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ECONOMIC ANALYSIS OF SEA LEVEL
RISE: KENNEBUNK, WELLS AND
YORK



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1. Introduction

The towns of York, Kennebunk, and Wells, Maine are among those expected to be impacted by sea level rise. All three towns rely heavily on their beaches and other ocean-front related shops and tourism-related businesses. This report outlines some of the expected impacts of sea level rise on the economies and residents of the three towns. The remainder of the report is structured as follows. Section 2 establishes a baseline profile of the three towns. Section 3 describes the economic analysis, including the tax implications for each of the towns. Finally, section 4 describes the implications for the wider region.

2. Economic Profile of the Study Area

2.1 Baseline Statistics

In order to fully understand the implications of sea level rise on the towns of Kennebunk, Wells, and York, we must first create a baseline economic profile of the area. Table 1 displays some basic socio-demographic statistics for the three towns.

Table 1: Economic Profiles – Kennebunk, Wells, and York

Variables	Kennebunk	Wells	York
Population (2019)	11,625	10,625	13,290
Average Annual Unemployment Rate (2019)	3%	3.2%	2.3%
Median household income (in 2019 dollars), 2015-2019	\$76,136	\$66,578	\$93,333
Per capita income in past 12 months (in 2019 dollars), 2015-2019	\$46,652	\$39,520	\$50,095
Persons in poverty, percent (2019)	6.5%	5.4%	6.1%
Gross Regional Product (2018)	\$642 million	\$382 million	\$563 million
Total employment (2018)	9,217	5,595	8,075

Source: United States Census Bureau, Various Sources.

Figures 1 through 3 show the top industries by employment in each of the three towns.¹ The color of the bars in each graph is consistent for easier comparison; that is, health care and social assistance is the blue bar in each graph. As can be seen, health care and social assistance is the

¹ The Quarterly Census of Employment and Wages defines “employment” as the total number of people on the payroll of non-farm jobs, both part-time and full-time.

top industry by employment in Kennebunk and York, whereas it is the fifth largest industry by employment in Wells. Accommodation and food service is the second largest industry in both Kennebunk and York, whereas it is the largest industry in Wells. Retail trade is the third most important industry by employment in Wells and York, whereas it is the fifth largest industry in Kennebunk (Maine Department of Labor, 2019).

Figure 1: Top Industries in Kennebunk by Average Employment (2018)

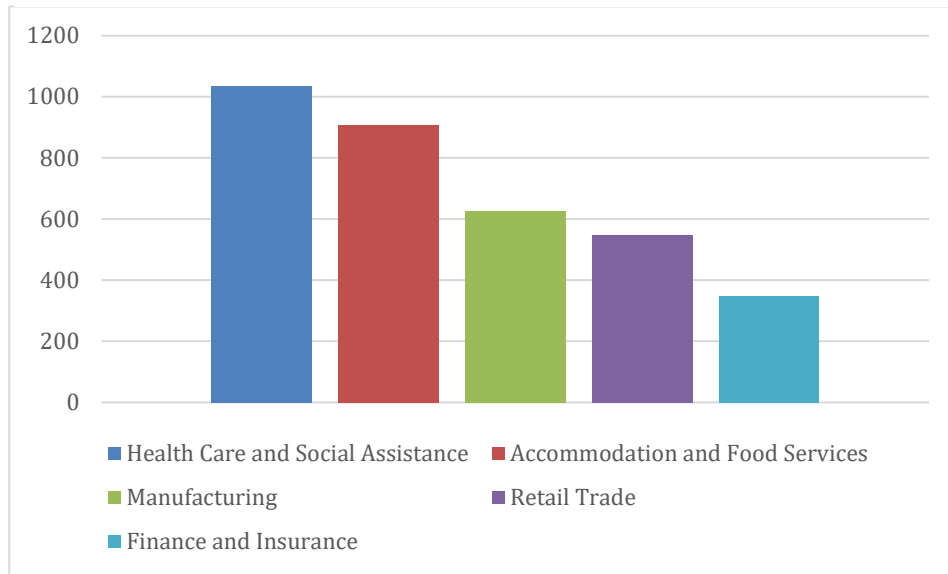
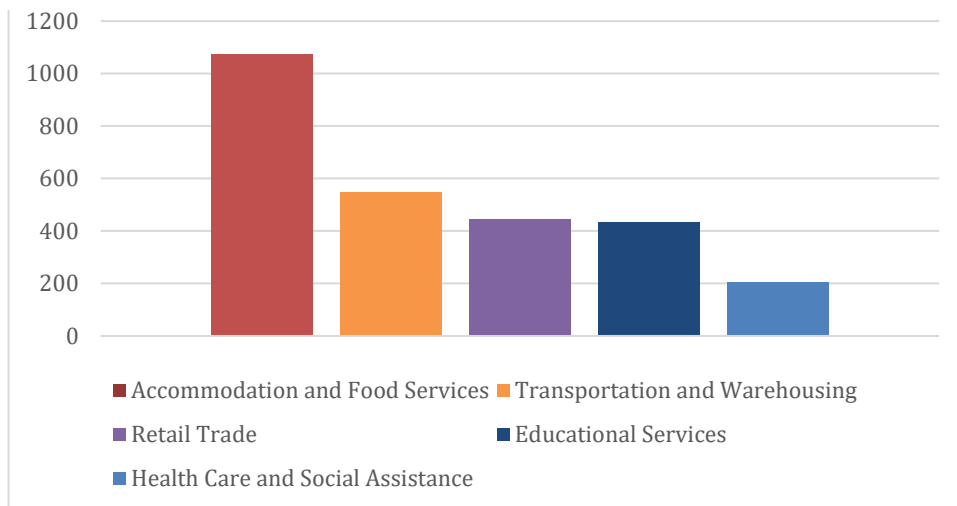
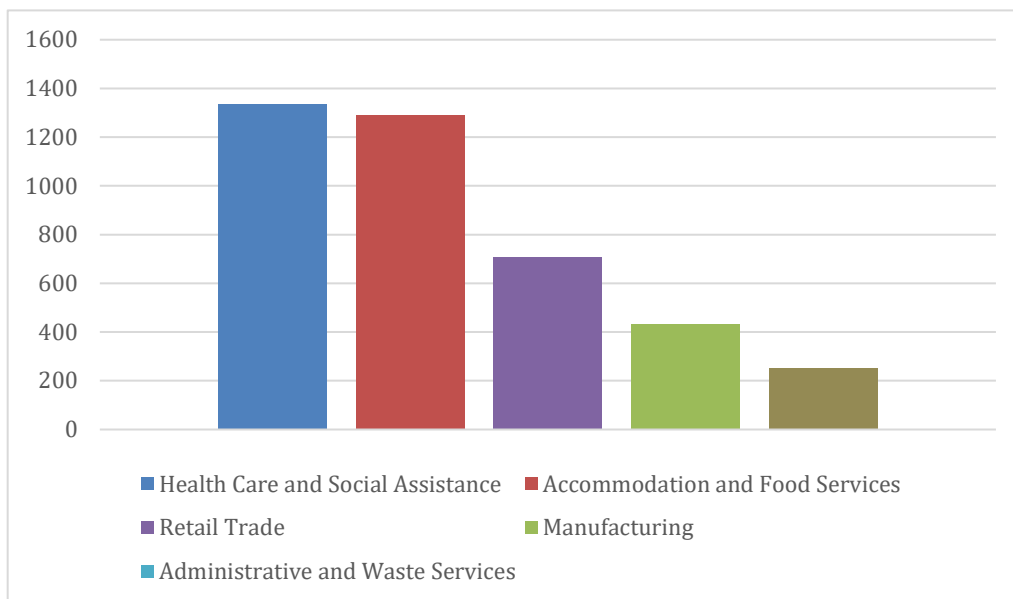


Figure 2: Top Industries in Wells by Average Employment (2018)



Source for Figures 1 and 2: (Maine Department of Labor, 2019) and authors' calculation

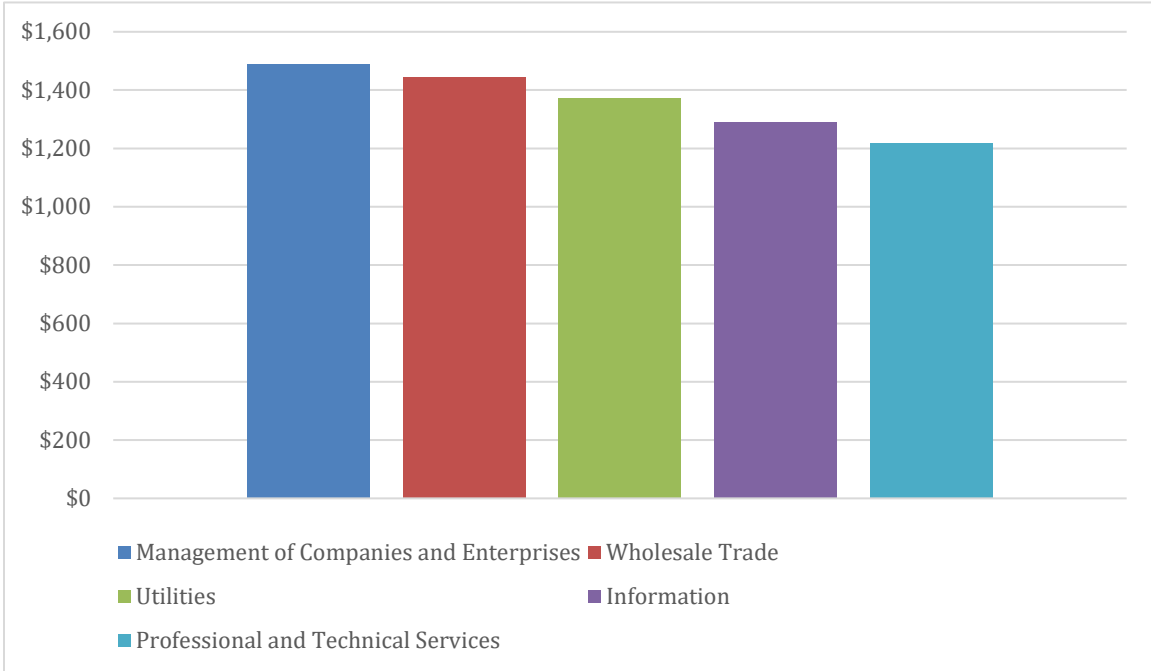
Figure 3: Top Industries in York by Average Employment (2018)



Source: (Maine Department of Labor, 2019) and authors' calculations

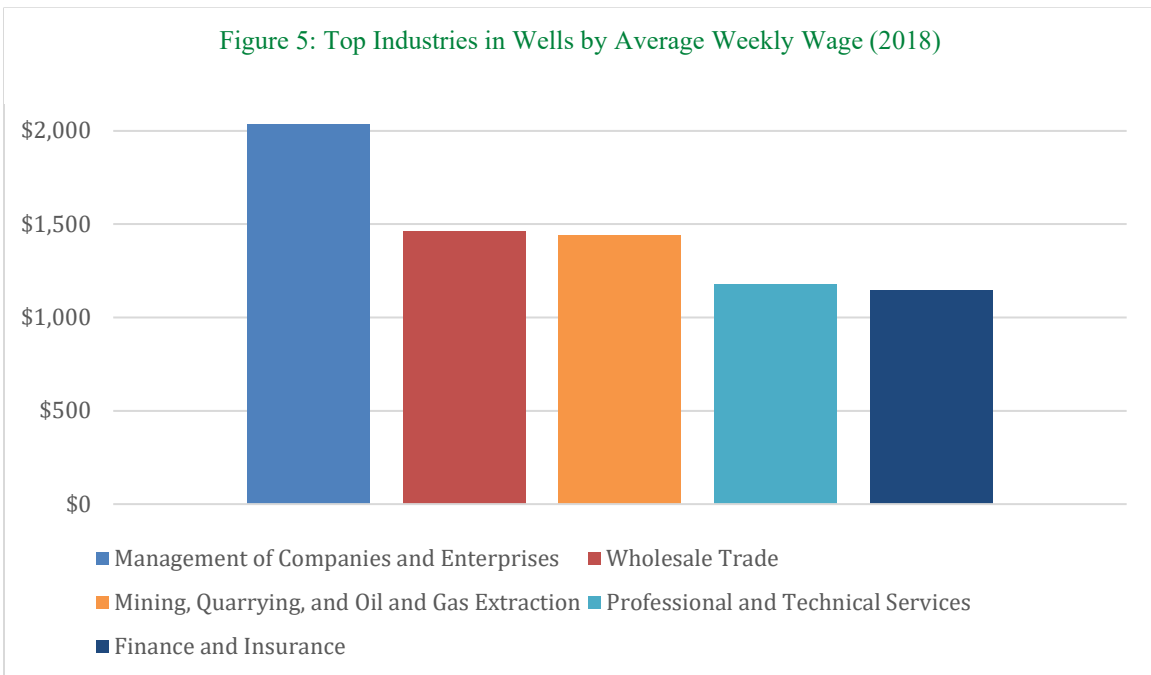
Figures 4 through 6 show the top industries in the three towns, this time ranked by average weekly wage. These graphs show a different picture. None of the top five industries by employment showed up in the top five industries by average weekly wage, an interesting result in itself. Another striking result is that the top industries by wages are remarkably consistent between the three towns: management of companies and industries is the most highly paid industry, followed by wholesale trade. The last three industries vary (utilities is the third highest paid industry in Kennebunk, probably largely due to Kennebunk Power and Light), whereas mining, quarrying, and oil and gas extraction is in the number three position in Wells, most likely due to the presence of Pike Industries. Information, professional and technical services, and finance, insurance and real estate round out the top five.

Figure 4: Top Industries in Kennebunk by Average Weekly Wage (2018)



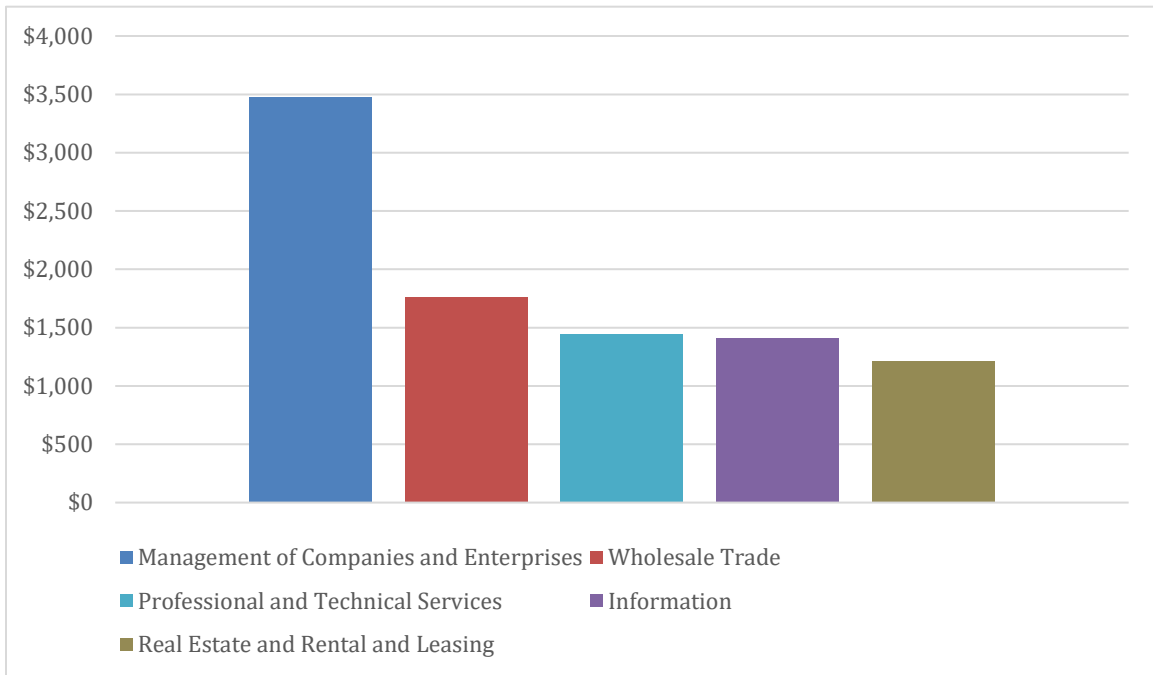
Source: (Maine Department of Labor, 2019) and authors' calculations

Figure 5: Top Industries in Wells by Average Weekly Wage (2018)



Source: (Maine Department of Labor, 2019) and authors' calculations

Figure 6: Top Industries in York by Average Weekly Wage (2018)



Source: (Maine Department of Labor, 2019) and authors' calculations

2.2 Basic and Non-basic Industries

Looking at whether an industry is considered basic or non-basic can yield some insight into the relative importance of that industry to a particular town. A “basic” industry is one where the industry is large enough that it serves customers from outside the area; it is called “basic” because it serves as the “base” of its economy. Non-basic industries serve primarily local customers. While non-basic industries are important to the local economy as well, they don’t attract outside money into the region. An industry with a location quotient greater than one is considered basic, while industries with location quotients less than one are considered non-basic.

Table 2 shows the location quotients by industry for each of the three towns. Of note are the relatively high location quotients in the accommodation and food services industry, as well as in arts, entertainment, and recreation. These industries typically cater to tourists, providing further evidence of the importance of the tourism industry to this region.

Table 2: Location Quotient by Employment (2017)

Industries	Kennebunk	Wells	York
Health Care and Social Assistance	1.49	0.38	1.70
Accommodation and Food Services	1.73	2.82	2.28
Manufacturing	1.43	0.67	0.92
Retail Trade	0.97	1.09	1.24
Finance and Insurance	1.35	0.34	0.47
Professional and Technical Services	0.85	0.53	0.56
Construction	0.90	0.95	0.86
Other Services, Except Public Administration	1.45	1.05	1.20
Arts, Entertainment, and Recreation	1.51	0.95	2.37
Wholesale Trade	0.51	0.50	0.67
Information	0.70	0.76	0.19
Administrative and Waste Services	0.20	0.43	0.43
Utilities	2.86	N/A	N/A
Real Estate and Rental and Leasing	0.58	0.85	1.00
Management of Companies and Enterprises	0.26	0.09	0.04
Transportation and Warehousing	N/A	4.25	0.29
Educational Services	N/A	22.62	N/A
Mining, Quarrying, and Oil and Gas Extraction	N/A	1.33	N/A

Source: US Bureau of Labor Statistics, 2020. Quarterly Census of Employment and Wages. <https://www.bls.gov/cew/additional-resources/open-data/home.htm>.

3. Town-Level Economic Analysis

3.1 Methodology and Data Collection

The economic analysis presented in this section relies upon IMPLAN, an economic development software. IMPLAN uses a model of a region's economy to measure the interdependencies between various industry sectors. IMPLAN measures the total direct, indirect, and induced

effects in output, employment, and earnings produced by an industry. The direct effects consist of the output of the firms or industries that are being evaluated; indirect effects consist of the purchases that those firms make from other businesses. Both the direct and indirect output produce household income for their employees; a proportion of this income is re-spent on consumption goods, creating the induced effect. IMPLAN provides the contributions in terms of the dollar value of gross receipts (output), dollar value of wages and salaries (earnings), and number of jobs (employment). Employment numbers are considered an annual average of employment and includes full-time, part-time, and seasonal employment. (In other words, employment data should not be considered full-time equivalent.) (IMPLAN Group LLC, 2020)

Data on businesses in the three towns were collected from two sources: the Maine Department of Labor (MDOL) and a commercially available database called Data Axle. The MDOL dataset is derived from the quarterly reports that Maine employers submit to the MDOL (those subject to state Unemployment Insurance programs). They indicate the number of employees and the wages received at each establishment.² As the MDOL data were not complete,³ we augmented the data by purchasing data from Data Axle.

Data Axle collects its data from a variety of sources, including state business listings, phone listings, census listings, and others. These are supplemented with additional lists that they may purchase from other companies. These lists are kept up to date by noting when new businesses register in states, and through phone verification. Data Axle attempts to verify businesses annually if at all possible. Most of the businesses in our dataset were verified in 2019. Businesses in the Data Axle database were then cross-checked against the MDOL database for verification purposes. Duplicates were eliminated. Finally, using Google Maps and Google Earth, we recoded some businesses that appear to have been misclassified in either the MDOL database or the Data Axle dataset. We then reached out to our partners at GEI to identify which businesses were in the inundation areas under each sea level rise scenario (1.6, 3.9, 6.1).

It is important to recognize the assumptions and limitations of the study. IMPLAN is based upon an input-output matrix of the economy, which makes several assumptions. First among these is the principle of homogeneity. Each business is associated with a particular industry; a social

² According to the Bureau of Labor Statistics, “An establishment is an economic unit, such as a farm, mine, factory, or store that produces goods or provides services. It is typically at a single physical location and engaged in one, or predominantly one, type of economic activity for which a single industrial classification may be applied. Occasionally, a single physical location encompasses two or more distinct and significant activities. Each activity is reported as a separate establishment, if separate records are kept, and the various activities are classified under different NAICS industries.” (Bureau of Labor Statistics, 2020)

³ As establishments are economic entities that are at a single location (see footnote 1), any missing businesses in the MDOL dataset may fall into one of two categories: 1. The missing entities may not have been subject to Unemployment Insurance laws; or 2. The missing entities are part of a larger firm that has multiple locations. If that is the case, the owner of that firm is only required to report employment at branches with more than 50 employees. We believe the primary reason is the latter; however, we are unable to verify that.

account matrix assumes that each industry’s output is associated with a unique set of inputs or a unique production function. Second is the assumption of linearity: all inputs consumed by an industry are a linear function of output – that is, inputs consumed vary directly with the output produced and there are no economies of scale. Third, all input-output models assume that there are no supply constraints – there are no restrictions on employment or raw materials. In the case of sea level rise, that assumption may not hold. An input-output model also assumes constant technology and as such is more suited to short-term snapshots rather than predictions. Obviously in the case of sea level rise, we are projecting approximately 30 years into the future, making such an assumption precarious at best. There are no price changes built into the model as well. Finally, the results presented here show *current* assets at risk. As the towns grow and develop, the number and value of the assets at risk from sea level rise could increase or decrease.

Because of these assumptions, and because of the uncertainties inherent in any prediction related to sea level rise, results in this report should be considered illustrative only, and not considered predictive.

3.2 Output and Employment Results for Each Town

Table 3 shows the number of businesses and employment in the inundation zones for each sea level rise scenario. Data are suppressed for 1.6 feet of sea level rise because of the low numbers of businesses affected.

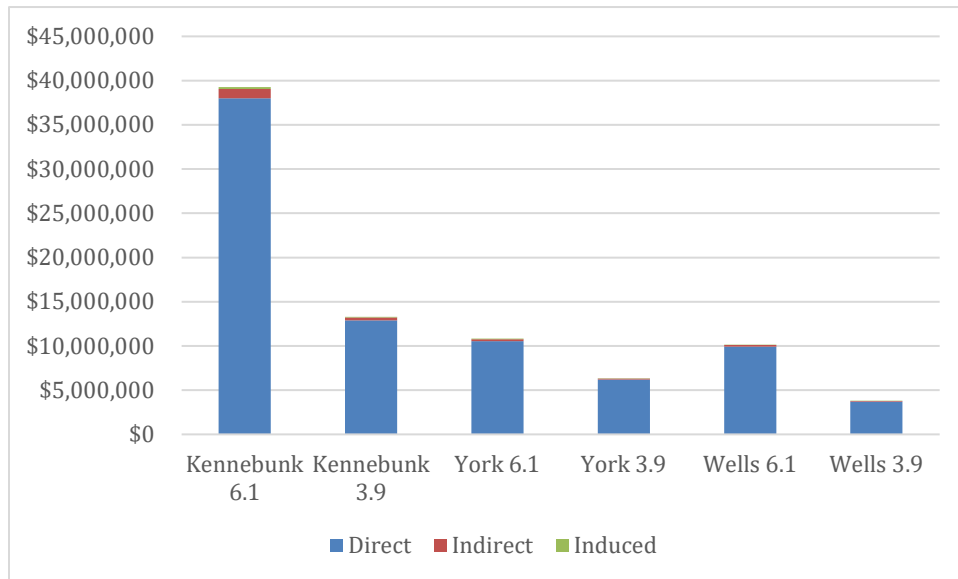
Table 3: Businesses and Employment Located in Inundation Zones

	6.1 feet	3.9 feet
Kennebunk		
Affected Businesses (2019)	35	14
2019 Employment in Affected Businesses (Percent of total 2019 employment)	328 (3.6%)	125 (1.3%)
Wells		
Affected Businesses (2019)	20	11
2019 Employment in Affected Businesses (Percent of total 2019 employment)	186 (3.3%)	81 (1.4%)
York		
Affected Businesses (2019)	30	21
2019 Employment in Affected Businesses (Percent of total 2019 employment)	259 (3.2%)	188 (2.3)

However, these numbers only include those businesses located in the inundation area. Using the IMPLAN software, we are able to determine the indirect and induced effects of each sea level rise scenario. As stated previously, the induced effect includes the supply chain effects (when a restaurant buys bread from a local bakery, for example), and the induced effects are when an employee spends his or her money locally (a restaurant employee buys her groceries at the local grocery store). The following figures show the total output, value added, and employee compensation at risk under the 6.1 and 3.9 feet of sea level rise scenario.⁴ The indirect and induced effects are rather low because each town is used as the reference region. This means that any supply chain or household spending that takes place outside of the town is not counted. As a large portion of the population of each town commutes out of town to work, and a large portion of each town’s labor force lives outside (see section 4.2), those effects will only be seen at a larger geographic area. Those results will be discussed in section 4.1.

Finally, results presented here only represent the economic activity directly connected with sea level rise in each town. Missing from this picture are wider effects such as the potential consequences to the tourism industry in the region. These results will be discussed in section 4.3.

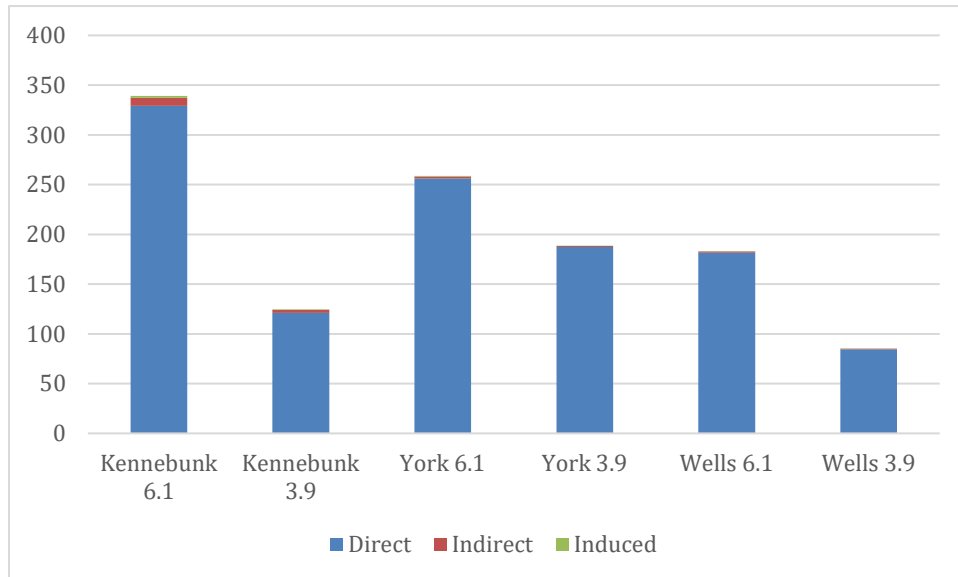
Figure 7: Output at Immediate Risk from 6.1 and 3.9 feet of SLR



⁴ In these and the following figures and tables, the 1.6 foot scenario is not presented due to privacy considerations. As the numbers of businesses in the inundation areas are low, they could be identifiable.

Figure 8 shows the employment immediately at risk in each scenario.

Figure 8: Employment at Immediate Risk from 6.1 and 3.9 feet of SLR



3.3 Industry Analysis

Whereas the previous section described the potential effect of sea level rise on the overall output and employment in the three towns, this section breaks down those results by industry for 6.1 feet of sea level rise. Differences between the three towns are rather striking. In Wells, more than half (52 percent) of the total output impacts are concentrated in the restaurant industry, while in Kennebunk, the restaurant industry accounts for about a third (34 percent) of the impacts by industry. In York, the majority of the impacts are spread more or less evenly between restaurants (25 percent), accommodations (21), and services (16 percent). From an employment perspective, the restaurant industry will be the hardest hit in all towns: more than three quarters of the total jobs at risk are in the restaurant industry (75 percent in Wells, 40 percent in Kennebunk, and 53 percent in York).

From an industry perspective, the restaurant industry will be particularly hard hit in each town. Results suggest that nearly 20 percent of the revenue and 14 percent of the employment generated by the restaurant industry in Kennebunk is associated with an affected business,

whereas those same numbers are about 11 percent of output and 20 percent of employment in Wells, and 7 percent of output and 24 percent of employment in York.

Accommodations will be disproportionately affected in Kennebunk. Nearly 24 percent of the revenue and 30 percent of the employment in the hotel and motel industry in Kennebunk is potentially affected by 6.1 feet of sea level rise, while only three percent of output and employment may be affected in Wells. In York, about 19 percent of the employment and eight percent of the revenue from the accommodations industry is at risk.

3.4 Property Tax Implications per Town

One of the greatest and most measurable impacts of sea level rise will be in the potential reduction of property tax revenue. The values in Table 4 represent the property value at risk in each town under the different sea level rise scenarios. These figures were calculated using the method outlined in the appendix to GEI's vulnerability analysis for the three towns. In essence, a property could be impacted in two ways: 1. Parcels were classified as "buildings and land" when the centroid buffer of their parcel was located in the inundation area (see GEI's report for the technical details). 2. Parcels were classified as "land only" if only a certain percent of the land is predicted to be inundated under a certain scenario. The values in Table 4 reflect the percentage of the parcel that is predicted to be affected. Therefore, the values in Table 4 represent a sum of the value of the parcels that were located completely in the inundation area, as well as a percentage of the value of the affected parcels. It is important to recognize that, even if a certain property or part of a property were flooded at high tide under certain scenarios, it does not imply that the value of the land would immediately fall to zero. How a property's assessed value will change under flooding scenarios is difficult to predict. However, the table does give an idea of what is at risk.

Even under the lowest level scenario of 1.6 feet of sea level rise, towns are at risk of losing millions of dollars of revenue. In order to give some context to these dollar amounts we calculated the percentage this potential loss represents when compared to each town's expenditures as outlined in their respective (proposed FY 2020) budgets.

York stands to lose the equivalent of nearly 5 percent of their total expenditures in the 1.6-foot scenario and over 25 percent in the 6.1-foot scenario. Kennebunk stands to lose the equivalent of 12 percent of their expenditures at 1.6-feet of sea level rise, but ends up with the highest impact at the 6.1 foot scenario with the equivalent loss of more than half the town's expenditures. Wells stands to lose the equivalent of 21 percent of their expenditures at 1.9 feet, but comes in just behind Kennebunk at 50 percent in the 6.1 foot scenario.

Table 4: Property tax impacts for 1.6, 3.9, and 6.1 foot sea level rise scenarios

	SLR	Kennebunk	Wells	York
Impacted Value ⁵	1.6	\$ 110,467,678	\$ 433,185,221	\$ 101,867,774
	3.9	\$ 330,318,996	\$ 754,619,443	\$ 357,583,872
	6.1	\$ 489,051,066	\$ 1,080,587,296	\$ 554,852,922
Tax Rate/Thousand		17.50	10.48	11.10
Property Tax Impacts (\$)	1.6	\$ 1,933,184	\$ 4,808,355	\$ 1,067,574
	3.9	\$ 5,780,582	\$ 7,908,411	\$ 3,747,478
	6.1	\$ 8,558,393	\$ 11,324,554	\$ 5,814,858
Town Expenditures		\$ 16,246,375	\$ 22,482,693	\$ 22,390,777
Loss as % of town expenditures	1.6	11.90%	21.39%	4.77%
	3.9	35.58%	35.18%	16.74%
	6.1	52.68%	50.37%	25.97%

Source: GEI Analysis, (Town of Kennebunk, 2020) (Town of Wells, 2020) (Town of York, 2020)

It is important to recognize that sea level rise will have fiscal impacts on the expenditure side of the ledger, not just on the revenue side. According to the “Municipal Climate Adaptation Guidance Series,” a series of guidance documents from the Municipal Planning Assistance Program and nine of Maine’s Regional Planning Organizations (with funding from the Maine Coastal Program), infrastructure such as culverts, roads, bridges and stormwater-related infrastructure that was built to withstand historical conditions may need upgrades or replacement under future sea level rise conditions (Municipal Planning Assistance Program and others, 2017). Likewise, emergency management resources may not be adequate to a changing climate (see the extensive list of infrastructure and assets at risk in GEI’s Vulnerability Assessment) (Pike & Gray, 2020).

3.5 Tax Implications per Town (other than property tax)

IMPLAN automatically calculates the taxes generated (or in this case, at risk) related to the economic activity associated with any changes. Table 4 shows the tax impact associated with the affected industries at the local level. Please note that this table does not include state or federal

⁵ Impacted property values retrieved from GEI Analysis

taxes, and does not include household property taxes, which are discussed in the previous section. As can be seen from the table, Kennebunk has the most tax income directly at risk.

Table 5: Taxes from Economic Activity at Risk from 6.1 and 3.9 Feet of Sea Level Rise

	Examples	Kennebunk	Wells	York
Sales/Excise Tax	Meal, lodging, and "sin" taxes			
	6.1 feet	\$18,600	\$3,200	\$3,500
	3.9 feet	\$5,580	\$1,000	\$2,200
Commercial Property Tax	Business property tax (other than land)			
	6.1 feet	\$1,234,800	\$212,600	\$233,100
	3.9 feet	\$370,500	\$62,900	\$146,300
Other Taxes	Licenses and fees			
	6.1 feet	\$21,900	\$3,800	\$4,100
	3.9 feet	\$6,600	\$1,100	\$2,600
Total				
	6.1 feet	\$1,275,300	\$219,600	\$240,700
	3.9 feet	\$382,680	\$65,000	\$151,100

3.5 Impact on Poverty Rates and Housing

GEI indicated six census block groups that had the greatest amount of land impacted by 6.1 feet of sea level rise in their vulnerability assessment. GEI included age and income demographics for these block groups. This next section reviews some additional measures of the population including poverty rates and housing for those block groups. (For reference, GEI includes a map in their vulnerability assessment. Please refer to figure 75 in their report.)

Poverty Rate

The percentage of the population that lives below the poverty rate for Kennebunk, Wells, and York is 6.5 percent, 5.4 percent, and 6.1 percent respectively (United States Census Bureau, 2020c) (United States Census Bureau, 2020d) (United States Census Bureau, 2020e) The six block groups that have the highest amount of land impacted at 6.1 feet have rates that are slightly lower, implying that those who live in those block groups are slightly better off financially than others.

However, that does not indicate a reason for complacency. Residents who live below the poverty level may not have the resources to relocate should their homes become flooded or uninhabitable. Residents in each of these communities may also find relocating within the same town prohibitive due to housing costs.

Table 6: Persons living below poverty level for six block groups with highest impacted land area at 6.1 feet of sea level rise

Block Group	Total	Percent of Persons Below Poverty Rate
0280021 (Kennebunk)	660	5.6
0280022 (Kennebunk)	413	0
0340014 (Wells)	367	3.8
0340015 (Wells)	385	5.7
0360012 (York)	335	0
0360015 (York)	57	0

(United States Census Bureau, 2020b)

Housing Occupancy

The six block groups that GEI designated as having the greatest amount of land covered under the 6.1 foot sea level rise scenario have housing counts that range from 278 to 1564 residences. The number of residences does not reflect the number of people that live in these areas. The occupancy rate of all but one of these groups is below 50 percent and goes as low as 18 percent (United States Census Bureau, 2020f).

U.S. Census Bureau’s American Community Survey data show that this may be due to the high number of seasonal and vacation rental homes in the area. (United States Census Bureau, 2020a) While this may mean displacement of fewer local residents, it may also mean increased loss of income for local residents who own these properties.

Table 7: Housing occupancy rates 2018-2019

Block Group	Total Residences	%Unoccupied
0360012 (York)	1564	82%
0340015 (Wells)	1551	81%
0340014 (Wells)	964	59%
0280022 (Kennebunk)	949	58%
0280021 (Kennebunk)	896	14%
0360015 (York)	278	59%

(United States Census Bureau, 2020)

Seasonal Rental Housing

Each of the three towns has a substantial amount of housing that is either seasonally occupied or used as short-term vacation rentals. As seen above this number is as high at 82 percent in some areas. The potential economic impact of the loss of those rental properties is not covered in this report, although it may be substantial.

3.6 Other Potential Impacts of Sea Level Rise

In addition to the results of the economic analysis in the previous sections, sea level rise has been shown to impact the health care and social assistance industry – an important part of the economy in all three towns - in various ways. Sea level rise has been shown to have negative consequences on human health, such as blood pressure spikes induced by the stress of floods (Parker, 2014). Mental health can be negatively impacted after floods from sea level rise, and exposure to mold from these floods damages health. In addition, travel times to hospitals and other emergency facilities could be disrupted by flooding transportation routes (Johnson et al., 2018).

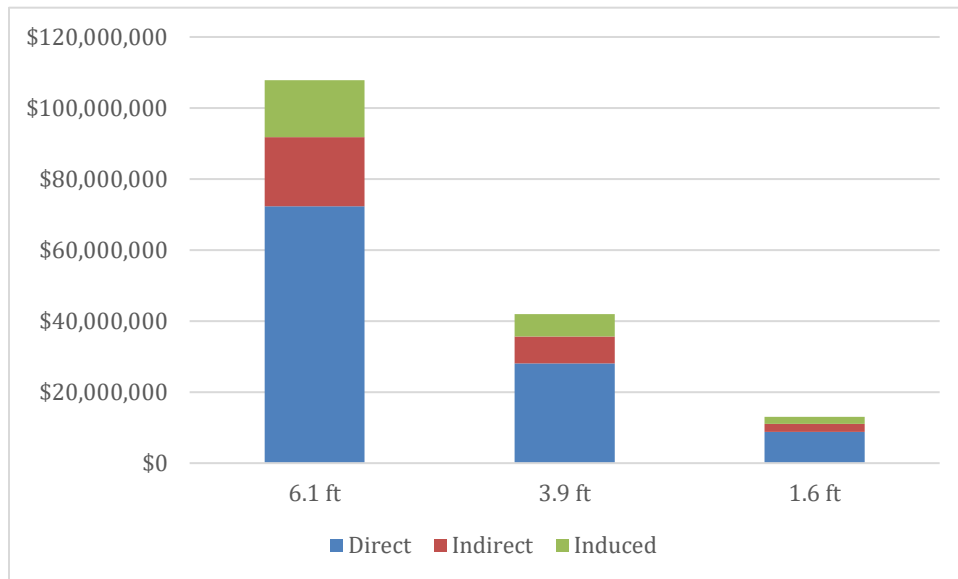
4. Regional Economic Analysis

4.1 Output and Employment Impacts to York County

While the previous section details the immediate economic impacts to the towns themselves, this section demonstrates the wider implications to York County. By aggregating the affected businesses in all three towns, and determining the indirect and induced effects to the rest of the

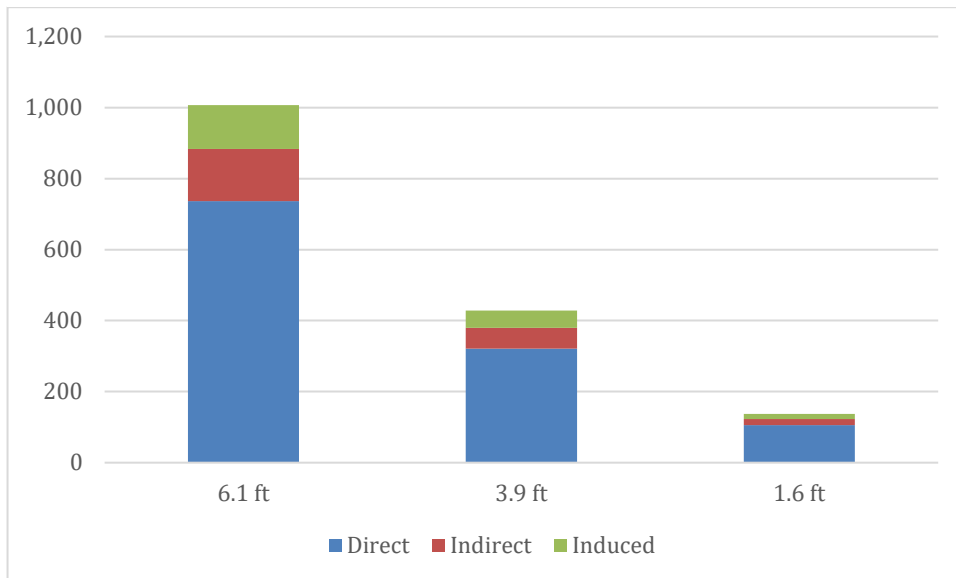
region, we can get a more complete view of the immediate impacts of sea level rise in these three communities to the region. Figures 9 and 10 show the direct, indirect, and induced effects on both output and employment using York County as the reference region. Recall from section 3 that the reference region “captures” the induced and indirect effects of an event occurring in a particular geographic area. For example, section 3 used each town itself as the reference region, implying that any induced or indirect effect that took place outside the town was considered leakage. By expanding the reference region to include all of York County, any induced or indirect economic activity that takes place within York County is included as economic impacts.

Figure 9: Output at Risk from 6.1, 3.9, and 1.6 feet of SLR in combined region, using York County as reference region



Results demonstrate that 6.1 feet of sea level rise would put nearly \$110 million of output at risk in York County, just from those three towns alone. That represents nearly 0.7 percent of the entire county’s economic output. Figure 10 shows that 6.1 feet of sea level rise could directly jeopardize 1,000 jobs, or nearly one percent of the total employment in York County. When the effects of sea level rise are calculated for other towns, the results will likely be much greater.

Figure 10: Employment at Risk from 6.1, 3.9, and 1.6 feet of SLR in combined region, using York County as reference region



However, these numbers only represent the output and employment directly connected to the businesses physically at risk from sea level rise. The wider implications to the region may include impacts to commuters, discussed below, and impacts to the wider tourism industry, discussed in section 4.3.

4.2 Implications for Commuting Patterns

There are substantial inflow and outflow patterns in each town. Table 4 shows the percentage of each town that live in town but commute outside to work, and the percentage of each town’s labor force that commute in.

Figure 11: Percent of Population/Labor Force Commuting Into/Out of Towns

	Percent of Labor Force Living Outside Town (2017)	Percent of Population Employed Outside Town (2017)
Kennebunk	78.3	76.5
Wells	76.5	82.2
York	66.8	66.3

Source: (US Census Bureau Center for Economic Studies, 2017)

The majority of commuters in Kennebunk, Wells, and York commute to work by car, van, or truck (U.S. Census Bureau, 2020). Sea level rise could impact commuter routes in each of the three towns. Our review looked primarily at main roads that might impact commuter access,

using the results of GEI's vulnerability assessment (Pike & Gray, 2020). Side roads or smaller roads, such as those in a housing development, are not included. All roads indicated are impacted at the 1.6 foot scenario.

In Kennebunk, the primary impacted road is Route 9 where it crosses the Mousam River and Little River as well as two smaller streams that are between Hart Road and Parson's Beach Road. Route 9 is a travel route between the Kennebunk's Lower Village and Route 1 in Wells. In Wells three roads of note are impacted. Harbor Road, while not a major commuting route, connects Wells Harbor to Route 1. Mile Road, the primary road used to connect to Wells Beach, will also likely be impassible. Route 1 at Pope Creek in downtown Wells is also impacted.

In York Route 103/Lilac Lane is impacted where it crosses the York River. This road connects the town on either side of the York River. Route 1 may also be impacted where the road crosses the York River. This road is a major travel route through York and facilitates commuter connection to Route 95.

A study by the Natural Resources Council of Maine found that Route 1, which runs through all three towns, will need to be moved and rebuilt, while 13 miles of roadway will be at risk from 1 meter of sea level rise in Wells (Natural Resources Council of Maine, 2013). The 2019 draft Comprehensive Plan in Kennebunk specifies that Parsons Beach Road, Beach Avenue, Crescent Surf Drive, and Durrell's Bridge Road are all considered major concerns from hurricane storm surge impacts.

The results from this section imply that even if a particular business is not in the inundation zone, their employment, supply chains and customer base may be at risk. The towns should consider investing in infrastructure that will either protect against road flooding or provide alternative routes. The individual towns may have more input on this as their familiarity with local commuting and travel patterns will likely provide additional insight.

[4.3 Implications for the Regional Tourism Industry](#)

It is important to emphasize that the employment and output numbers used in this report thus far represent the direct, indirect (supply chain), and induced (household spending) effects associated with those businesses immediately affected by sea level rise. However, it is not as if those establishments exist in isolation, where the loss of one business does not affect others in the region. When tourists come to a particular location (or when new residents move to an area), they are drawn by the vibrancy of the area, not by a particular business. If multiple businesses

are forced to close or relocate away from the waterfront, the entire tourist “ecosystem” may suffer.

Recent statistics back up the connection between the businesses, the economy, and the geography. While the beaches are not the only draw to these three towns, they are one of the primary attractions. A survey of overnight visitors to the Maine Beaches Region in 2019, for example, revealed that 41 percent of respondents listed water activities as among the most important reasons for visiting the region, with 50 percent listing sightseeing (which presumably includes ocean views), and a whopping 67 percent listing food and beverage (Maine Office of Tourism, 2019).

The dependence of the three towns on tourism is no secret. In Kennebunk, for example, the tourism industry (restaurants, accommodation, entertainment, and certain retail establishments) represents nearly 1 out of every five jobs, or 20 percent, and nearly 30 percent of all output (*IMPLAN Group LLC*, 2020) and authors’ calculations. In Wells, those numbers are about the same for employment (23 percent), but represent nearly half of all output. York seems to be slightly less dependent on tourism: 12 percent of employment and 19 percent of revenue or output. A shock to the tourism sector – as we are seeing during the current pandemic – can have wide-reaching consequences.

Such a shock can come not only through the loss or relocation of a particular business, but the loss of the beaches themselves. The recent study released by the Maine Climate Council indicates that York County is expected to see a reduction of its dry beach area⁶ by 42 percent under a 1.6-foot sea level rise scenario, 75 percent under a 3.9-foot scenario, and virtually disappear under an 8.8-foot sea level rise scenario (the Council did not consider a 6.1-foot sea level rise scenario) (Maine Climate Council Scientific and Technical Subcommittee, 2020).

A report conducted for the Maine Climate Council by Eastern Research Group recently estimated that the loss of dry beach area in York County associated with 1.6 feet of sea level rise could result in the loss of 1.1 million visitors (about 8 percent of the current level of visitation) and \$136 million in tourism spending annually (Eastern Research Group, 2020). At 3.9 feet, the report assumes that the number of tourists will decline by 45 percent. Such a scenario could be devastating to local economies, including the three towns profiled, who depend upon tourism for a substantial portion of their economy.

⁶ The dry beach area is defined as the land between the dune vegetation line and the mean high water line.

Table 8: Beach and Tourism Percentage Loss for Sea Level Rise Scenarios

Sea Level Rise Scenario	Percent Total Dry Beach Loss	Percent Lost Attendance
1.6 feet	42	8
3.9 feet	75	45
8.8 feet	98	98

Source: (Eastern Research Group, 2020, p. 50)

While such estimates are alarming, it is important to recognize that there is a great deal of uncertainty about how tourists will react to changing conditions. The figures in the last column of Table 8, for example, are extrapolated from a survey of Florida beachgoers, many of whom indicate that they will simply go to another beach if their first choice is reduced in size. However, if all beaches in the area – including in seacoast New Hampshire or in Massachusetts – are subject to the same phenomenon, it is difficult to predict how tourists would react. Beachgoers may be more likely to simply put up with more crowded beaches, rather than forgo their seaside visit altogether.

While there has been much research on the likely effects of climate change on tourism, there is less evidence on the impacts of sea level rise, specifically, on the decision-making and spending behavior of tourists. Moreover, in those studies that have been conducted, it is unclear how contemporary tourists and future tourists might differ in their perception of sea level rise, adaptive techniques, or defensive infrastructure such as dikes or sea walls. For example, a 2012 study of beach erosion and restoration in Playcar Mexico revealed somewhat complex reactions to defensive measures:

Those with a positive view largely focused on the additional recreational opportunities provided by the erosion control structures in the water. Those with negative reactions were often unaware of the eroded beaches and had expected the state of beaches as reflected in marketing images. A third “reconciliatory” group viewed beach erosion control measures as aesthetically unpleasant but appeared to understand their role in beach protection. The study also found that some tourists associated degraded beach conditions with climate change and expected this to become more common in the future (Gössling et al., 2012).

Research in this area points to the importance of integrating the twin goals of coastal zone management with tourism management. One interesting area of study is the impact of marketing on the intersection of sea level rise and tourism management: in tourism research, tourists’ perceptions are shaped either by marketing (new visitors) or by previous experience with the area (returning visitors). If present conditions differ from remembered experiences, returning tourists’

experiences could be negatively affected more than those of new visitors. Managing tourists' expectations, then, could be key to a positive experience even in the face of change.

5. Conclusion

This report details the potential economic implications of sea level rise to the towns of Kennebunk, Wells, and York. Results imply that the consequences could be substantial, potentially affecting three percent or more of each town's employment and millions of dollars in output for the town. However, that number masks the distribution of the impacts: the restaurant and accommodation industries will be the most seriously affected. Property tax impacts range from a low of 4 percent of current expenditures in York for the 1.6-foot sea level rise scenario to nearly half of Kennebunk's expenditures for the 6.1-foot scenario.

Repercussions to the tourist economy of the three towns could be severe, as tourism generates a significant part of each town's economy. Moreover, the loss of beach area could have further impacts on tourism and visitation to the region.

There are four categories of responses to the threat of sea level rise: mitigation, adaptation, defense, or retreat. Mitigation would require policies such as reducing greenhouse gas emissions, increasing energy efficiency, and the like. Adapting to sea level rise would include strategies to "live with" the rising water and perhaps implement strategies such as raising roadways, increasing building elevation, and replacing culverts at road crossings. Defensive strategies include constructing infrastructure such as dikes or seawalls to protect against the rising seas. Finally, retreat implies relocating people and assets to higher ground. All strategies are associated with costs and trade-offs. However, doing nothing has its own costs. This report shows a snapshot of the population, businesses, and other assets at risk under current projections and at current levels of development. How the towns choose to manage their assets and their economic development could alter that picture.

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