



ECONOMIC VALUATION OF LAKE WORTH LAGOON, PALM BEACH COUNTY, FL

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PFM Group Consulting LLC**



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The Everglades Law Center is a nonprofit law firm dedicated to representing the public interest in environmental and land use matters. Working with more than thirty national, state and local environmental and conservation groups, our firm utilizes advocacy, policy development, and when necessary, litigation to protect and sustain this region's unique and irreplaceable ecosystems and communities. Our attorneys are uniquely positioned throughout the Everglades ecosystem and handle a wide range of environmental matters, including land use, wetlands permitting, endangered species, public lands, and sustainable energy development.

Our mission is to educate, advocate, negotiate, and when necessary, litigate to protect and restore the South Florida ecosystem.

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Executive Summary

The Everglades Law Center (“ELC”) is a nonprofit law firm that has long used advocacy, policy development, and litigation to protect and sustain South Florida’s unique and irreplaceable ecosystems and communities. PFM Group Consulting LLC (“PFM”) works at the intersection of policy, operations and budgeting to focus on the complex challenges faced by public sector leaders, to deliver in-depth analysis that can truly make a difference.

ELC retained PFM to research and write this report to support ongoing efforts to protect and restore the Lake Worth Lagoon (“Lagoon”), both by raising awareness of the robust role the Lagoon plays on Palm Beach County’s economy and by providing a reliable estimate of the overall economic value of the Lagoon ecosystem.

Based on an analysis of more than 100 professional and academic studies, this report first identifies the key components comprising the overall economic value of the Lake Worth Lagoon and then provides an estimate of the economic value of each component. PFM believes the valuations determined in this report are valid and representative within a reasonable margin of error of the true economic value of the Lake Worth Lagoon.

Economic values and impacts of the Lagoon include government spending on restoration efforts and an estimate of increased spending in the local economy that derives from the higher property values that waterfront residences command (compared to inland residences). Lagoon economic values also include those attributable to recreational use of the Lagoon – money spent on trips taken by residents to fish, boat, and otherwise enjoy the unique resources of the Lagoon as well as trips taken by non-local tourists. Business and commerce that rely on the Lagoon include marine and related industries (from boat storage to sonar equipment repair) and add both jobs and economic activity to Palm Beach County. Lastly, non-market values can be translated into a dollar value and include the range of ecosystem services provided by natural resources, as well as people’s willingness to pay for improved environmental quality and aesthetic beauty.

Adding those values together, the report concludes that **the overall economic value of the Lake Worth Lagoon is \$5.37 billion, representing the combined one time value plus the present value of ongoing economic benefits and spending derived from the Lake Worth Lagoon over the next 25 years.**



Table E.1. Summary of The Economic Value of Lake Worth Lagoon

| Value Type | Direct Impact | Indirect/Induced | Total Economic Valuation |
|--|------------------------|------------------|---|
| One-Time Values | | | |
| Lake Worth Initiative/Palm Beach County Restoration Spending | \$88,000,000 | N/A | \$88,000,000 |
| Wealth Effect Spending from Residential Property Value Increase | \$10,776,298 | N/A | \$10,776,298 |
| One-Time Cash Spending | | | \$98,776,298 |
| ***** | | | |
| Market and Use Values | | | |
| Residential Trip Cost Method | \$127,833,796 | N/A | \$127,833,796 |
| Tourist Trip Cost Method | \$42,356,273 | \$18,557,541 | \$60,913,814 |
| Commercial Business Activity | \$401,073,284 | \$224,041,735 | \$625,115,019 |
| Annual Recurring Market and Use Value PV 25 Year Annual Spending | \$571,263,353 | \$242,599,276 | \$813,862,629 \$4,026,656,179 |
| ***** | | | |
| Non-Market Values | | | |
| Resource Value | \$52,155,156 | N/A | \$52,155,156 |
| Residential Property Value Increase | \$449,012,419 | N/A | \$449,012,419 |
| Non-market Willingness to Pay (1-time) | \$745,409,828 | N/A | \$745,409,828 |
| Non-Market Value | \$1,246,577,403 | N/A | \$1,246,577,403 |
| ***** | | | |
| TOTAL One-Time, Market Use, and Non-Market Value | | | \$5,372,009,880 |

Source: PFM



1.0 Introduction

The Lake Worth Lagoon has long been a highly valued part of Palm Beach County.¹ The natural resources to which the Lagoon is home include oyster reefs, seagrass beds, and other habitat for a broad range of species, including fish, migratory birds, and rare and endangered species like green sea turtles and manatees. Residents and tourists alike value these resources for their natural beauty, for the services they provide protecting and restoring environmental quality, and for the dollars they draw into the Palm Beach County economy as a result of fishing, boating, birdwatching and related tourism.

Some areas in and adjacent to the Lagoon are particularly valuable. The Lagoon north of Pine Point Road to Munyon Island and MacArthur Beach State Park encompasses some of the highest quality seagrass beds -- critical for fish breeding, cleaning waters, and helping trap greenhouse gases to slow and mitigate climate change. Similarly, Peanut Island and its surrounding waters from Phil Foster Park south to Osprey Park is a center for recreational activities from boating to recreational diving.

Although much work has already gone into lagoon restoration efforts, more remains to be done. State and local agencies, joined by non-profit environmental group partners, have allocated more than \$88 million towards Lagoon restoration projects.² Habitat enhancement and restoration projects have created more than 70 acres of habitat, ranging from mangrove, spartina, and maritime hammock, to seagrass beds and oyster and artificial reefs. Stormwater treatment projects have mitigated the effects of runoff from homes, streets, and yards that would otherwise have spilled, untreated, into the Lagoon. Plans for future restoration work include water storage projects to reduce damaging discharges to the lagoon, more restoration of seagrasses, tidal marshes, and oyster reefs, and the establishment of additional protection and enhancement of the Lagoon's existing mangrove and seagrass areas. Studies suggest that current seagrass beds in the Lagoon amount to only about half of what was present historically; this represents an improvement from a nadir in the 1970s but makes clear that much remains to be done. Newly created and restored oyster and artificial reefs improve water quality, provide erosion control, and serve as habitat for a variety of fish and other species; more of these habitats would provide even more of these critical ecosystem services.

Even as efforts are ongoing to restore the Lake Worth Lagoon, it remains at risk for continued degradation. Historic and continuing population increases, as

¹ The Lake Worth Lagoon extends from North Palm Beach to Ocean Ridge. See Figure 1 (highlighting north and south inlets to the lagoon).

² Through the Lake Worth Lagoon Initiative, Florida's Department of Environmental Protection can direct legislative appropriations to Lagoon restoration projects. Projects have included septic to sewer conversions, stormwater retrofits, the creation of intertidal islands and living shorelines, and public use facilities.



well as altered hydrology of the historic Everglades and large-scale freshwater releases from regional canals continue to stress the Lagoon's ecology, threatening additional habitat loss and degradation of water quality. Current threats include loss of critical shoreline habitat as a result of proliferating armored seawalls and decreasing water quality in the central Lagoon as a result of excess nutrients carried in water discharged from Lake Okeechobee and local runoff in regional canals. **Continued progress requires broad engagement and understanding of the value that the Lake Worth Lagoon represents.**

This report reviews and evaluates extensive existing literature and data sources to determine the overall economic value of the Lake Worth Lagoon. It categorizes different types of economic values. Some economic values represent "cash values" and stem from activities related to the Lagoon that circulate dollars and generate economic activity in Palm Beach County. Others are non-cash values, and do not reflect actual dollars circulating in the local economy, but are based on widely accepted approaches to quantify measurable economic value. These non-cash values include, on the one hand, the services natural resources provide in terms of cleaning water, supporting breeding and spawning species, and preventing erosion, and on the other hand, the willingness of people to pay for environmental quality and aesthetic beauty.

The Everglades Law Center ("ELC") is a nonprofit law firm that has long used advocacy, policy development, and litigation to protect and sustain South Florida's unique and irreplaceable ecosystems and communities. **ELC retained the PFM Consulting Group to create this report to support ongoing efforts to protect and restore the Lake Worth Lagoon. The report seeks to raise awareness of the Lagoon's diverse economic impacts on the Palm Beach County community and provide a reliable estimate of the overall economic value of the Lagoon ecosystem.**



2.0 Economic Characteristics and Direct Value of the Lake Worth Lagoon

This report evaluates the economic value of the Lake Worth Lagoon based on an extensive literature review and uses widely accepted methods to ascribe economic values to portions and components of the lagoon ecosystem. Nearly 150 published reports, studies and academic papers were studied, reviewed, compiled and excerpted to determine the average resource value or activity value for the components of the Lake Worth Lagoon. The components of the Lagoon examined include:

- The value of natural resources;
- The value of the Lagoon as a recreational asset;
- The value of the Lagoon for business and commerce;
- The value the Lagoon casts on surrounding real estate;
- Additional spending resulting from real estate wealth;
- Environmental restoration project spending; and
- A monetary value created by people's willingness to pay for preservation.

Each of these components represents a significant asset valuation and contribution to the Palm Beach County economy. The bibliography of research materials used to help derive these values accompanies this report as Appendix 2.

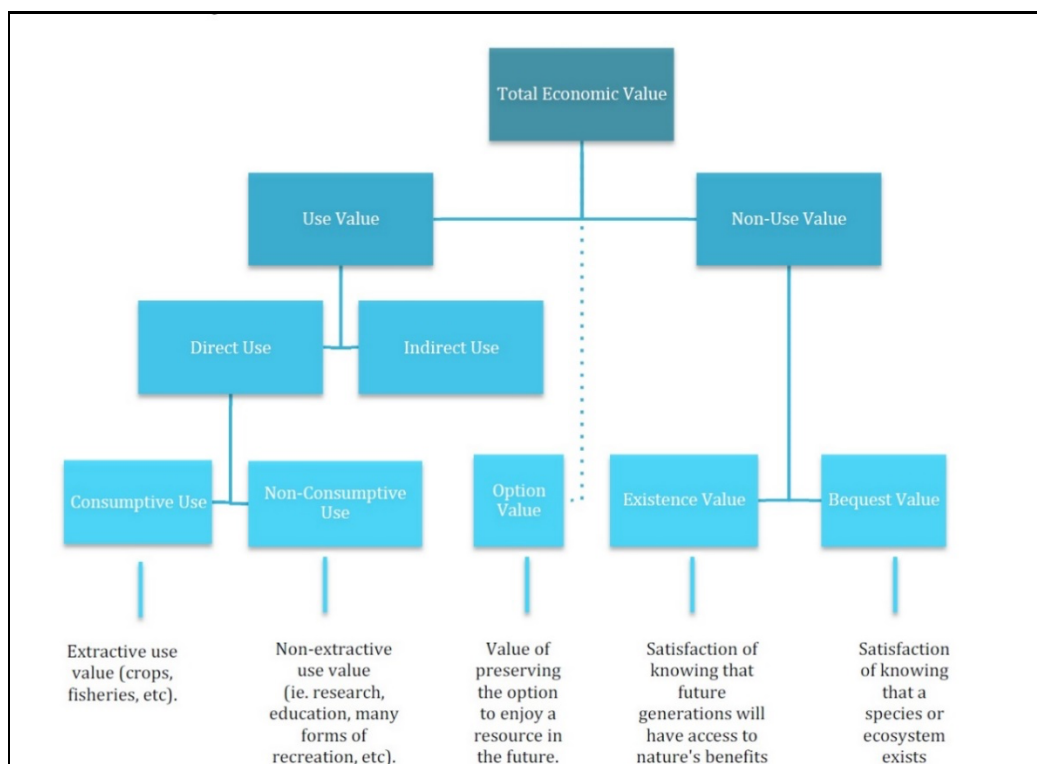
The components of Lagoon that together comprise its valuation may be cash or non-cash values. Cash values represent payments, spending and revenues generated by activities, whether consumptive (e.g., recreation) or extractive (e.g., fishing). These activities circulate dollars and generate economic activity in the Palm Beach County economy. Non-cash values are expressed in monetary terms such as the dollar value of a species, the dollar value of habitat, or the willingness to pay for preservation and future use. These non-cash values represent measurable economic value, even though they do not circulate cash in the economy. For valuation, policy and comparative purposes, they are widely accepted as a valid and appropriate means to measure the importance of these elements, in a standardized (dollar denominated) manner. These valuations are in fact mandated for use for the purposes of evaluating Federal funding or Federally mandated cost/benefit analyses, when considering policy decisions such as fees, taxes or Federal grant funding. In this way, valuation information – including standard methods for ascribing economic value to values that do not circulate cash in the economy – becomes a crucial tool for decision making in gauging funding and policy actions, as well as understanding the economic importance of the resource itself.

Figure 1 illustrates examples of the types of economic values that could be included in a valuation of Lake Worth Lagoon; this figure divides economic value into use value, non-use value, and “option” value (a measure of the public's willingness to pay to preserve a resource so that it may be used in the future). In this report, PFM seeks to value use, non-use and option value of the Lake Worth



Lagoon. In addition, this report evaluates economic value represented by the increased value that proximity to the Lagoon casts on adjacent real property, as well as value reflected in government spending on/investment in restoration projects. PFM divides values broadly into categories reflecting actual cash that would circulate in Palm Beach County on the one hand and those that do not reflect actual cash spending on the other. The remainder of Section 2.0 describes the value components measured which reflect cash spending in the local economy. Section 3.0 describes value components which are measured in dollars, but do not represent cash values circulating in the economy.

Figure 1. Components of Resource Valuation



Source: Economic Valuation Strategies for Instream Flows; Friends of the San Francisco Estuary, Aug. 2016, Fig. 1 Pg. 3.

The methodology that PFM used to determine the economic value of the Lake Worth Lagoon in this report is based on a review of published economic and academic literature. Multiple studies were considered in valuing different components of the Lagoon's economic value. PFM reviewed studies for each of the components, and where possible averaged like study results together, to determine a value for each component. Once common values are established for different components of the Lagoon ecosystem and resources, the total economic valuation is scaled specifically to the Lagoon, based on the participation rates, population, land area, or other specific local measures which calibrate the final valuation of each element specifically to the Lagoon.



Other means of determining value also exist. These may include direct public surveys, specialized hedonic price models for real estate, detailed business licensing and valuation records as may be publicly available, and others. Often, these means were used in the published studies relied on for this report. By relying on published studies and aggregating like studies to reinforce the reliability and robustness of findings, we are able to prepare a more comprehensive look at the wide variety of valuation components.

2.1 Government Spending

In conjunction with the Lake Worth Lagoon Initiative, local and state governments have spent a combined \$88 million³ in environmental rehabilitation, restoration and remediation in support of the Lagoon. This spending has taken place over 20 years⁴ and includes such projects as septic to sewer conversions, stormwater retrofits, Peanut Island enhancement, the creation of intertidal islands and living shorelines, and dozens of other projects that help improve water quality in the Lagoon or its watershed or that restore or enhance habitats in the Lagoon. These projects are each one-time investments.

2.2 Spending Due to Increased Real Estate Wealth

Nationally, it is estimated total consumer spending has increased by \$600 billion as a direct result of an increase in consumer wealth of \$25 trillion, since 2009⁵. This is spending of approximately 2.4 cents for each \$1 dollar of added wealth, where wealth is measured by the increase in equity asset values and housing prices.

Section 3.2 of this report addresses the property value wealth effect and evaluates the extent to which the Lagoon has generated additional wealth in the local economy. It concludes that the Lagoon generates \$449 million in increased value of residential properties due to these properties being on the Lake Worth Lagoon waterfront.⁶ Using the spending/wealth metric, we apply the spending rate to the Lake Worth Lagoon's waterfront residential property value wealth effect of \$449 million. The resulting additional spending is \$10.8 million in one-time spending. The \$10.8 million in spending is the cash value of dollars spent in the local economy due to increased residential property wealth as seen in Table 1. Because wealth effect spending is undertaken by existing residents, these dollars

³ This does not include monitoring expenditures or additional projects funded outside the Lake Worth Lagoon Initiative, for example, Florida Inland Navigation District or Florida Department of Transportation-funded projects.

⁴ This number has not been adjusted to reflect present values; as a result it underestimates that actual present value of these investments.

⁵ Weighing the Wealth Effect, March 2018 by Moody's Analytics-Mark Zandi in conjunction with Visa and Equifax, p.5

⁶ There are 13 municipalities on the Lagoon waterfront: the City of Boynton Beach, the City of Lake Worth Beach, the City of Riviera Beach, the City of West Palm Beach, Town of Hypoluxo, Town of Lake Park, Town of Lantana, Town of Manalapan, Town of Ocean Ridge, Town of Palm Beach, Town of Palm Beach Shores, Town of South Palm Beach and Village of North Palm Beach.



are not accompanied by a multiplier effect, since they are dollars already present in the local economy. Wealth effect spending, however, does represent a beneficial cash value of the Lagoon, in the form of spending in the local economy, and so is included in the overall measure of the value of the Lagoon.

Table 1. Residential Property Wealth Due To Waterfront Location⁷

| | Unit Count Waterfront Units | Additional Value per Unit | Incremental Property Value |
|---|-----------------------------|---------------------------|----------------------------|
| Single Family, Hotel | 3,689 | \$73,761 | \$272,102,870 |
| Condominium | 15,667 | \$11,292 | \$176,909,548 |
| Property Value Increase from LWL Frontage | | | \$449,012,419 |
| Additional Spending from Wealth | | | \$10,776,298 |

Source: PFM

⁷ Although it is likely that properties beyond those immediately adjacent to the Lagoon waterfront enjoy increased value because of their proximity to the Lagoon, an analysis of the relationship between incremental property value increases and distance from the waterfront was beyond the scope of this report.



2.3 Recreational Asset Valuation

The recreational aspects of the Lake Worth Lagoon are extensive. Residents, regional day visitors and out of town overnight tourists visit the Lagoon to enjoy a wide variety of recreational activities. These activities include non-commercial fishing, beach going, swimming, scuba diving, snorkeling, recreational boating, personal watercraft including canoe, jet-ski, kayak, recreational boat rentals, Peanut Island boat shuttle and bird watching. In addition, park-like activities are also included with visits to Peanut Island, such as barbeque/picnic, hiking and limited camping.⁸

Based on the literature research (please see Appendix 2) , a common and broadly accepted method to value recreational assets is the “Trip Cost Method”. The Trip Cost Method determines the average cost for each type of trip mentioned above, such as swimming, boating, scuba diving etc., and then multiplies the average cost by the number of trips. The resulting value is the amount of money placed into circulation in the local economy when residents and visitors engage in these recreational activities. It is an empirical measure of how visitors and residents value the resources, as these amounts reflect what they spend to engage in these activities.

Trip cost calculations are usually determined by survey. That is, people undertaking these activities are asked to fill out a survey questionnaire which asks the spending amounts for travel, supplies, rental equipment, food, other related purchases and lodging if applicable. Trip costs vary significantly from activity to activity. The total valuation is then calculated based on number of trips per activity type multiplied by trip cost for that activity.

For this study of the Lake Worth Lagoon, PFM did not undertake direct empirical surveys. Rather, PFM conducted literature studies to determine and calculate average trip costs, by activity type, and relied on additional surveys from published literature to determine participation rates and resulting trip counts (please see Appendix 2). Trips were calibrated to Palm Beach County, based on local and regional activity participation rates as described in the published literature and County level population counts and visitor counts. Separate participation rates were determined for resident population and for visiting tourist populations per the literature and calibrated to Palm Beach County specific data.

To determine the Recreational Value, trips, based on County participation rates for population and visitors and by activity type, were multiplied by trip cost per activity type. Average trip costs were inflation adjusted to current dollars, based on when trip cost data was published in the literature survey.

The resulting Recreational Value by activity type was further adjusted to reflect specific Lake Worth Lagoon activity only, as a share of total Palm Beach County values. As a reasonableness check to determine the validity of Lagoon only trips, these data were compared with other Lagoon specific data sources such as Peanut Island Water Taxi admission volumes and estimated customer volumes

⁸ Fishing, kayaking and snorkeling are particularly popular at MacArthur Island Beach Park. Breakwater/artificial reef restoration in the vicinity of the Palm Beach Inlet and Peanut Island offer unique opportunities for regional snorkeling.



for Lagoon dive activity only, at local dive shops based on interview data with local dive shop owners in Palm Beach County.

The result is a Recreational Value of Lagoon recreational activity, in today's dollars, based on the Average Trip Cost method, by recreational activity type, for residents and tourists. Based on this approach the direct Recreational Value of the Lake Worth Lagoon is \$199.8 million, on a recurring annual basis. The trip based spending is detailed in Table 2.

Of this spending, we estimate leakage of \$30 million to places outside Palm Beach County, leaving \$170.2 million spent locally in the Palm Beach County economy. Leakage of spending out of area represents purchases of specialty equipment and supplies necessary to support local recreational activity as well as corporate profit for national chains (mainly hotels). Recreational value is real spending, rather than a non-cash value and as such, calculating multiplier effect for portions of this spending is appropriate. Table 3 illustrates the recreational trip based spending by spending category for the \$170.2 million remaining in the local economy.

Thus, in addition to the direct value of spending, the multiplier effect of recreational spending is applicable to the portion of recreational spending by visitors to the area. A multiplier effect is not applied to the resident portion of recreational spending since local spending is cash already present in the local economy. The multiplier effect is applied to the visitor portion of the recreational value because visitor spending represents new money brought into the local economy from outside the area. The multiplier effect applied to visitor spending adds an additional \$18.5 million. The total Direct and Multiplier Effect Recreational Value of the Lagoon is \$188.7 million. Table 3 also illustrates the Direct and Indirect/Induced effects of recreational activity spending on activities within the Lagoon.

Table 2. Trip Based Spending in Palm Beach County

| Population/Tourist Base | 1,433,417 | 7,200,000 | | | | | |
|--|--------------------------|-------------|----------------|---------------------------------------|--------------------------|--------------------------|----------------------|
| Trip Type | Unit Volume - # of TRIPS | | Value per Trip | Countywide Activity Value Residential | Countywide Value Tourism | Lagoon Value Residential | Lagoon Value Tourism |
| | PER RESIDENT | PER TOURIST | | | | | |
| Recreational Fishing Resources | 1,318,744 | 237,600 | \$58 | \$76,148,293 | \$13,719,751 | \$19,037,073 | \$3,429,938 |
| Recreational Beach/Swimming | 5,418,316 | 3,600,000 | \$34 | \$186,045,645 | \$123,611,153 | \$46,511,411 | \$30,902,788 |
| Recreational Diving | 57,337 | 72,000 | \$181 | \$10,405,735 | \$13,066,904 | \$4,162,294 | \$5,226,762 |
| Recreational Boating | 1,433,417 | 259,200 | \$57 | \$81,611,196 | \$14,757,479 | \$40,805,598 | \$7,378,740 |
| Comm. Eqpt Rent, Boats, Jet Ski, etc. | 258,015 | 72,000 | \$55 | \$14,119,435 | \$3,940,078 | \$4,235,831 | \$1,182,023 |
| Bird Watching | 3,511,872 | 201,600 | \$50 | \$174,680,396 | \$10,027,578 | \$34,936,079 | \$2,005,516 |
| Countywide Activity Level | | | | \$543,010,700 | \$179,122,944 | | |
| Residential and Tourist Combined | | | | | \$722,133,644 | | |
| Lake Worth Lagoon Share of Trip Costs | | | | | | \$149,688,286 | \$50,125,766 |
| LWL Residential and Tourist Combined | | | | | | | \$199,814,052 |

Source: PFM; IMPLAN copyright 2019



Table 3. Trip Based Recreational Spending LWL by Expenditure Type

| Visitors | Transport | Lodging | Convenience Food | Shopping | Park Areas | Equpt. Rental | TOTAL |
|--|--------------|-------------|------------------|--------------|-------------|---------------|----------------------|
| | 25% | 13% | 26% | 7% | 9% | 20% | 100% |
| | \$11,904,870 | \$5,538,897 | \$8,471,255 | \$2,631,603 | \$4,285,753 | \$9,523,896 | \$42,356,273 |
| Residents | Transport | Lodging | Convenience Food | Shopping | Park Areas | Equpt. Rental | TOTAL |
| | 28% | 0% | 24% | 12% | 6% | 30% | 100% |
| | \$39,817,084 | \$0 | \$23,351,373 | \$13,471,946 | \$8,532,232 | \$42,661,162 | \$127,833,796 |
| Trip Based Spending - Lake Worth Lagoon with Leakages Out of Market | | | | | | | \$170,190,069 |
| TRIP BASED SPENDING – Lake Worth Lagoon; with Leakages; with Tourist spending Multiplier Effect | | | | | | | \$188,747,610 |

Source: PFM; IMPLAN copyright 2019

2.4 Business and Commerce

There is substantial commercial and business activity associated with the Lake Worth Lagoon; this includes waterfront uses, harbor, port, ocean access/inlet and other recreational related business activity. Within this activity, the Port of Palm Beach includes freight shipping and cruise ship activity. The Port operations also includes waterfront terminal operations, port and harbor facility operations, freight forwarders, transportation services, and support activities.

Surrounding the Lagoon are marinas, and water transportation services like water taxi and boat/watercraft rentals. Supporting the marine industry in Palm Beach County are ship and boat builders, and ship/boat repair facilities. Support industries surrounding these businesses include sonar and navigation equipment repair, electronic and precision instrumentation equipment repair and maintenance. Last, the construction and maintenance of specialty structures for marinas, ports and boat storage facilities also represent business and commerce activity supported by the Lagoon.

The value of this business activity has been measured at the county level using IMPLAN economic impact software.⁹ Once county level data was determined, an examination of the share of county level activity attributable to the Lake Worth Lagoon was estimated. These estimates are based on local empirical analysis and discussions with industry officials in Palm Beach County.

Business and commerce activity¹⁰ in the marine and related industries, as well as non-residential construction & structure maintenance in Palm Beach County is \$2.5 billion. The portion estimated to

⁹ A more detailed discussion of IMPLAN is included in this report as Appendix 1.

¹⁰ We did not include some business activities and income that might reasonably be construed to result, in part, from proximity to the Lagoon, such as waterfront restaurants and annual high profile events including Sunfest and LagoonFest. Excluding these activities from our estimates results in a more conservative – smaller -- valuation of the Lake Worth Lagoon.



be attributable to the Lake Worth Lagoon is \$401 million, on an annual basis. Direct employment attributable to this level of activity is 3,708 full-time jobs as seen in Table 4.

Commercial activity is characterized by real business spending activity and so a multiplier effect is calculated to reflect the indirect and induced impacts of business activity. The multiplier effect creates an additional \$224 million in local indirect and induced economic activity, resulting in a total value of Lake Worth Lagoon related commercial activity of \$625 million in annual spending activity. The \$625 million supports 4,726 full time jobs with annual labor income of \$235.4 million, as seen in Table 5. This brings the average wage of occupations supported by the Lagoon to \$49,825 based on the 2015 IMPLAN wage profile. Using this wage profile, jobs supported by the Lagoon have wages which are 12% higher than the countywide average wage.

Based on the industry profile representing Lake Worth Lagoon commercial activity, 60% of this activity is generated by Port of Palm Beach activity. The remaining 40% is non-Port related business activity.



Table 4. Value of Commercial and Business Activity in Palm Beach County Attributable to Lake Worth Lagoon

| Description | Port & Freight Shipping, Cruise; Water Trans, Water Taxi | Scenic, Water trans, Harbor, Terminal & Port Ops, Freight Fwd, Support | Marina & Other Amusement and Rec | Ship Building & Repair | Boat Building | Maint., repair constr. of nonres. struc. | Sonar & Nav., Elec., Precision Eqpt. Repair & Maint | TOTAL |
|---|--|--|----------------------------------|------------------------|---------------|--|---|-----------------|
| Sector Empl. PBC | 108 | 2,605 | 8,923 | 218 | 189 | 6,237 | 1,413 | |
| PBC Sector Output | \$91,235,130 | \$408,189,301 | \$774,989,624 | \$44,831,989 | \$44,803,970 | \$1,005,659,424 | \$179,746,872 | \$2,549,456,310 |
| Labor Income | \$14,990,788 | \$156,445,274 | \$363,949,035 | \$9,900,733 | \$4,474,043 | \$302,298,637 | \$80,520,205 | |
| Output Per Worker | \$845,337 | \$156,719 | \$86,854 | \$205,313 | \$236,987 | \$161,247 | \$127,184 | |
| Labor Income Per Wrkr | \$138,897 | \$60,065 | \$40,788 | \$45,341 | \$23,665 | \$48,471 | \$56,974 | |
| % Empl Attrib to LWL | 95% | 50% | 20% | 60% | 60% | 1% | 15% | |
| LWL Employment | 103 | 1,302 | 1,785 | 131 | 113 | 62 | 212 | 3,708 |
| LWL Income | \$14,237,637 | \$78,222,650 | \$72,789,449 | \$5,941,485 | \$2,685,031 | \$3,023,039 | \$12,078,203 | 188,977,494 |
| LWL Commercial Local Direct Spending | \$21,662,817 | \$173,480,881 | \$139,498,120 | \$17,487,740 | \$17,477,554 | \$8,548,155 | \$22,918,016 | 401,073,284 |

Source: PFM; IMPLAN copyright 2019

Table 5. Multiplier Effect of Commercial and Business Activity Attributable to Lake Worth Lagoon

| ImpactType | Employment | Wages | Output |
|---------------------|--------------|----------------------|----------------------|
| Direct Effect | 3,708 | \$188,977,494 | \$401,073,272 |
| Indirect Effect | 529 | \$25,613,713 | \$116,574,933 |
| Induced Effect | 488 | \$20,864,093 | \$107,466,813 |
| Total Effect | 4,726 | \$235,455,300 | \$625,115,019 |

Source: PFM; IMPLAN copyright 2019



3.0 Non-Market Value of LWL

As set forth in Figure 1, there are two broad segments of value to be measured. One is the market value which reflects cash spending and is generally a “use value.” The second is non-market value, measured in dollars, which is generally a “non-use value” and does not reflect circulating cash in the local economy. Components of non-market value include direct resource value, wealth effects, such as those which accrue to real estate, and a “willingness to pay” for the preservation, existence and reservation of future use of the resource in question.

This section of the study examines these three components of non-market value of the Lake Worth Lagoon, including resource value, wealth effects and willingness to pay.

3.1 Natural Resources - Wildlife and Habitat Lands Valuation

To conduct its study of natural resources, wildlife, and habitat lands valuation in the Lake Worth Lagoon, PFM examined the Lake Worth Lagoon Resource Inventory, 1990,¹¹ the Lake Worth Lagoon Management Plans from 2008 and 2013, and numerous other studies regarding mangroves, seagrass beds as well as materials from the Lake Worth Lagoon Initiative. The natural resources found within the Lagoon and valued in this section include artificial reefs, oyster beds, seagrass beds, tidal flats, commercial fishing areas, estuary habitat, sea turtle habitat, mangroves, water quality components, bird watching habitat, Everglades restoration contributions, and contributions to carbon sequestration in support of climate change mitigation. PFM conducted a literature review addressing these natural resource aspects of the Lake Worth Lagoon.

PFM evaluated both marine and avian life in its Lake Worth Lagoon natural resources valuation. Multiple fish species, shellfish, sea turtles, and manatees were considered, plus birdlife represented by herons, gulls, terns and others. In addition to species, habitat lands (whether submerged or dry) were also examined, including seagrass beds, mangroves, artificial reefs, oyster beds and overall estuary and lagoon area of the Lagoon itself. Habitat areas include natural areas, as well as plantings and restorations, which have been undertaken by the Palm Beach County Department of Environmental Resources Management (along with Lake Worth Lagoon Initiative partners) over the past 20 years. In terms of natural areas, species and natural resources, the Lagoon is highly biologically diverse.

A natural resource study of the Lake Worth Lagoon undertaken in 1990 by Dames & Moore found over 195 species of marine life—many of which are endangered and protected. In addition to fauna, the ongoing resource mapping program undertaken by Palm Beach County documented 1,552 acres of seagrass beds as of 2018, with an additional 220 acres of other restored habitat including intertidal islands, mangrove shorelines, oyster reefs, seagrass beds, coastal hardwood hammock and bird habitat. Seagrass beds are particularly important because they provide food, habitat and nursery

¹¹ Lake Worth Lagoon Natural Resources Inventory and Resource Enhancement Study, Dec 15, 1990; Dames and Moore in conjunction with Palm Beach County Dept. of Environmental Resources Management



areas for many commercially and recreationally important fish species as well as numerous vertebrate and invertebrate species including the threatened Florida manatee and endangered green sea turtle. Island restorations and mangrove plantings stabilize sediments and protect shorelines throughout the Lagoon as well as provide essential habitat to numerous bird species. Restored islands also host human recreational activity. Places like Peanut Island, Munyon Island and Phil Foster Park represent substantial land value in recreational lands and habitat support for wildlife resources.

In examining the literature available for this study, an attempt was made to consider each of these natural components separately and determine an economic value for each. Through this process PFM found valuations for many, but not all, of the economic elements and features. In addition, among these valuations the methods and the units of measure differed. For example, some natural resources were valued on a per-household per acre basis, while others were valued on a per-household per acre per year basis, and some valued on a per acre per year basis. Converting each of these measures to a standardized unit of measure was made more complicated because of the differing points in time in which the studies were conducted; some being published in the 1990's and some published twenty years later. Thus, standardizing measures required both unit standardization and inflation adjustments to account for the passage of time. Based on these complexities, each of which could introduce additional measurement error, a simpler approach was taken. Using two studies which were methodologically consistent, measuring similar natural environments and published in proximate time of each other, PFM determined an average value for overall estuary resources and habitats. This is a comprehensive approach which takes into consideration all of the components of an estuary lagoon and establishes an average, one-time, value per acre.

The two studies used in calculating the average per acre valuation approach were The Florida Ecosystem Valuation Project (Duke University)¹² and The Economics of the Everglades¹³. The adjusted average value from these studies is a one-time value of \$6,543 per acre, reflective of overall estuary natural resources in the Lagoon. Additional values for 1,600 acres of seagrass beds plus lagoon/salt ponds are also added to the value. Based on this the value to the entirety of the Lake Worth Lagoon, some 7,958 acres, for natural resource value is \$52.1 million, please see Table 6. By comparison, public offsite regional mitigation for restoration and enhancement in Palm Beach County, administered in year 1999 by South Florida Water Management District had a cost of \$9,650¹⁴ per acre. In our view, it is reasonable to believe the Lake Worth Lagoon commands similar value. Either of these measures is a conservative measure as more recent land bank mitigation sales at one South Florida mitigation bank have ranged from \$27,000 to \$69,000 per acre, depending on the environmental credits needed, location and environmental quality.¹⁵

¹² The Florida Ecosystem Valuation Project, 2014; Duke University, Nicholas Environmental School

<https://sites.duke.edu/floridamp/>; Results for: Intertidal coastal, Marine, and Estuarine ecosystem services

¹³ The Economics of the Everglades Watershed and Estuaries; Florida Atlantic University, Center for Urban and Environmental Solutions, April 2009; Table 22, Estuaries valuation adjusted for non-use benefits

¹⁴ "Wetland Mitigation Policy Review"; Office of Program Policy Analysis and Government Accountability, Florida Legislature, March 2000, Table 5, page 22.

¹⁵ "Is Florida Running Out of Mitigation Sites?"; <https://www.bisnow.com/south-florida/news/economy/mitigation-credits-florida-98740>



The conservative \$52.16 million valuation is a non-cash, one-time, value, because these Lake Worth Lagoon natural resources will not transact or be sold in the market place. Further, since no cash actually circulates from this direct value, calculation of an additional multiplier effect is not applicable.

Table 6. Habitat and Estuary Resource Value

| Unit Type Per Acre | Unit Volume (ac.) | Value per Unit | Total Value |
|--|-------------------|----------------|--------------|
| Seagrass Beds | 1600 | \$0.87 | \$1386 |
| Habitat – Salt Ponds – Lagoon other | 7958 | \$10.53 | \$83,813 |
| Overall Estuary | 7958 | \$6,543.10 | \$52,069,956 |
| Summary of Resource Value | | | \$52,155,156 |

Source: PFM

3.2 Wealth Effect of Residential Property Value Increase

The hedonic pricing model approach is a generally accepted method to identify deterministic factors of real estate pricing. This method requires extensive analysis of a large scale database, and economic regression to statistically determine the effect of various factors influencing residential real estate prices. Developing a Lake Worth Lagoon hedonic price model approach is outside the scope of the current study. However, there are published studies of such hedonic pricing models, and PFM used the values calculated in these studies to determine the portion of increased real estate value attributable to properties' location on the waterfront of the Lake Worth Lagoon. Such models examine enhanced value based on distance to the lagoon or enhanced value only for properties directly fronting on the lagoon. Such a study was identified in Sarasota County which provides baseline data for residential price differentials for residential properties on the Intracoastal Waterway (ICWW) in Sarasota County. Because Sarasota County has waterfront property on a bay, the Gulf of Mexico and the Intracoastal Waterway, PFM believes this is a reasonably good analogue analysis and applicable to the waterfront properties on Lake Worth Lagoon. The Sarasota County study found "on average, being in close proximity to Sarasota Bay increases the value of properties in Sarasota and Manatee counties, holding other factors constant."¹⁶ The mean price differential for the discreet on/off ICWW waterfront analysis is \$57,049 in Sarasota County, according to the Sarasota study. Based on analysis of ICWW waterfront properties in Sarasota, PFM determined this to be 3.145% of the average waterfront residential property value. This percentage calculation is believed to be conservative because it likely represents the low end of the range of the portion of property value reasonably attributable to a property's location on the Lake Worth Lagoon waterfront.

¹⁶ The Sarasota Bay Economic Valuation Project: Phase II, February 2014. Page 12



PFM then compiled the total market value of more than 19,300 waterfront residential properties in Palm Beach County, spanning the 20+ miles of lagoon frontage on each side of the Lagoon (east and west)¹⁷. The total market value of these properties exceeds \$16.2 billion. The 3.145% portion of value attributable to the Lagoon frontage was then calculated to be \$449 million.

The \$449 million valuation for increased value of waterfront residential properties on the Lagoon, and attributable to their waterfront location, is a wealth effect. The wealth effect is a non-cash value for the purposes of economic impact analysis. These values only transact occasionally in the marketplace, and normally remain as capital wealth “locked” into real estate value. Since cash does not circulate in the local economy from this value, the wealth effect is considered a non-cash value. Further, because this is a non-cash value, a calculation of a multiplier effect is not applicable. However, it is reasonable (and in accordance with general economic valuation practice) to include the wealth effect in the overall valuation of the Lake Worth Lagoon.

Increased wealth does have a positive spending effect, meaning marginal consumption among households increases as wealth increases. This means additional cash spending does occur in the economy as a result of the wealth effect created by Lake Worth Lagoon waterfront properties. Section 2.2 on cash value spending from increased wealth details the additional spending in the local economy from the wealth effect.

¹⁷ There are 13 municipalities on the Lagoon waterfront: the City of Boynton Beach, the City of Lake Worth Beach, the City of Riviera Beach, the City of West Palm Beach, Town of Hypoluxo, Town of Lake Park, Town of Lantana, Town of Manalapan, Town of Ocean Ridge, Town of Palm Beach, Town of Palm Beach Shores, Town of South Palm Beach and Village of North Palm Beach



Figure 1. Waterfront Property Examined for LWL Wealth Effect on Residential Values



Source: PFM; Palm Beach County Property Appraiser



3.3 Willingness-to-Pay for LWL Environmental Quality and Habitat

There is extensive published literature, worldwide, documenting the public's willingness-to-pay for the preservation, existence and reservation of future use of natural resources. Willingness-to-pay is commonly measured using a survey technique called contingent valuation. In contingent valuation, study respondents are surveyed and asked what amount of money they would be willing to pay, or in the case of damages willing to accept, to preserve or restore certain environments. A wide range of willingness levels have been reported for many different types of environmental resources. When responses within a survey are averaged together, the resulting value is considered representative of the value of the resource. These studies and reports have been used as the basis for public policy regarding preservation of natural resources, imposition of taxes or other revenue dedications to fund such endeavors and settlement agreements in significant litigation cases involving environmental damages. One of the more notable litigation settlement cases where contingent valuation analysis was used to determine the value of environmental damage estimates was the Exxon Valdez oil spill, in Prince William Sound, Alaska, which occurred in March 1989¹⁸. A contingent valuation study was conducted and used to measure the loss of passive use values due to resource injuries from the oil spill. Resource injuries included oiled shoreline, bird and mammal deaths and effects on fish. The resulting valuation was the basis for part of the financial settlement between the State of Alaska and the Exxon Corporation as a result of damages from the oil spill.

Contingent value studies used in the valuation of the Lake Worth Lagoon reflect only non-use, non-market values. In this regard, use values such as private services such as commercial fishing claims or revenues, and direct use public services such as recreation, are excluded from willingness-to-pay measures. Cash values from spending and use of the Lake Worth Lagoon are discussed earlier in Section 2.0 of this report. The result of the willingness-to-pay portion of this study is a value reflecting primarily passive values of the Lagoon. These values include beach protection, beach existence, habitat/estuary/lagoon preservation, and water quality. These are broad categories and are intended to be interpreted to include beach going/sunbathing; swimming; birdwatching; artificial reef environments; species preservation such as manatee, oyster, sea turtle, estuary habitat for hundreds of species of fish which are found in the Lagoon; vegetative and other specialized habitat areas such as seagrass beds, mangroves and tidal flats, all of which are found in the Lake Worth Lagoon and depend on improved water quality; carbon sequestration with seagrasses; sea level rise and climate change protection; and support for a diverse, sustainable and thriving environmental community. The willingness-to-pay for these amenities is a value which is found to be in addition to the trip cost spending to undertake use of certain of these recreational amenities.

PFM reviewed more than two dozen published studies to conduct a willingness-to-pay analysis for the Lake Worth Lagoon. These studies primarily used the contingent value method of analysis. Throughout these studies, the values are expressed in varying monetary dimensions. For example, some study results are reported on a per person basis, or a per household basis, or a per party basis (for tourist surveys). Some valuations are expressed as one-time payments, or in the form of ongoing annual taxes, or fixed payments over a finite period such as a five year or ten year

¹⁸ A Contingent Valuation Study of Lost Passive Use Values Resulting From The Exxon Valdez Oil Spill", November 10, 1992; A Report to the Attorney General of the State of Alaska



payment program. Last, the publication date among these studies varies from as old as 15+ years to very current (within the past year or two), necessitating some standardization of values to account for inflation over time.

In order to report a comprehensive contingent value, representative of the many diverse components of Lagoon's environmental quality and habitat, study results were standardized and inflation adjusted to present dollars, based on publication date. Some studies were eliminated from inclusion due to reporting characteristics and dimensions which made them incompatible with other studies. Further, some studies, though comprehensive, were eliminated due to comparability and cultural differences, particularly those studies from elsewhere throughout the world where cultural norms and values may result in valuations deemed not applicable to the Lagoon.

Care was taken not to double count valuations. For example, inclusion of a more comprehensive study result would necessitate the elimination of smaller aspects or components which might be intuitively thought to be included in the more comprehensive measure. Finally, dollars were converted and expressed in the common dimension of a one-time payment, on a per person basis. This allowed the scaling of values to Palm Beach County based on the current permanent population of the county.

The compilation, analysis and distillation of contingent value studies yields a total contingent value and one-time willingness to pay for the Lagoon's environmental quality and habitat of \$745 million, within Palm Beach County. This is comprised of \$143.6 million for beach protection; \$29.4 million for beach existence (among non-users of beach amenities); \$97.8 million for overall estuary, habitat, and lagoon preservation; and \$474.7 million for water quality (including pollution cleanup, runoff control, sewage treatment, waterflow management such as algae bloom prevention, and dedicated measures to prevent deterioration of waters which could lead to unsustainable conditions for all wildlife). Table 7 summarizes the contingent valuation analysis.



Table 7. Lake Worth Lagoon Willingness-To-Pay, Contingent Valuation Summary¹⁹

| | Unit/Paymt Type | PBC Population | Value/Unit | Total Value |
|-------------------------------|-------------------|----------------|------------|----------------------|
| | | 1,433,417 | | |
| Beach Protection | 1 time per person | | \$100 | \$143,658,402 |
| Beach Existence | 1 time per person | | \$34 | \$29,244,746 |
| Estuary and Habitat | 1 time per person | | \$68 | \$97,849,353 |
| Water Quality | 1 time per person | | \$331 | \$474,657,326 |
| CONTINGENT VALUE TOTAL | | | | \$745,409,828 |

Source: PFM

4.0 Total Valuation of Lake Worth Lagoon

The economic valuation of the Lake Worth Lagoon comprises market and non-market values. Market values represent annual cash spending in the local economy, plus the multiplier effect of this spending, where applicable. Non-market values reflect economic values which typically do not transact in the marketplace. Because non-market values represent non-market goods, market prices, such as “what is a manatee worth?”, are difficult to establish. Techniques like contingent valuation and willingness-to-pay are means to establish values for non-market goods, which are represented in dollar terms. While non-use values do not represent circulating cash in the local economy, they are considered valid measures of economic value and are used at the Federal, state and local levels to establish policy parameters, set tax rates and provide measures applicable in cost benefit analyses and grant funding. PFM conducted literature based analyses to identify market and non-market values of the Lake Worth Lagoon and to employ appropriate valuation techniques for each to establish the economic value of the Lagoon. Further study of each value component could help evaluate the appropriateness of assumptions used and gather locally specific survey and spending information.

The summary of value components are found in Table 8. A number of different market values were identified within the Lagoon. Market values have been determined using a summary of studies identifying values.

¹⁹ These values reflect value to the population as a whole. PFM reduced total population value for Habitat, Water Quality and Beach Existence on a percentage basis to reflect that some of this value would be derived from resources other than the Lagoon (habitat value is 2/3 of total value; water quality is 50% of total value, and Beach Existence is 40% of total value).

Beach Protection was not reduced based on the judgment that the analysis was missing other aspects of willingness to pay with respect to mud flats, oyster beds, bird watching, climate change mitigation, and potentially even benefits to future real estate development (such as the riverfront redevelopment in Riviera Beach) and perhaps other unspecified benefits. Although -- if these assumptions are inaccurate -- the Beach Protection value may thus overstate benefits, it does not represent a large portion of the overall valuation and does not change the overall perception or order of magnitude of the findings.



Initial one-time spending as part of Lake Worth Lagoon valuation includes spending of \$88 million in state and local projects for environmental rehabilitation and restoration.²⁰ These projects have been undertaken over the past twenty years and include tertiary sewage treatment projects, mangrove and seagrass restoration, water quality monitoring and other projects supporting resource enhancement.

Additional one-time cash spending in the local economy is included from incremental spending, as a result of increased real estate wealth conferred upon direct waterfront properties. Incremental spending is found to be 2.4 cents for each additional one dollar of wealth. One-time incremental spending due to the wealth effect is \$10.8 million. Our conservative estimate of combined one-time cash spending is \$98.8 million.²¹

The trip cost method establishes the value of an activity by estimating the cost of the trip by residents and tourists to engage in the use activity. In the case of the Lake Worth Lagoon, use activities include recreational fishing, beach/swimming, recreational scuba diving, recreational boating, commercial equipment rental such as boats (including kayaks), jet skis, stand-up paddleboards and other equipment, and birdwatching. Trip costs measured include transportation, convenience store and other shopping, equipment rental costs, admission fees and lodging. Published literature provides the average trip costs and population participation rates. These data were scaled to the local resident and tourist populations to determine the use value countywide. Countywide values were then adjusted to reflect the portions of this activity attributable to the Lake Worth Lagoon alone. This adjustment is a reflection that boating, scuba diving and the other use activities can take place at numerous locations throughout the county and only portions of countywide activity in these uses take place within the Lagoon. The trip cost value method yields annual spending activity of \$188.7 million.

Commercial business activity directly related to the Lagoon is also a large component of the Lake Worth Lagoon's cash value. This activity includes Port of Palm Beach port operations, commercial water transportation such as cruise, freight activity, water taxi, pleasure craft rental, amusement and recreation related businesses (including dive shops, tours etc.) derived from Lagoon activity including marinas, ship building and repair, specialty construction and maintenance such as docks, seawalls, marina buildings; and electronic, precision, and navigation equipment repair and maintenance. Commercial business activity due to the Lake Worth Lagoon is \$625.1 million annually. Of this amount, 60% is estimated to be specifically related to Port of Palm Beach, amounting to \$375 million.

Summing these values, the use value of the Lake Worth Lagoon is found to be \$813.9 million per year. This represents annual cash spending through business and recreational use activities related

²⁰ The \$88 million only captures restoration and enhancement projects funded through the Lake Worth Lagoon Legislative Funding Request Program and is thus a conservative estimate of one-time spending. Additional dedicated funds from other sources support monitoring, clean-up and environmental restoration (e.g., vessel registration fees and saltwater fishing license fees, and manatee funds of about \$750,000 annually to support manatee protection and habitat).

²¹ Again, PFM excluded some possible sources of one-time restoration spending from this analysis, so it represents a conservative estimate of one-time spending. Although it is a one-time value, it does include a time component, comparable in dimension to a 25 year present value for annual spending, allowing for the combination of these values with other values in this report.



to the Lagoon. Because this represents annual spending, a present value of the annual spending over time is utilized to assign a one-time cash value of Lagoon use values. Based on a 25 year time horizon, with a discount rate of 20%, the present cash value of Lake Worth Lagoon's use value (both commercial and recreational) is \$4.0 billion.

The non-use value components of the Lake Worth Lagoon represent additional values associated with the Lagoon, but which are not cash spending. These values are non-market goods which do not transact in the local economy, but nevertheless have definable value. The non-use value is also expressed in dollar amounts. Non-use values of the Lagoon include the direct resource value of Lagoon lands both submerged and otherwise; the increased property value due to residential property with water frontage on the Lagoon; and people's willingness-to-pay for existence, preservation, habitat and future use of the Lake Worth Lagoon. These values are one-time values as described in the research conducted for this study, however they are not cash payments. The one-time, non-use value of the Lake Worth Lagoon is \$1.25 billion.

The combined use and non-use value of the Lake Worth Lagoon is \$5.37 billion. See Table 8. This conservative estimate is an extraordinary value of a diverse natural amenity which contributes substantially to both business and recreation in Palm Beach County. The cash value of the Lake Worth Lagoon represents 5.6% of the \$73 billion gross regional product of Palm Beach County.



Table 8. Summary of the Economic Value of Lake Worth Lagoon

| Value Type | Direct Impact | Indirect/Induced | Total Economic Valuation |
|---|------------------------|------------------|--------------------------|
| One-Time Values | | | |
| Lake Worth Initiative/Palm Beach County Restoration Spending | \$88,000,000 | N/A | \$88,000,000 |
| Wealth Effect Spending from Residential Property Value Increase | \$10,776,298 | N/A | \$10,776,298 |
| One-Time Cash Spending | | | \$98,776,298 |
| ***** | | | |
| Market and Use Values | | | |
| Residential Trip Cost Method | \$127,833,796 | N/A | \$127,833,796 |
| Tourist Trip Cost Method | \$42,356,273 | \$18,557,541 | \$60,913,814 |
| Commercial Business Activity | \$401,073,284 | \$224,041,735 | \$625,115,019 |
| Annual Recurring Market and Use Value | \$571,263,353 | \$242,599,276 | \$813,862,629 |
| PV 25 Year Annual Spending | | | \$4,026,656,179 |
| ***** | | | |
| Non-Market Values | | | |
| Resource Value | \$52,155,156 | N/A | \$52,155,156 |
| Residential Property Value Increase | \$449,012,419 | N/A | \$449,012,419 |
| Non-market Willingness to Pay (1-time) | \$745,409,828 | N/A | \$745,409,828 |
| Non-Market Value | \$1,246,577,403 | N/A | \$1,246,577,403 |
| ***** | | | |
| TOTAL One-Time, Market Use, and Non-Market Value | | | \$5,372,009,880 |

Source: PFM



5.0 Portions of Lake Worth Lagoon Valuation at Risk

There are specific areas within the Lake Worth Lagoon that represent disproportionately high portions of resource values, recreational, commercial and habitat values, of the Lagoon's total valuation. Specifically, the area north of Pine Point Road to the Munyon Island/MacArthur Beach State Park boundary includes an area of high density/high species diversity seagrass beds, which provide prime habitat and food for commercially and recreationally important fish species, the endangered green sea turtle and the threatened Florida manatee. Seagrasses are equally important for sediment stabilization, maintaining water quality, creating a "carbon sink," and supporting local economies.

Additionally, a second area surrounding Peanut Island, from Phil Foster Park south to Osprey Park is most notable for boating, tourist visits, swimming, snorkeling and recreational diving. This area has a significant concentration of marinas, valuable and extensive seagrass beds, restored mangrove habitat, and shallow water fishing areas. Peanut Island and Phil Foster Park are prime areas for snorkeling in the Lagoon. In fact, Phil Foster is world renowned as a dive site for shore diving and for its high fish and invertebrate species diversity. This area is also heavily used by manatees because of its proximity to seagrasses and the warm water refugia at Manatee Lagoon/Florida Power and Light EcoDiscovery Center.

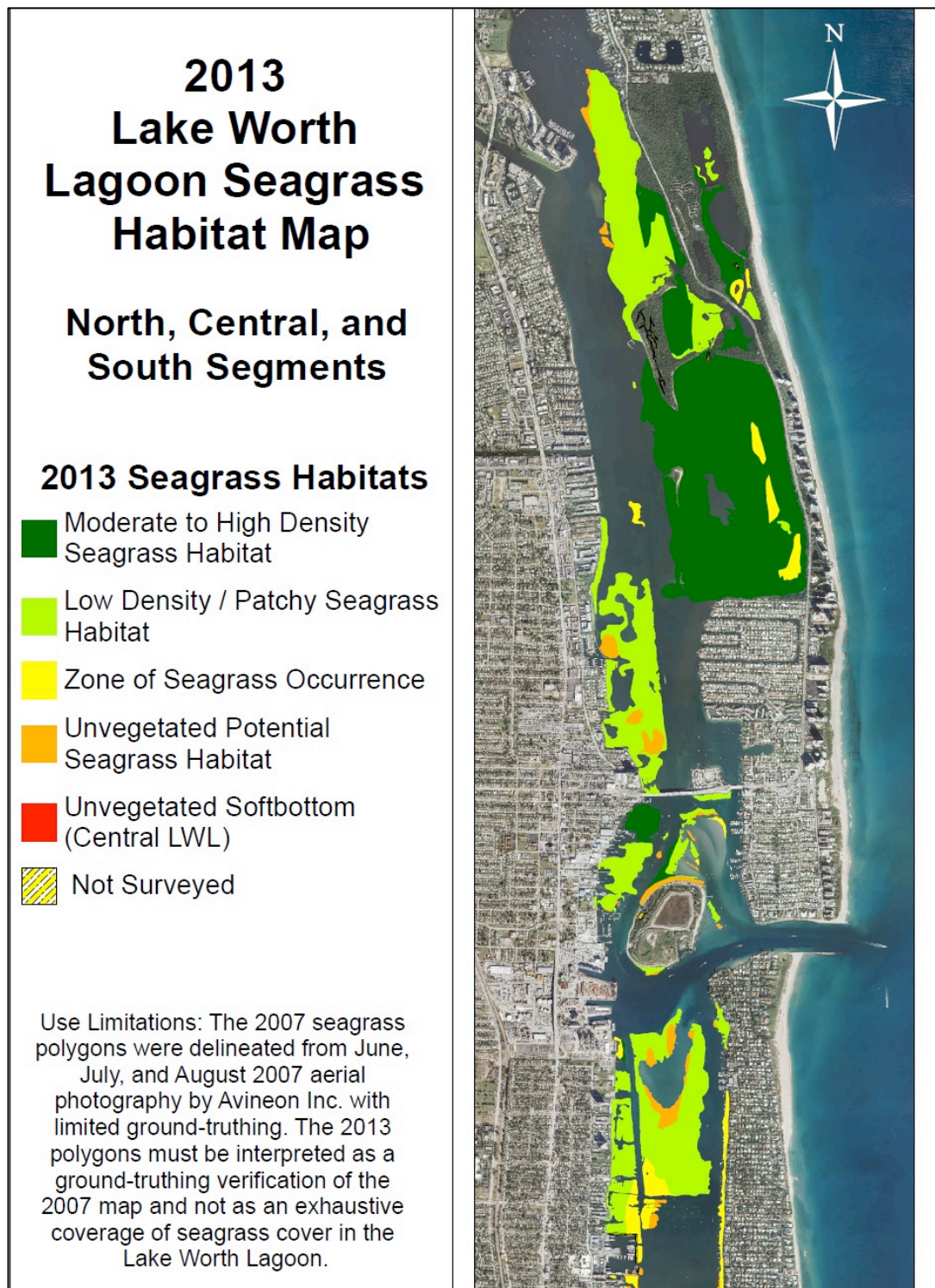
These areas are facing threats to their environmental sustainability, viability and value to the economy. The seagrass bed area consists of submerged lands which are primarily privately owned. Ongoing concerns exist as to the development entitlements these lands may carry. Any form of development, such as stilt houses or docks, can negatively impact some of the most desirable, and highest quality seagrass beds in the Lagoon.

The Peanut Island Park/Phil Foster Park area faces disruption, silting and other impacts and threats from dredging the inlet channel and Port Basin depth at Port of Palm Beach. Dredging can adversely impact environmental quality, water quality, and recreation opportunities such as swimming, boating and diving, impact fishing and overall habitat quality for the flora and fauna in the area; dredging may also threaten nearby artificial reefs.

The Lake Worth Lagoon valuation study calls particular attention to these areas because of the disproportionate share of the Lagoon's value they contain. Degradation or disruption to these areas has wider economic impacts and costs than just the perceived benefit of either a dredge project or of submerged lands development.



Figure 2. 2013 and 2018 Seagrass Beds








2018 Lake Worth Lagoon Seagrass Habitat Map

North Segment



2018 Seagrass Habitat

-  Moderate to High Density Seagrass Habitat
-  Low Density / Patchy Seagrass Habitat
-  Emergent Shoal Low Density / Patchy Seagrass Habitat
-  Zone of Seagrass Occurrence
-  Unvegetated Potential Seagrass Habitat

Use Limitations: The 2013 polygons are a ground-truthing verification of the 2007 aerial delineation map and not an exhaustive coverage of seagrass in the Lake Worth Lagoon. The 2018 map is based on ground-truthing surveys of the 2013 polygons with new seagrass habitats added from seagrass surveys for permitted and proposed dredging projects in the LWL between 2013 and 2018 and ground-truthing of additional areas not surveyed in 2013 (outlined in white).

Credits: Seagrass bed ground-truthing surveys and bed edge delineation were completed from July 27, 2018 to November 14, 2018 by Coastal Eco-Group Inc. Work was performed for Palm Beach County Department of Environmental Resource Management. January 2017 aerials were provided by Palm Beach County Department of Environmental Resource Management.

For a complete description of 2018 seagrass ground-truthing map creation methods, results, and habitat classification definitions, refer to the associated '2018 Lake Worth Lagoon Seagrass Mapping Report' (CEG, 2019).



Coastal Eco-Group Inc.

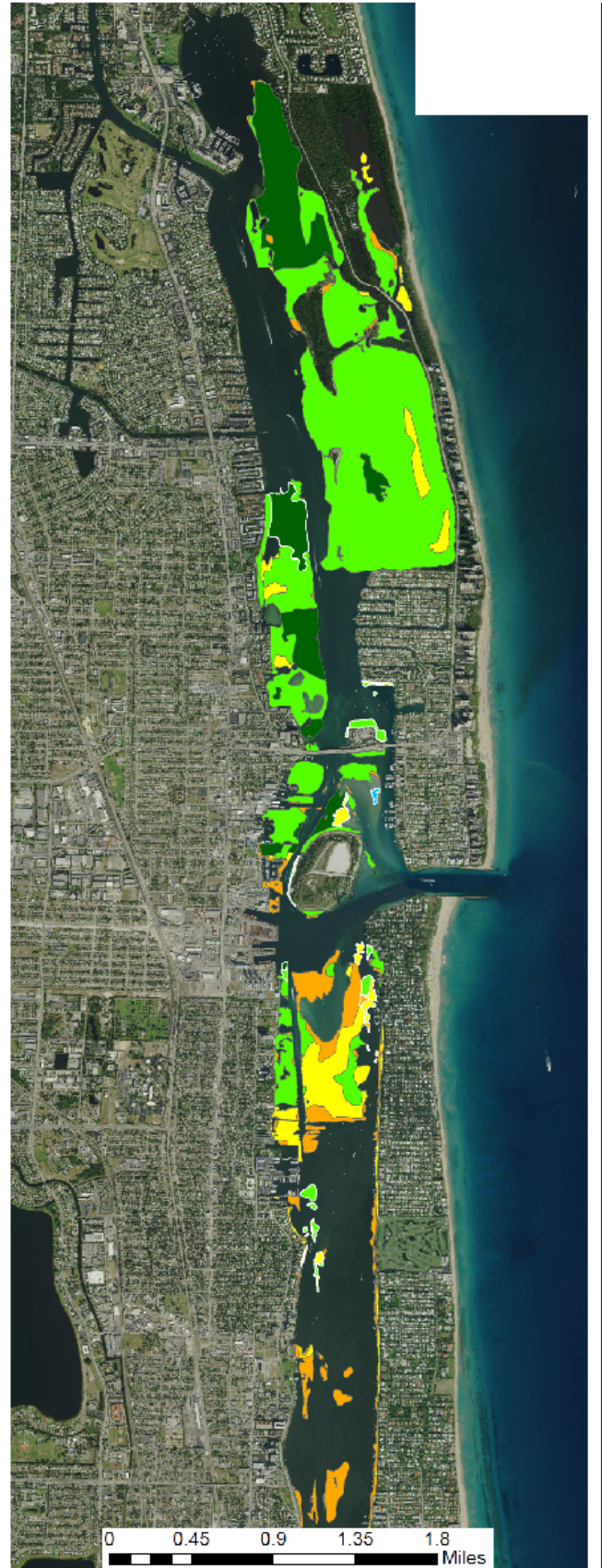
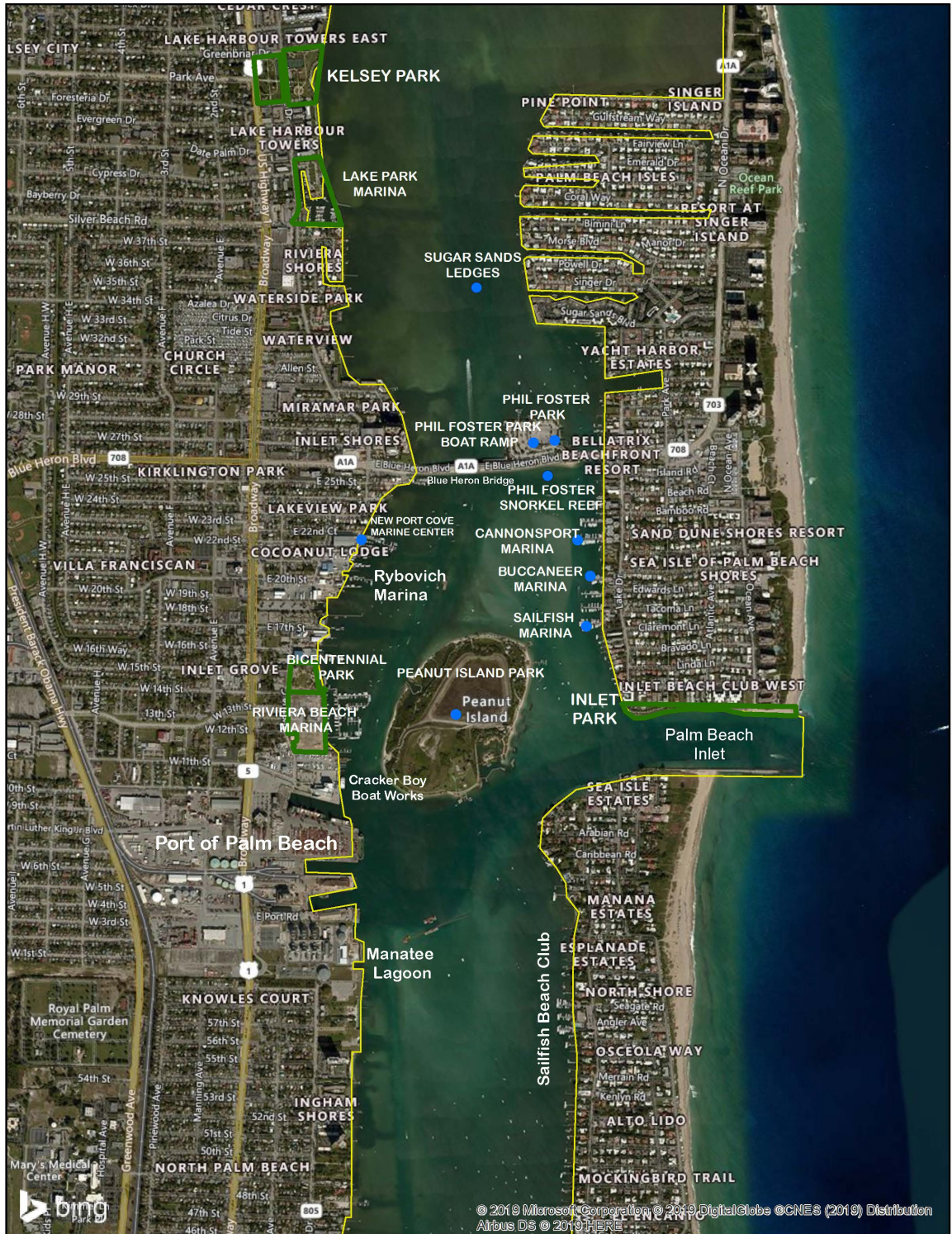




Figure 3. Peanut Island Area





APPENDIX 1 - Economic Impact Methodology - IMPLAN

The economic impact methodology utilized to determine the multiplier effects is IMPLAN (Impact Analysis for PLANning).

IMPLAN's Social Accounting Matrices (SAMs) capture the actual dollar amounts of all business transactions taking place in a regional economy as reported each year by businesses and governmental agencies. SAM accounts are a better measure of economic flow than traditional input-output accounts because they include "non-market" transactions. Examples of these transactions would be taxes and unemployment benefits.

Multipliers

Social Accounting Matrices can be constructed to show the effects of a given change on the economy of interest. These are called Multiplier Models. Multiplier Models study the impacts of a user-specified change in the chosen economy for 440 different industries. Because the Multiplier Models are built directly from the region specific Social Accounting Matrices, they will reflect the region's unique structure and trade situation.

Multiplier Models are the framework for building impact analysis questions. Derived mathematically, these models estimate the magnitude and distribution of economic impacts, and measure three types of effects which are displayed in the final report. These are the direct, indirect, and induced changes within the economy. Direct effects are determined by the Event as defined by the user (i.e. a \$10 million dollar order is a \$10 million dollar direct effect). The indirect effects are determined by the amount of the direct effect spent within the study region on supplies, services, labor and taxes. Finally the induced effect measures the money that is re-spent in the study area as a result of spending from the indirect effect. Each of these steps recognizes an important leakage from the economic study region spent on purchases outside of the defined area. Eventually these leakages will stop the cycle.





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