoration projects	This pilot EIB can lay the groundwork for future collaboration and co-investment with local asset owners, as the public and private sector work cooperatively to protect Louisiana's coastal economy, assets and jobs.
Measuring wetland performance and paying for outcomes	
5. Opportunity to evaluate the value of wetlands on the ground	This transaction's focus on measuring wetland outcomes focused on economic benefits allows CPRA to observe and highlight flood risk reduction benefits provided by wetlands and build enduring public support for wetland restoration. Learnings from this project can be incorporated into planning future CMP restoration investments in order to maximize efficient use of coastal restoration funding.
6. Hedge risk of performance, additional to PBC contract, leading to a potentially less costly PBC contract	The EIB can be structured to allow CPRA to transfer risk of wetland non-performance to private investors, as those investors could make a payment to CPRA if expected wetland performance thresholds are not met.

4.2 Partner-payor incentives

A partner joining CPRA as a payor could be any entity that realizes benefits from the construction of wetlands, including oil and gas companies, navigation companies, Port Fourchon or other local asset owners in the vicinity of the port. For the purposes of this report, the project team identified and conducted initial discussions with some of these potential partner entities, including the port itself. Identified benefits are outlined in **Table 6** below.

TABLE 6

Benefits to "partner-payors"

Benefit	Description
1. Flood risk reduction for on-site assets	Most entities understand and value wetlands for the services they provide as a physical buffer between the Gulf and these entities' buildings and assets. The construction of wetlands as part of the CMP will provide protective benefits to businesses and residents who are located near those wetlands.
2. Accelerated construction timeline for nearby wetland restoration projects	Participation in this EIB may facilitate the earlier construction of wetland restoration projects near the partners' assets, ensuring that wetland benefits are provided sooner than otherwise scheduled in the CMP. In this sense, private entities share an interest in using an EIB to ensure the CMP projects are completed sooner than planned, as flood risk reduction benefits will accrue sooner.
3. Beneficial use of dredged materials resulting in lower disposal and offset costs	The port and its lessees conduct maintenance dredging to maintain sufficient depth of channels and berths. Dredged materials must be placed in an environmentally-sensitive manner per Section 404 of the Clean Water Act or Section 103 of the Marine Protection, Research and Sanctuaries Act, and other federal regulations. Regional management of sediment allows cost effective beneficial use of sediment resources and is increasingly encouraged by law (e.g., 33 USC 2326). As a result, these entities might be interested in contributing dredged materials to nearby wetland restoration in order to reduce disposal costs. As discussed previously, the port is also considering a significant expansion in order to increase the depth of the channel in the port to 50 feet. This material could be used for nearby wetland restoration, as is being explored in a study currently underway by the port, Shell, Chevron, and Danos in conjunction with The Water Institute of the Gulf.
4. Avoided business disruption related to flood or storm surge events	Flood and storm surge mitigation by wetlands can be directly linked to protection of critical assets, including access roads, power lines and buildings in coastal areas.
5. Long-term economic stability of the region	The port is a key economic driver in the region. Securing the port contributes to protecting the long-term viability of doing business in a vulnerable area.
6. Possible additional monetization of wetland value streams	"Partner-payors" may be interested in additional revenue streams that could be generated through participation in the project, such as NRDA credits or carbon credits. This topic was not a focus of this report but could be explored further in future analysis.
7. Possible realization of tax benefits	There may be tax benefits to the partner if the contribution takes the form of a philanthropic gift (to be determined in the transaction structuring phase).

4.3 Investor incentives

Investor compensation for the risk of buying a bond from a new issuer is reflected in the base (market, non-adjusted) interest rate, while the amount that rate is lowered by and fixed at is offset by the potential for receiving a performance payment if the project "over-performs." Additionally, this EIB achieves social, economic, and environmental benefits for investors who are interested in these impacts in addition to financial return. Investor incentives and perspective are outlined in greater detail below in Section 5 on The Investor Perspective.

4.4. Wetland restoration contractor incentives

Because CPRA would gain access to up-front project capital through the EIB transaction, contractors may have the opportunity to undertake work sooner than otherwise planned under the CMP. Further, contractors could receive a portion of the performance payment as recognition of superior performance — aligning their incentives with those of investors, CPRA and other partners. Beyond receiving such payment, the contractor may also receive reputational benefits that could be manifested in additional work by others desiring quality wetland restoration.

4.5 Determination of feasibility

A key determinant in the feasibility of a transaction is that there is a financial arrangement that benefits each stakeholder and satisfies their needs and constraints. Through this analysis, the project team concludes that this multi-payor EIB transaction could provide benefits to all parties and serve as a template for future multi-payor transactions to support coastal restoration.

CHAPTER 5

The investor perspective: anticipating due diligence

The project team engaged a broad range of investors and financial service professionals to inform this study and to collect feedback on potential EIB transaction structures. Investor input was used to refine the proposed transaction structure, identify key investor questions and concerns and offer insight on how to mitigate risks and attract investors to participate in a potential transaction.

5.1 Investor advice during project planning

Investors engaged in the development of this EIB concept provided a set of three overarching insights to guide transaction design for this wetland restoration EIB:

1. **Highlight environmental, social and economic impact:** Investors noted a genuine increase in investor interest in performance-based transactions like environmental impact bonds. Investors are interested not just in environmental outcomes of these types of projects, but also the benefits to Louisiana's communities and economy.
2. **Aim for simplicity:** The CPR FC is a new bond issuer, and the environmental impact bond will require some additional diligence for investors given the parties involved and the outcome measurement linked to repayment. As a result, investors encouraged a focus on keeping the transaction as simple as possible so that due diligence requirements would not deter investors or add undue cost to the transaction.
3. **Clarify repayment streams:** Investors were keenly interested in how secure the Deepwater Horizon settlement revenues would be for repayment of the bond, as well as understanding any restrictions on the use of funds that might affect or impede repayment (and therefore increase the interest rate for borrowing).

Additional detail on these interviews and insights is provided in **Appendix G**. This advice contributed to the proposed design of the transaction, and also informs Section 6: Conclusions and Next Steps of this report in addressing key investor concerns.

5.2 Evaluating the proposed transaction: investor returns

From the investors' perspective, as long as capital commitments for principal repayment, interest and performance payments are certain, the presence of a "partner-payor" for the performance payment (or otherwise) does not affect their returns. The key return drivers for investors in this scenario include the cost of sediment used for construction and the share of performance payment that goes to Port Fourchon. On the cost of sediment, returns will depend on whether dredged material to build the wetland is sourced from the port. Doing so lowers the overall costs of the project and investment required, while the performance payment size remains the same, meaning they get more potential return from a lower initial investment. Additionally, investor returns depend on whether and by how much the upside performance payment is shared with wetland contractors. **Table 7** below illustrates internal rates of return for the EIB from the investors' perspective.

TABLE 7

Illustrative investor return scenarios, depending on use of port sediment or not

	Base or lower performance	Over-performance
Traditional bond	2.50%	—
All performance payment ($8 million) to investors (either single or multi-payor)		
No sediment from port	1.82%	3.54%
Sediment from port at $5/yd^3	1.72%	3.67%
$1 million performance to contractors, $7 million to investors (either single or multi-payor)		
No sediment from port	1.90%	3.43%
Sediment from port at $5/yd^3	1.82%	3.54%

5.3 Anticipating investor due diligence: initial transaction risk assessment

In considering going out to the capital markets to raise financing for CPRA's wetland restoration efforts, CPRA and the CPR FC will have to address investors' risk analysis related to the project and transaction. Some of these risks and possible mitigation strategies are outlined below. These risks will merit further consideration should CPRA and the CPR FC move forward with this transaction. Some of these considerations are unique to the EIB (specifically related to outcome metrics and measurement), while some will hold true regardless of the bond structure that CPRA pursues to support coastal restoration efforts.

These risks, while real, are common to many types of project investment, and the focus for CPRA in developing this transaction would be the same as with all projects: identifying mitigating strategies for each risk and clarifying those strategies in the investor diligence process. Further engagement with potential investors during the transaction structuring process can allow CPRA and the CPR FC to surface additional concerns and develop mitigation strategies.

TABLE 8

Risks and risk mitigation approaches

Risk	Description	Risk mitigation approach
Financial transaction risks		
Repayment risk	Investors consulted as a part of this project focused primarily on repayment: what ownership or claim the CPR FC has on the Deepwater Horizon settlement revenues that would be used for repayment, what restrictions are placed on the use of those funds, and what additional recourse there could be beyond those revenue streams if they were not allocated.	This is a key issue for CPRA and the CPR FC to resolve in any bond issuance, through engaging bond counsel to determine how to dedicate those future settlement revenues to repayment of a bond. Bond counsel will also need to research and consider state law implications (particularly Art. VII, Section 14 of the Constitution).
Credit risk	The CPR FC has not issued a bond previously, meaning that CPRA and the CPR FC will have to engage a rating agency to assess the credit rating of the bond, assuming it is a public bond issuance rather than issued in private placement. Investors will focus diligence efforts on evaluating CPRA's credit worthiness. In general, because this bond would be backed by anticipated revenue streams from Deepwater Horizon oil spill settlement funds, rather than being a General Obligation (GO) bond, the risks may be viewed as higher as there would not be recourse to the state or access to the state's credit rating.	The performance payment offsets or compensates for some credit risk by offering an increased potential reward to investors.
Measurement & validation risk	The repayment of this bond to investors is dependent on the measurement of outcomes related to avoided land loss. Investors need not only to be comfortable with the outcomes themselves and the related performance thresholds that trigger payments, but they also need to be confident in the approach taken to measuring those outcomes. This report proposes the use of remote sensing technology, coupled with on-the-ground field observation, to determine avoided land loss (see Appendix D).	The validation methodology would be disclosed as part of the bond issuance. Further, the approach as designed (the use of a platform that visualizes the analysis of remotely sensed data) is intended to make the validation transparent and accessible to investors and other project stakeholders.
Traditional project-related risks		
Land ownership and access risk	The parcel evaluated in this project is owned by ConocoPhillips, a large landowner in the area and along the coast. Through initial meetings, landowner interest and willingness will be gauged. As with any wetland development effort, CPRA and the CPR FC would need to secure rights to construct a wetland on that property, through a mutual agreement with the landowner. The agreement would typically not be in place until preliminary design is complete.	Investors would likely want to see evidence of landowner commitment to allowing site access prior to the financing to ensure that the project would not be delayed if any issues related to access and ownership should arise.
Site and construction risk	The wetland restoration contractor faces task- and site-specific risks that can affect the timely successful completion of wetland restoration projects, including: • Permit acquisition: Obtaining access, local, state and federal permits. • Site conditions: Soil contamination, abandoned pipelines, archeological or historic artifacts, state- or federally-listed as threatened or endangered species, and large debris. • Pipeline discovery: Discovery and damages due to hitting pipelines, which are often poorly mapped and whose depths have changed over time. • Sediment availability: Availability of clean sediment of the appropriate grain size. • Equipment and contract issues: Equipment availability, breakdowns and associated delays as well as contractor/subcontractor credit or bankruptcy issues.	All of the above are typical of most any contract for infrastructure work in coastal areas. Hiring of science-based consultants and experienced construction firms with local expertise and trained crews will aid management of many of these risks, as will clear definition of performance expectations and goals.
Outcome and performance risk	While many of the above factors that influence the performance outcome are addressed during engineering and design, risks remain. For example, if sediment settlement rates are greater than anticipated or that sediment does not stay were needed, placement of additional suitable material would be required, adding time and costs. Planted vegetation may not thrive as planned due to water and air temperatures, salinities, disease, invasive species or excessive herbivory. When plants die out, the root system that binds the soil can also disappear, and the newly created marsh becomes vulnerable to erosion. With excessive erosion, the marsh gets fragmented, affecting the integrity of the restored wetlands' habitat value and ability to reduce land loss and flood damages.	These factors are mitigated through careful project design and execution, though this performance risk is one of the key parameters justifying an environmental impact bond approach.
Political risk	Investors will focus on whether local, state, or federal political decisions or dynamics could affect project timeline.	Gaining public/political buy-in and establishing legal contracts and commitments can provide reassurance on these concerns.
Force majeure risk	The project will be constructed in a storm-prone geography, and as a result, there is a risk of large and unanticipated weather events that could affect or damage the wetland during the construction or monitoring period. Currently, force majeure risks reside with CPRA in typical contracts. If the project is salvageable with contingency funds, then a change order will be processed. Otherwise, the project may be reduced in scale or scope.	These force majeure risks could be covered through insurance or may in some cases be transferred to the project contractor. The contractor will hold their own responsibility (and insurance coverage) for potential equipment loss.

CHAPTER 6

Conclusions and next steps

A transaction is feasible

This report provides an overview of a possible EIB transaction that could help accelerate CPRA's investment in wetland restoration in the coming years. The goal of this effort was to assess the feasibility of such a transaction and, as outlined in the preceding sections of the report, the project team believes that such a transaction is viable and could bring benefits to CPRA, investors, local asset owners and communities along the coast.

The goal is to start with a relatively simple structure, in which returns to investors look like a more "traditional" municipal bond if the project performs as expected, and in which they receive a "bonus" performance payment — shared with the wetland contractors — if the project over-performs. This model is designed to be a starting point for CPRA to work with private asset owners in a low-risk, low-commitment manner to accelerate the pace of investment in coastal restoration across the state.

If willing "partner-payors" were not secured from project beneficiaries, an EIB transaction may still be feasible. For example, a philanthropic foundation might be willing to participate as a "partner-payor" in place of a private (or public) asset owner to demonstrate the effectiveness of wetlands in reducing flooding and prove out the EIB concept as a means to catalyze greater investment in coastal restoration. Even without any additional "partner-payor" for performance, CPRA / CPR FC could still benefit as a sole payor in an EIB through the risk-hedging mechanism, showcasing innovation, accessing new investors, and building an evidence base of wetland restoration outcomes.

A roadmap to execution

With an EIB transaction scoped and assessed, two work streams will be needed to pursue this Louisiana wetlands restoration EIB: activating the CPR FC's bonding authority and proceeding with transaction structuring and issuance of the proposed environmental impact bond. This section provides recommendations on how CPRA and its partners could proceed on these two fronts. Transaction structuring entails a number of steps as outlined in **Table 9** that can be led internally or by outside consultants.

1. Utilize CPR FC's bonding authority

The CPR FC was established as a conduit to channel funds into the Coastal Protection and Restoration Fund (CPRF). As defined in Louisiana's state constitution, Article 7 § 10.2,[42] the CPR FC has the ability to bond in order to create current assets for the CPRF, which is in turn controlled by CPRA. CPRA and the CPR FC need to address several issues to issue the EIB or any bond. As described in Box 3, the Tobacco Settlement Financing Corporation provides a template for the CPR FC in Louisiana.

- **Clarify and resolve any restrictions on use of Deepwater Horizon oil spill-related funds for possible repayment:** As outlined in **Table 1** and **Box 2**, the Deepwater Horizon oil spill settlement revenues would be dedicated for principal repayment (and some of these funds operate in a grant reimbursement model where once a project is approved for funding where the state must first complete work and apply for reimbursement). These revenues — controlled by the RESTORE Council or Deepwater Horizon NRDA Trustees — are subject to rules governing federal funds. To explore more complex but more financially advantageous transactions, CPRA could secure clarification from the federal Office of Management and Budget (OMB) on such questions as whether Deepwater Horizon oil spill settlement funds can be used to pay interest on a state bond or to pay a performance "bonus." Depending on OMB's findings, and the desired transaction design, CPRA and the CPR FC may wish to seek additional federal legislation to allow transactions. Such information will be important to lessen the potential that these restrictions represent to investors a significant risk (i.e., if they introduce uncertainty as to whether projects would be eligible for repayment).
- **Determine tax-exempt status of the bond:** Bond counsel will need to determine if public benefit, even where restoration is conducted on private land, is adequate to maintain the tax-exempt status of the issuance, as well as consider other legal and statutory requirements and restrictions.
- **Hire additional professional support:** In order to proceed with issuing a bond, the CPR FC will need to conduct an RFP to hire one or more professional partners to support the issuance, including bond counsel, a financial advisor and underwriter(s).

2. Pursue transaction structuring

Simultaneous to activating bonding authority, CPRA and CPR FC can work together to move forward on finalizing the details of the proposed EIB transaction and then moving into transaction structuring:

- **Determine site selection and size:** CPRA and the CPR FC can either commit to proceeding with this site, elect to choose another parcel in the vicinity of Port Fourchon or choose an entirely different site. Even if another site is selected, CPRA can use the methods developed for analyzing this site and assessing its performance as outlined in this report.

  By issuing a larger bond (greater than $40 million), CPRA could expand the amount of wetland restoration at whichever site it selects and make a stronger case regarding its land loss reduction and the flood risk reduction benefits that would accrue to local asset owners.

[42] Louisiana House Bill. (2017, 22 June). H.B. 618. Retrieved from: http://www.legis.la.gov/legis/ViewDocument.aspx?d=1031588.

- **Address land ownership:** As is true with many CMP projects, the land evaluated in this report is owned by a private party — in this case, ConocoPhillips. CPRA and the CPR FC will need to work to secure agreements with the landowner regarding site access and the ability to build and maintain wetlands on their property. Bond counsel can also help CPRA and the CPR FC determine that the use of public funds on private property will provide net benefits to the state.
- **Secure willing partner-payor(s):** This project has identified a set of possible parties who might be willing and able to contribute to some aspect of the transaction (e.g., performance payment, payment of interest or some portion of principal). CPRA and CPR FC will need to work with one or more of these payors to secure commitment to move forward in the process. Ideally, the partner will be willing to sign a Memorandum of Understanding or a Letter of Intent indicating their willingness to move forward with CPRA in serving as a "partner-payor" in the EIB transaction. CPRA will then be able to work closely with this partner to develop a final transaction structure that serves the interests of all parties involved.
- **Secure a financial intermediary:** To help secure willing partners and develop the details and agreements necessary to execute a transaction, CPRA will need a financial intermediary to assist with the design and execution of the EIB. If state funding is not available or sufficient to move the EIB towards execution, EDF or another organization could seek resources necessary to shift some of the burden from the state and support expeditious completion of the EIB transaction.
- **Pursue transaction structuring:** Once the transaction details have been decided upon and the legal issues regarding repayment have been resolved, the CPR FC, CPRA and its partners can move forward into transaction structuring. Overall, the transaction structuring process is expected to take six to eight months, and the key steps in this process are outlined in **Table 9**, right.

TABLE 9

Overview of transaction structuring steps

Action	Lead (support)	Description
Finalize project and transaction details		
CPRA and CPR FC meet to set goals and roles	CPRA & CPR FC	Determine how CPRA & CPR FC will work together toward bond issuance.
Finalize site selection	CPRA & CPR FC	Determine the exact parcel and project that will be financed through the environmental impact bond.
Finalize outcomes, thresholds for performance payments and performance payment amounts	CPRA & CPR FC (with support from Financial Intermediary)	Determine and agree upon thresholds that will trigger performance payments as well as performance payment amounts.
Secure partner agreement(s) regarding payments	CPRA & CPR FC (with support from Financial Intermediary)	Engage partners, negotiate and establish contractual agreements that indicate their willingness to move forward with the financing and commitment to contributing to bond repayment.
Set transaction structure	CPRA & CPR FC (with support from Financial Intermediary)	Delineate financial flows between parties.
Establish Special Purpose Entity (SPE) for the project (as necessary)	CPRA & CPR FC (with support from Financial Intermediary)	Determine whether the transaction may require a project SPE (e.g., an intermediary or escrow) that joins CPRA and the "partner-payor", and legally establish this entity including all relevant contracts. Engage a financial intermediary as required. Explore opportunities for philanthropic benefits to "partner- payors", such as determining if "partner-payor" contribution could generate tax benefits.
Finalize term sheet and deal parameters	CPRA & CPR FC (with support from Financial Intermediary)	Draft a term sheet in partnership with the financial advisor and bond underwriter that will set the terms for the bond issuance.
Model projected flood risk reduction and benefits (optional but desirable)	CPRA with Louisiana State University (LSU), other academic institutions, or The Water Institute of the Gulf	Conduct modeling of site to assess with- and without-project-future flood risks to predict projected changes in flood risk; evaluate benefits to asset owners to further build business case for voluntary participation.
Engage transaction stakeholders		
Engage bond counsel	CPRA & CPR FC	Bond counsel will confirm tax-exempt status, ensure appropriate enabling legislation is in place, evaluate bond structure and terms, and draft documents including financial covenants, such as additional indebtedness. Bond counsel will also ensure that any bonds issued by the CPR FC will not be considered Net State Tax Supported Debt.
Engage underwriter and financial advisor	CPRA & CPR FC	The underwriter and financial advisor will coordinate the bond issuance and market the deal to potential investors.
Select financial intermediary	CPRA & CPR FC	Determine whether a financial intermediary is required to manage the SPE and channel funds between the investors and CPRA & the "partner-payor(s)", and, if so, contractually engage that financial intermediary.
Select evaluation partner	CPRA & CPR FC (with support from Financial Intermediary)	Determine roles and responsibilities for ongoing monitoring and evaluation, including procurement of a service or technology provider who can monitor outcomes that trigger payments.
Establish contracts between all relevant parties	CPRA & CPR FC (with support from Financial Intermediary)	Determine necessary contracts between transaction stakeholders (e.g., CPRA, CPR FC, "partner- payor(s)", Special Purpose Entity (SPE), evaluator).
Transaction placement and closing		
Market transaction to investors	Bond underwriter	The underwriter will market the transaction to investors. If the EIB is issued in private placement rather than as a public issuance, the investors may be involved in negotiating the deal terms with CPRA and the CPR FC.
Close transaction	Bond Counsel, Financial Advisor, Bond Underwriter, CPR FC	Issue the bond to investors and allocate proceeds to wetland restoration.

Beyond the pilot

The pilot EIB transaction supporting wetland restoration described in this report represents a small piece of the overall puzzle of securing Louisiana's coastlines. But the model creates a template to pursue opportunities within and beyond state boundaries. The model described here can readily be followed to create larger transactions at numerous other suitable sites across Louisiana where restoring wetlands improve flood damage reduction. These transactions, whether executed singly or bundled together, would help Louisiana accelerate investment in coastal restoration and engage private partners to leverage private investment.

Because the pilot will provide further proof of o the value of wetlands in protecting Louisiana's coastal communities and infrastructure, gathering additional "partner-payors" from the many stakeholders that can benefit from the construction of wetlands should become easier. Those stakeholders include public agencies who own or manage transportation or flood control infrastructure, to communities situated in vulnerable areas, to private entities seeking to ensure business continuity, to homeowner associations wishing to lower flood insurance rates. The transaction described in this report adjacent to Port Fourchon can provide a data point to these stakeholders on both how wetlands generate economic benefits from reduced rates of land loss and how these partners can help support and expedite investment in Louisiana's coastlines.

Other coastal states, and indeed coastal countries across the world, are watching Louisiana and how it works to ensure the future of its coastal communities and economies. This transaction can highlight Louisiana's commitment to innovative approaches and to making the most of scarce resources to create the broadest possible benefits to the state's inhabitants. This transaction is just a starting point — the opportunities for replicating this transaction and approach can resonate far beyond the wetland restoration site that would benefit from this investment. Therefore, it is the hope of the project team that the findings of this report can provide motivation to Louisiana to continue its leadership in innovative and cost-effective coastal restoration and in securing a sustainable economic future for its citizens.

CHAPTER 7

Appendices

APPENDIX A

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APPENDIX B

Site selection process details

This appendix outlines the process for choosing a pilot site to focus on in this report.

Besides the site selection factors presented in the report related to basic EIB features, the team gathered feedback from CPRA and collected additional data on performance risks and potential beneficiaries to narrow down the list of 31 marsh creation projects in the CMP to a handful of projects with most potential for this pilot. Available information was organized in a selection matrix. This approach allowed the team to ranked projects based on their EIB suitability and could be used as a template for future site selection.

Selection factors

An initial list of selection factors was evaluated by CPRA and categorized as non-discerning and discerning factors for an initial screening of projects.

TABLE A-1

Initial selection factors evaluated by CPRA for initial EIB project screening

Non-discerning factors	Rationale
Repayment source	CPRA would be able to identify a revenue source for repayment for most CMP Implementation Period 1 and 2 restoration projects, so in principle this would not be a discerning factor for an initial screening of projects.
Permitting issues	Permitting issues (e.g., land rights) tend to be site specific and more work has to be done on engineering and design to identify these with certainty. Under performance-based contracting, these issues would primarily be the responsibility of the contractor.
Discerning factors	**Rationale**
Performance risks: exposure to sea-level rise and storm surge	Two performance risks that are relevant across different sites were identified: exposure to sea level rise and storm surge. The project partners agreed that a low performance risk could attract investors and help create demand for the bond.
Dependence on completion of other projects and sediment diversions	Two additional factors that could affect the success of a restoration project under the EIB are the dependence on completion of other projects and the influence of sediment diversions on the project site which could add a degree of uncertainty to the final outcomes. Sites that do not depend on these factors were prioritized in the selection process to avoid delays in moving from design to implementation of the pilot.
Links to structural projects	Linking wetland restoration to structural projects (e.g., levees) could help attract "partner-payors". Prioritizing restoration projects that provide a buffer of protection to a levee could engage beneficiaries through lower levee operation and maintenance costs and more protection to communities and assets inside the levee.

Additional data collection

Relative performance risks (factors that might affect the success of wetland restoration) were assessed using the following datasets:

- Lower exposure to relative sea level rise: CMP projections of land creation from restoration projects were used to identify the projected change in the area of land created between the Medium and High environmental scenarios of the CMP at year 50 for each of our 31 marsh creation projects.[43] Projects with lower exposure were prioritized, as relative sea-level rise posed risks to project longevity.
- Lower exposure to storm surge damage: This variable considers two factors: 1) mean flood depths for a 100-year event at year 50 under the medium scenario in the area of the project, and 2) location inside a FEMA V zone.[44] These two factors combined indicate potential risks from storm surge. Projects with lower potential for risks from storm surge were given a higher ranking.

To help identify beneficiaries of restoration potentially willing to add funds to this effort, the project team gathered data on parish and industry level economic output, critical landscape features contributing to wave attenuation, and restoration sites in the CMP with most potential to reduce storm surge. The following datasets and analysis supported this part of the selection process:

- **Economic output by parish and by industry:** The IMPLAN software provided data on the value of the production of two key economic sectors in Louisiana: oil & gas and navigation. These dataset gave the team an overview of the economic landscape of Louisiana coastal parishes and location of key assets and industries.
- **Critical landform features:** The U.S. Army Corps of Engineers (USACE) conducted a study after Hurricanes Katrina and Rita that identifies, through surge model analysis, critical landform features that reduce storm surge impacts by slowing surge movement along the coast.[45] These features are land bridges, ridges, and other types of landforms that buffer against storm effects.
- **RAND analysis of risk reduction from restoration:** RAND was hired under this project to analyze the impacts of 2017 CMP restoration projects on flooding risk, and disaggregate the CMP's estimates of damage reduction at a finer geographic scale (census tract). This analysis supported the final EIB site selection by providing additional evidence on specific restoration project locations with a potential to reduce flooding risks. The analysis focused on flood risk impacts to industrial assets, roads, and critical infrastructure.

[43] The CMP evaluated the results of restoration projects for different degrees of land subsidence and sea level rise to account for future uncertainties. The High Scenario represents higher rates of sea level rise and subsidence relative to the Medium Scenario.
[44] V zones are coastal high hazard areas. They are areas subject to high velocity water including waves.
[45] US Army Corps of Engineers. (2009). Louisiana coastal protection and restoration (LACPR): final technical report. doi: 10.13140/2.1.2732.4487.

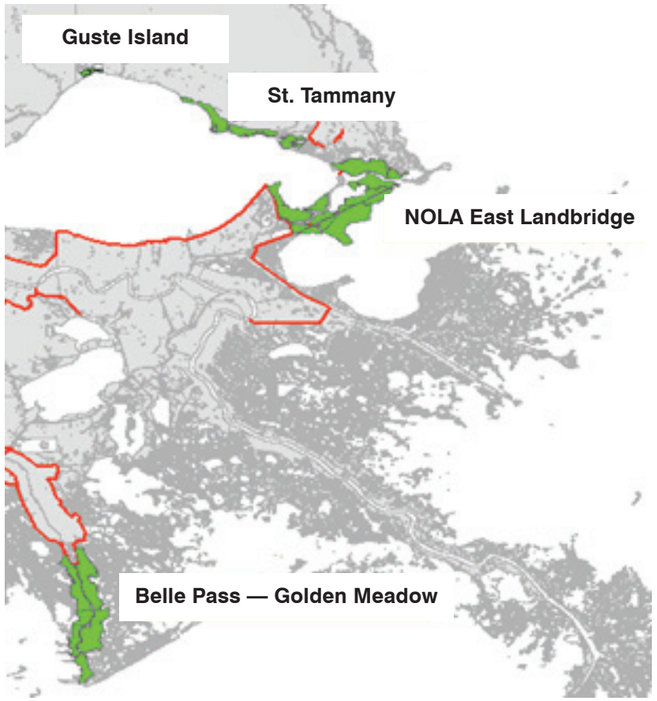
In the final selection step, CMP marsh creation projects highlighted in RAND's report, those overlapping USACE's critical landscape features, and those providing a buffer of protection to levees were identified as most likely to provide economic benefits to major industries and asset owners. These factors were used to weight the IMPLAN economic output data and link the risk reduction potential of different sites to the presence of assets and industries that could contribute as additional payors of the bond.

Shortlist candidate sites for EIB wetland restoration pilot

Based on the factors described above, the following 2017 CMP restoration projects were shortlisted:

FIGURE A-1

Shortlisted wetland restoration projects



Belle Pass-Golden Meadow marsh creation

This project is located in Lafourche Parish. The full project as outlined in the CMP is 23,200 acres with a cost per acre of about $68,000.[46] Based on the data collected, this project would have a medium level of performance risk as defined by relative exposure to sea level rise and storm surge damage. Potential beneficiaries of restoration would include the navigation and the oil and gas industries, given the location of Port Fourchon in the southern portion of the project. The project would sustain Bayou Lafourche and provide a buffer of protection for the levee in the north. Lafourche Parish and its levee board would also be beneficiaries.

New Orleans East Landbridge marsh creation

This 33,400 acre project is located in Orleans and St. Tammany Parishes and has a cost of approximately $44,000 per acre.[47] The project was given a high performance risk value. The project is important to both parishes and would also provide storm surge protection benefits to the north shore of Lake Pontchartrain. It would provide protection to the levee system and support the Intracoastal Waterway.

St. Tammany and Guste Island marsh creation

The St. Tammany and Guste Island Marsh Creation projects are located in St. Tammany Parish, which has a diverse economic base, including corporate headquarters of energy and manufacturing industries. St Tammany is a 6,700-acre project at a cost per acre of $29,000. Guste Island project is a smaller project of 700 acres at a cost per acre of about $89,000.[48] The project would provide flood risk reduction for the town of Madisonville, according to RAND's analysis, but no levees or key waterways would benefit from this project.

Both projects have a medium-low performance risks given their location in the higher delta region, with lower exposure to relative sea level rise and storm surge.

Selection: Belle Pass-Golden Meadow marsh creation

While each of the four sites has merit for assessing the feasibility of financing wetland restoration via an EIB, the Belle Pass–Golden Meadow Marsh Creation project best fits as it balances performance risk, risk-reduction potential for multiple stakeholders, and potential avoided costs for CPRA.

[46] Based on 2017 CMP estimates.
[47] Based on 2017 CMP estimates.
[48] Based on 2017 CMP estimates.

APPENDIX C

Economic importance of Port Fourchon

Port Fourchon is a key economic driver in the region, state, and country, making it an ideal location to test the measurement of flood risk reduction benefits to local asset owners. Key findings from a 2014 study of the economic importance of the port, commissioned by the port, are summarized below. Additional context was provided by the port's leadership team and other resources.

Local economic importance of the port

Nine of the top ten Lafourche Parish taxpayers operate from and/or utilize Port Fourchon, generating $19 million in tax revenues for the Parish in 2016. These top taxpayers are firms associated with offshore oil production and include operators of fleets, airline services, pipelines, deepwater port servicing, and storage facilities. Similarly, nine of the top ten Lafourche Parish employers use or operate from the port, for example, including Edison Chouest Offshore, Crosby Tugs and two shipyards.

The Houma-Thibodaux Metropolitan Statistical Area (MSA) is comprised of Terrebonne and Lafourche Parishes in their entirety. Within this MSA, ongoing operations at the port in 2013 created:

- Over $2.1 billion in sales from firms in the MSA
- $458.1 million in household earnings for MSA residents, and
- 8,015 jobs for MSA residents

[49] Greater Lafourche Port Commission. (n.d.) Port Facts. Retrieved from: http://portfourchon.com/seaport/port-facts/.
[50] Boudreaux, D. (2017, 25 September). Making a list: here are Lafourche's top 10 taxpayers. Houma Today. Retrieved from: http://www.houmatoday.com/news/20170925/making-list-here-are-lafourches-top-10-taxpayers.
[51] The top seven port-dependent taxpayers include Nautical Solutions (operator of offshore service fleet); Hornbeck Offshore Services (tugs, vessels and offshore servicing); Chevron/Texaco Exploration and Production; Bristow US (helicopter transportation and support); Gulfshore Americas, Inc. (offshore supply transportation & supply vessels); LOOP, the Louisiana Offshore Oil Port (the only U.S. port capable of offloading deep draft supertankers); and Texas Petroleum Investment Co.
[52] These figures represent conservative and significantly understated estimates because they derive solely from the responses from 17 Port tenants, which together make up just 60% of all Port revenues from tenants.
[53] Loren C. Scott & Associates, Inc. (2014). The economic impact of Port Fourchon, an update. Greater Lafourche Port Commission. Retrieved from: http://www.lorenscottassociates.com/Reports/PortFourchonImpact2014.pdf.

These port-derived jobs have salaries 27 percent higher than elsewhere in Louisiana. The combination of construction spending and ongoing port operations in 2013 generated at least $12.3 million in indirect sales taxes for local governments in the MSA. For every single job created at the port, 3.6 new jobs are created elsewhere in the MSA.[54,55]

Economic importance of the port to the state

Not including construction spending, Port Fourchon's ongoing operational activity in 2013 created:

- Almost $2.6 billion in sales for firms in the state
- $580.2 million in household earnings for state residents
- 10,804 jobs for State residents

For every one new job created at the port, 5.2 jobs are created elsewhere in the State. As at the Parish level, port-related jobs on average paid $53,702 in 2013, 28 percent higher than the annual wage in Louisiana. Including construction activity with ongoing operations, the port generated at least $46 million in taxes for the state.[56]

Economic importance of the port nationally

Louisiana is the country's top crude oil producer when production from its section of the federally administered Outer Continental Shelf (OCS) is included. When that production is excluded, Louisiana ranks ninth in the nation.[57]

Louisiana is also one of the top three natural gas-producing states in the country.[58] About three-fifths of the state's natural gas production typically takes place in the OCS, although substantial production takes place in the northern and southern parts of the state, as well as offshore in state waters.[59]

Port Fourchon currently services over 90 percent of the Gulf of Mexico's deepwater oil production.[60] Over 250 companies utilize Port Fourchon as a base of operation. Over 400 large supply vessels traverse the port's channels each day.

[54] Loren C. Scott & Associates, Inc. (2014). The economic impact of Port Fourchon, an update. Greater Lafourche Port Commission. Retrieved from: http://www.lorenscottassociates.com/Reports/PortFourchonImpact2014.pdf.
[55] Loren C. Scott & Associates, Inc. (2014). The economic impact of Port Fourchon, an update. Greater Lafourche Port Commission. Retrieved from: http://www.lorenscottassociates.com/Reports/PortFourchonImpact2014.pdf.
[56] Boudreaux, D. (2017, 25 September). Making a list: here are Lafourche's top 10 taxpayers. Houma Today. Retrieved from: http://www.houmatoday.com/news/20170925/making-list-here-are-lafourches-top-10-taxpayers.
[57] US Energy Information Administration. (n.d.). Rankings: crude oil production, March 2018. Retrieved from: https://www.eia.gov/state/rankings/?sid=LA#/series/46.
[58] US Energy Information Administration. (n.d.). Rankings: crude oil production, March 2018. Retrieved from: https://www.eia.gov/state/rankings/?sid=LA#/series/46.
[59] Louisiana Mid-Continent Oil and Gas Association. (n.d.). Industry sectors. Retrieved from: http://www.lmoga.com/industry-sectors/.
[60] Greater Lafourche Port Commission. (n.d.) Port Facts. Retrieved from: http://portfourchon.com/seaport/port-facts/.

In addition to its huge domestic hydrocarbon significance, Port Fourchon is the land base for Louisiana Offshore Oil Port (LOOP), which handles 10-15 percent of the nation's domestic oil, 10-15 percent of the nation's foreign oil, and is connected to 50 percent of US refining capacity. LOOP is the only US deepwater port capable of offloading Very Large Crude Carriers and Ultra Large Crude Carriers.

According to the Louisiana Mid-Continent Oil and Gas Association, Port Fourchon generates $5 - $8 billion per year in offshore revenue for the federal treasury, the most of any state.[61]

Economic costs of Port Fourchon shut-down or impairment

In addition to the ongoing economic benefits of Port Fourchon, disruption in port services and operations also presents significant potential economic costs. According to Port Director Chett Chiasson, when Highway 1 — the sole road access to the Port — is shut down due to surge overruns, it costs the U.S. economy $22 million every hour. A three-week disruption or shutdown in port services could occur due to damages from a hurricane, terrorist attack or other destructive, at the following levels:

- A loss of $11,226.7 million in sales at U.S. firms
- A loss of $3,156.2 million in household earnings in the U.S., and
- A loss of 65, 502 jobs in the nation.

Port Director Chett Chiasson has expressed concern about the vulnerability of the port's $1 billion in assets on the ground, $1 billion in floating assets, and another $300-500 in public assets (roads) that are that are increasingly vulnerable to coastal erosion.[62] Chiasson has advocated a need to build a buffer zone around the Port and parallel to Highway 1, which is the essential supply route highway to the port. The largest tenants of the port (Shell, Exxon Mobil, and other large integrated oil companies) are increasingly engaged in thinking about the vulnerability of Highway 1 and how to ensure the port will still be here in the face of increasing coastal land loss.[63]

By increasing the buffer wetlands around the port and in the vicinity of Highway 1, coastal restoration projects near the port can both protect the economic security of the Port and decrease the risk to port stakeholders, employees, Parish revenues and energy consumers nationwide.

[61] Louisiana Mid-Continent Oil and Gas Association. (2014, 20 August). Offshore committee members and local parish presidents meet at Port Fourchon. Press release. Retrieved from: http://www.lmoga.com/news/offshore-committee-members-and-local-parish-presidents-meet-at-port-fourcho/.

[62] C. Chiasson (Ex. Dir., Greater Lafourche Port Commission), telephone conversation, April 5, 2018.

[63] C. Chiasson (Ex. Dir., Greater Lafourche Port Commission), telephone conversation, April 5, 2018.

APPENDIX D

Proposed methodology for measuring outcomes

This EIB proposes to focus on the outcome of flood risk reduction, through measuring the proxy metric of avoided land loss. A key focus for EIBs is limiting the costs associated with measurement. The project team designed a methodology for measuring outcomes, and also evaluated the use of a technology platform based on satellite imagery and machine learning to enable efficient, transparent, and near-real time monitoring of avoided land loss. The applicability of this technology platform provided by Upstream Technology is under continued development beyond the scope of this report.

Selecting an outcome metric: avoided land loss

In order to select outcomes that indicate both a potential for long-term sustainability of the wetlands as well as potential for lower flooding and damages to assets, the project team considered a range of possible metrics and methodological approaches. With inputs from wetland experts, methods using both modeled and observational data to assess ecological outcomes and flooding risk outcomes were evaluated, as well as the potential to leverage existing resources for monitoring wetland projects such as the Coastwide Reference Monitoring System.[64]

Ideally, this transaction could directly measure and tie payments to flood risk reduction. However, detailed high resolution risk modeling would be necessary and is expensive. Furthermore, the relatively small size of the pilot EIB wetland restoration would limit the the potential magnitude of these benefits — it would be hard to attribute flood risk reduction benefits to this particular parcel. A full flood risk reduction analysis could be part of a future project to finance restoration at a larger scale than this pilot.

Given the need to connect outcomes to payments cost-effectively, and the interest in providing performance metrics that are compelling to different participants in this transaction, avoided land loss was chosen as a reasonable metric as a proxy for flood risk reduction. Other key variables that indicate a positive project trajectory toward protecting physical assets and reducing include vegetation density and the land-water ratio.

[64] See: https://lacoast.gov/crms2/.

Timeframe for measurement & validation

If the EIB finances a traditional contract (where there is no performance-based payment to contractors), then performance measurement could take place over the lifecycle of the investment — this ability to continuously monitor is a key advantage of this technology-enabled approach. Ultimately, the transaction would entail determining key points in time or milestones at which the wetland would either meet, not meet, or exceed the avoided land loss criteria set at the time of bond issuance.The success of the wetland or the exceedance of avoided land loss threshold at these milestones will trigger the performance payment to investors and wetland developers at the end of the bond period. The exact threshold would be set in the transaction structuring phase.

If the EIB financed a PBC, CPRA would evaluate the wetland contractor's performance based on its normal metrics and methodologies that would be established in the contract (i.e., a combination of factors that determine the areal extent and quality of wetland restored — including biotic factors such as plant species and foliar ground cover — and elevation of that land over time). Alternatively, knowing about the bond's intended performance outcomes, the state might opt to require measurement of area restored and elevation via remote sensing with machine learning alone or in addition to their standard performance metrics.

Additionally, the state might choose to shorten the period of time the contractor would be responsible for monitoring and making adjustments to ensure performance. Then the EIB's independent third party validator would take over performance measurement and the focus would shift to measuring avoided land loss — based on satellite data and statistical analyses — for the remainder of the bond term. These changes could both ensure adequate performance, reward "over performance", and, because the contractor is not held responsible for monitoring and adjustments for as long a period, may lower the state's contracting costs.

TABLE A-3

Illustrative EIB + PBC combined monitoring approach

Timeframe	Years 4-7 performance-based contract	Years 7-15 EIB
Metrics	Wetland area restored & elevation	Avoided land loss in project site and adjacent parcels *Possible additional:* Indicators of wetland health: vegetation density, land-water ratio, others.
Methodology	Field measurements Satellite imagery after construction	Analysis of historical and real-time satellite data, statistical analysis
Party performing monitoring	PBC	Independent third party
Party determining performance success	CPRA	Independent third party

Proposed EIB validation methodology

The goal of the EIB validation methodology is to monitor avoided land loss over time, relative to "counterfactual" outcomes of a control or reference site that is similar to the EIB parcel, but where wetland restoration efforts would not have taken place.

The proposed methodology for monitoring avoided land loss combines machine learning techniques with a causal inference approach commonly used to evaluate conservation policies. The impact of a specific restoration project is evaluated using satellite data compiled at different points in time to assess land loss within the project site as well as outside in adjacent areas, and defining a counterfactual scenario. Counterfactual outcomes are estimated by defining control or reference locations that are similar to the proposed restoration site in key determinants of land loss.

Matching approach

Matching is an evaluation technique that uses observable characteristics to find a similar control unit for each treated unit.[65] Using satellite data, the matching procedure generally follows these steps:

- Use observable, pre-intervention site attributes to characterize parcel located inside a project area;
- Select a matching estimator to define "similarity" between treated (intervention) and untreated parcels;
- Find control parcels - using the characteristics of 'similarity' defined in the prior step - outside of the 'treated' project area to estimate counterfactual outcomes; and,
- Compare post-intervention outcomes between the treated and the control parcels to estimate the causal impact of the intervention.

"Similarity" is defined based on key covariates, i.e., determinants of avoided land loss. Some proposed covariates to determine "similarity" are:

- Historical subsidence rates/ subsidence region
- Initial land elevation
- Exposure to sea-level rise, e.g. distance to the open water
- Vegetation type
- Salinity

A matching estimator (statistical approach) would be chosen to balance these characteristics across treated and control groups to provide a measure of the causal impact of the project. Different estimators such as propensity score matching or covariate matching can be tested to select the one that provides the best balance after matching. This approach can be used to test impacts of the project inside the site's boundaries, as well as spillover effects outside the boundaries.

[65] Abadie, A., and Imbens, G. (2016). Matching on the estimated propensity score. Econometrica. Volume 84, Issue 2, 781–807. doi:10.3982/ECTA11293.

Machine learning

The team collaborated with Upstream to design an evaluation methodology and establish a framework that integrates automated monitoring via empirical and machine learning layers to determine restored wetlands status, track changes, and validate whether desired outcomes were obtained.

Machine learning is a field that develops algorithms designed to be applied to datasets, with the main areas of focus being prediction, classification, and clustering. These tasks are divided into two main branches: supervised and unsupervised machine learning.[66]

Supervised machine learning focuses primarily on prediction problems: given a dataset with an outcome of interest, and relevant and known predicting criteria, the goal is to estimate model outcomes for a subset of the data and validate the model generated outcomes, using ground-truthed outcomes. This subset is called the training sample, and it is used for predicting outcomes in the remaining data, which is called the test sample. Unsupervised machine learning utilizes methods for finding patterns in data, such as recognizing and sorting images in clusters based on their specific and unique characteristics.[67]

Both supervised and unsupervised machine learning approaches can be applied to evaluate wetland restoration. In a future effort, beyond the scope of this report, Upstream will work with EDF and Quantified Ventures to employ its existing remote-monitoring technology, powered by machine-learning capabilities, to conduct analysis specific to project area comparison objectives, specified by EDF. Data utilized for 'training' will be sourced from CPRA's data warehouse (Coastal Information Management System, or CIMS), Louisiana State University's Wave Current Surge Information System (WAVCIS), and USGS coastal monitoring station database. Both empirical, remotely-sensed spatial data, and the spatial data derived from "trained" models will be employed to measure the of outcome metrics as described in Table A-3 above. By correlating the time and location of historical readings from these data sources with satellite imagery, machine-learning models can be trained to "see" relationships between the spectral signature (reflectance value of the emitted light waves) of each pixel within the imagery and in-situ measurements.

Upstream's platform can provide analysis of historical data and provide a real-time insight into the relationship between restored and unrestored wetlands to serve as reference points for temporal changes in the outcomes of restoration, including:

- Surface elevation
- Land-water ratio
- Vegetation density and extent (Normalized Difference Vegetation Index, Soil- Adjusted Vegetation Index, Enhanced Vegetation Index)
- Edge erosion/accretion
- Inundation

Comprehensive monitoring of these metrics can help better understand "wetland health" and the restoration project's performance.

[66] Athey, S. (2018). The role of machine learning on economics. Retrieved from: http://www.nber.org/chapters/c14009.pdf.
[67] Athey, S., & Imbens, G.W. (2017). The state of applied econometrics: causality and policy evaluation. Journal of Economic Perspectives, 31(2), 3-32.

The results of this evaluation would be made available online in the Upstream Dashboard,[68] which enables easy, collaborative exploration of historical analyses, near real-time monitoring of conditions and report generation. This platform could be accessed by project stakeholders, payors, investors, wetland contractors, and others.

Combining causal inference techniques and machine learning

Recent studies suggest the potential to integrate causal inference methods with machine learning in order to harness the strengths of each and provide a rigorous measurement of relevant project outcome metrics.[69] Promising methods combine the estimation of the association between outcome metrics of interest and the covariates, and of the association between the treatment indicator and the covariates.[70]

Performance threshold(s)

Performance thresholds can be defined in terms of a unit quantity (acres) of avoided land loss, the difference in land loss in a wetland with a constructed project and without, to trigger a performance payment to investors. These threshold values would ultimately be finalized in the transaction structuring phase, though the project team considered two potential approaches to determining an appropriate threshold to tie to the performance payment.

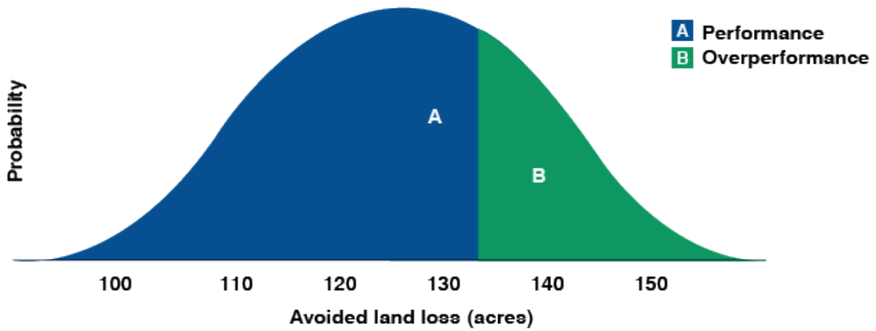
The first approach is to use the "matching estimator" to determine if the project had a statistically significant impact on avoided land loss at the end of the monitoring period and compare it to reference sites included in the counterfactual scenario. Investors would receive a performance payment if the project in fact slowed down land-loss, compared to the untreated control area referred to as the "reference area." In this case, "over-performance," as described in Section 3: Proposed EIB Transaction Structure would mean that there was a statistically significant positive difference, whereas the "base performance" would mean that the analysis did not show a statistically significant difference between the restored wetland area and the reference area.

An alternative approach would use a supervised machine learning model to predict the expected land-loss avoided from the project as well as its confidence interval (see **Figure A-2** for an example). In this case if the final project outcome exceeds the expected and agreed-upon threshold for over-performance, investors (and ideally contractors) would receive a performance payment.

[68] Available at www.upstream.tech.
[69] Athey, S., & Imbens, G.W. (2017). The state of applied econometrics: causality and policy evaluation. Journal of Economic Perspectives, 31(2), 3-32.
[70] One approach to linking causal inference and machine learning would be to use a double selection procedure for the covariates in the model, first using a Least Absolute Shrinkage and Selection Operator (aka LASSO) regression to select covariates that are correlated with the outcome, and then again to select covariates that are correlated with the treatment. A final integrated regression including the union of the two sets of covariates improves the estimation the average treatment effect compared to simple regularized regression of the outcome on the covariates and the treatment. These approaches can be used in the evaluation of wetland restoration outcome to improve model predictions as well as the estimation of causal effects.

FIGURE A-2

Avoided land loss predicted probability distribution



Frequency of evaluation

Since Upstream can monitor all observable performance metrics in an automated machine-learning environment, measurements and predictions could be made more frequently. To increase accuracy and decrease variability in coverage due to clouds and other operational disruptions, monthly or quarterly monitoring and reporting is suggested.

With additional available funding to further develop the Louisiana EIB concept, Upstream could continue to work with EDF and Quantified Ventures to develop and improve approaches to wetland performance monitoring that provides scalable, inexpensive, and real-time monitoring of relevant outcome metrics.

APPENDIX E

Evaluating a role for Tax Increment Financing (TIFs) in wetland restoration

The project team considered a number of alternative financing structures in the course of its analysis of how best to create an EIB. One of the many alternatives that the team evaluated was creating a tax increment financing (TIF) district and issuing TIF bonds to finance this and potentially future avoided land loss coastal restoration efforts.

TIF is a financing tool used by local governments to promote economic development and redevelopment. The TIF process splits tax revenue generated from properties within the TIF district into two components:

- **Base revenues:**
  - Amount available before the TIF district is established; base revenues are shared among a mix of local governments that have the power to assess property taxes: cities, counties and special taxing districts.
- **Incremental revenues:**
  - New revenues in excess of the base revenues that are generated by development projects.

By giving exclusive use of incremental revenues to the sponsoring governmental entity, the successful tax increment financing process generates a revenue stream for repayment of bonds issued to underwrite projects within the TIF district. In the case of a potential TIF for avoided land loss coastal restoration, the "incremental" revenue would be the continued incremental property tax revenue flowing to the issuing unit of government as a result of the avoidance or slowing of coastal land loss.

Although popular for governments undertaking large public investments, TIFs are not without their procedural and structural nuances and complexities, even excluding the normal challenges of implementing local taxes. Although the state of Louisiana has passed enabling legislation allowing units of government to create TIF districts and issue TIF bonds, there are lingering (and potentially complex) questions surrounding a potential tax increment financing for the express purpose of avoided land loss coastal restoration. Key questions for evaluation of a TIF in this instance would include:

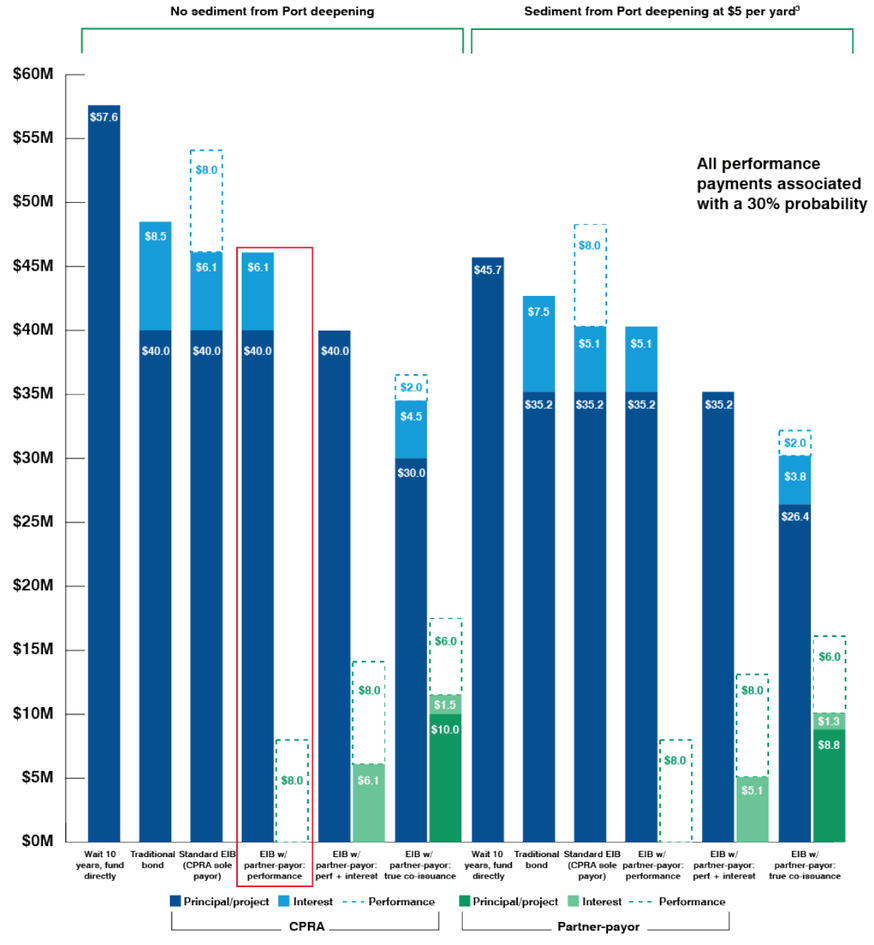
- **Land rights:** There is uncertainty regarding ownership interests and tax treatment of land that has subsided, remains subsided, or is returned and the enforcement of those ownership rights.
- **Geographic ring-fencing:** Whether structured as a TIF, an economic/environmental development/opportunity zone, or some other special purpose district, the state would also need to determine how to properly ring-fence the geography in question.

- **Economic valuation:** The state would need to determine how to capture the economic value of wetland restoration. The traditional TIF metric is identifying an increase in tax revenue by virtue of the activity funded to use as a source of bond repayment. In this case, the metric would be more likely to be a stabilization in tax revenue or the mitigation of loss in tax revenue due to subsidence.

Given these uncertainties, the project team concluded that pursuing a TIF structure for the purpose of crafting and issuing an EIB added layers of complexity that would be challenging to absorb within the framework of this pilot EIB issuance in coastal Louisiana. However, the state could continue to evaluate this TIF approach and concept as part of its broader CMP financing strategy going forward.

APPENDIX F

Financial model outputs



APPENDIX G

Investor feedback

Investor interviews were conducted from February through April 2018.The project team provided interviewees with a presentation that included summary information on the Belle Pass-Golden Meadow wetland restoration project and a series of possible EIB transaction structures.

One of the most salient refrains offered during the investor engagement process concerned the tradeoffs associated with increasingly complex EIB transaction structures. Having only been introduced in 2011, impact bonds — whether social, environmental, or otherwise – have such a limited record of performance that even the most basic transaction structures will require more robust due diligence. Investors also raised questions regarding counterparty risk and tax treatment associated with any performance-based payments. They commented that structures including multi-tiered performance payments and/or additional third party payors would ultimately prove more difficult to analyze and attract a more limited subset of investors.

Investors consistently expressed the need for clear identification of all parties responsible for making interest, principal, and performance-based payments. Investors need a clear line of sight as to whose credit worthiness they need to analyze before they properly evaluate the investment opportunity, and determine whether they want to invest in the project. They also emphasized the need for detailed information regarding the revenue streams that make up CPRA's claims from the Deepwater Horizon oil spill settlements. They will need to understand the processes that dictate how different revenue streams from the Deepwater Horizon oil spill are allocated and distributed to fund wetland restoration projects.

Two clear points came through: 1) CPR FC's lack of bonding experience adds risk to the transaction and will likely increase the cost of capital, and, 2) despite this lack of experience, investors expressed a preference for CPR FC to issue the securities over a Special Purpose Entity (SPE). Experienced bond-issuing entities' performance records inform investors' credit analysis. Their performance histories reduce the analysis necessary to evaluate new securities when these entities return to the capital markets. While investors are sophisticated enough to conduct the analysis necessary for new issuers, it will certainly take longer than for more experienced issuers. Investors are likely to charge a premium for an inexperienced issuer with a limited track record.

Investors' preference for the CPR FC issuing the securities over an SPE owes to tradeoffs associated with more complex transaction structures. The project team proposed the inclusion of an SPE to accommodate multi-payor EIB transaction structures. Investors were quick to comment that transactions that include an SPE are more challenging and time consuming to analyze. The additional complexity will naturally increase diligence costs and potentially reduce the risk-return profile of the investment. Interviewees questioned whether there is a way to structure the transaction that avoids the use of an SPE but allows for a portion of the bond to be non-recourse to the CPR FC, representing the cash flow strip that is the performance-based payment. In summary, investors reiterated that in terms of structuring the transaction, the closer it resembles a more traditional deal, the better.

While the primary focus of the project team's conversations with investors centered on transaction structuring, interviewees also shared feedback and questions on the restoration project itself. They were quick to suggest that investors will be eager to understand the risks posed by the wetland restoration companies involved in the project, regardless of the inclusion of PBCs that stipulate acceptable project completion standards. They suggested establishing specialization criteria within the bidding process to identify wetland restoration companies best suited to meet the performance standards of the project.

Investors will also require clarity on the causal relationships between the restoration project, targeted outcomes, and associated performance metrics. The scientific basis for any performance metric used to trigger outcomes-based payments, and the methods employed to validate that outcomes have materialized, must be clearly communicated and accepted by all parties involved in the deal. Investors also expressed a preference for performance metrics that are directly observable, as they help to avoid potential false negatives.

Interviewees also shared their thoughts on the types of investors that would be interested in investing in the coastal wetland EIB. They suggested that tax-exempt funds with an allocation to green or socially responsible investments would likely be interested in the deal. Corporations that have their own green investment mandates could also emerge as interested investors. Interviewees reiterated that the complexity of the transaction would have significant implications for the types of investors interested. While the final terms and structure of the transaction will play a pivotal role in attracting investor interest, interviewees highlighted that sales desks have seen growing, genuine interest in these types of performance-based transactions.

APPENDIX H

Acronyms

CMP	Coastal Master Plan
CPRA	Coastal Protection and Restoration Authority
CPR FC	Coastal Protection and Restoration Financing Corporation
CRMS	Coastwide Reference Monitoring System
CIMS	Coastal Information Management System
EDF	Environmental Defense Fund
EIB	Environmental Impact Bond
GOMESA	Gulf of Mexico Energy Security Act
LA TIG	Louisiana Trustee Implementation Group
LSU	Louisiana State University
MSA	Metropolitan Statistical Area
NFIP	National Flood Insurance Act
NRDA	Natural Resources Damage Assessment
O&M	Operations and maintenance
OMB	Office of Management and Budget
PBC	Performance-based contract
RESTORE	Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States Act
QV	Quantified Ventures
SPE	Special purpose entity
USGS	United States Geological Survey
USC	United States Code
WAVCIS	Wave Current Surge Information System

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