COST-BENEFIT ANALYSIS OF OPTIONS TO PROTECT OLD BAR FROM COASTAL EROSION

Final Report

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Executive Summary

The community of Old Bar faces difficult and challenging decisions due to coastal erosion. The community's reliance on its proximity to the coast, continued costs and hazards of ongoing erosion, and costs associated with the alternatives available for dealing with the erosion require careful analysis to underpin critical decisions. Substantial engineering judgment has informed Greater Taree Council of the options that appear to be most feasible from a physical perspective. The analysis conducted herein considered social, economic, and environmental implications of the options under consideration.

At the outset, it is important to note that there are no clear "winners" in view of the serious recession scenario. All of the options represent loss to some party – loss of the greater part of the beach, in some scenarios; loss of private property in others; loss of sensitive habitat; or lifestyle for others. The analysis herein attempts to compare, on an apples-to-apples basis, the overall costs and benefits of each option. Community residents are understandably concerned about the challenges they face, and divided on the course which Council should take to manage the situation. Council faces financial constraints and the uncertainties of coastal processes and weather. If the solution was clear-cut and readily addressed, houses would not have already been lost. The decisions at hand are difficult, and complex.

There is substantial uncertainty associated with each of the options at hand. As with any coastal erosion scenario, there are multiple aspects to the uncertainties that are unique to Old Bar: when significant additional recession will occur; how long the community will maintain property premiums associated with beach towns after a sea wall is built; ultimately, the timing of natural events that could affect each option is uncertain. The uncertainty associated with natural events means that erosion events over the next five or ten years may or may not prove to be dire. Decisions made in the current time frame may preclude other decisions in future time periods, and may suit an approach of adaptive management.

The cost benefit analysis finds that the most cost effective option is a Planned Retreat with Purchased Easements, which provides limited compensation for beachfront property owners in return for their agreement to vacate when trigger events occur. From a Net Benefits perspective (Total Benefits less Total Costs), and based upon a discount rate of 7% and the "Almost Certain" hazard line, this approach nets approximately $35 million in benefits over a 20 year period. In order of decreasing net benefits, the Easement option is followed by Planned Retreat without easements (net benefits of $29 million over 20 years), Stage 1 Sea Wall (–$9 million), Stage 2 Sea Wall (–$45 million) and Base Case: Business as Usual (-$70 million). Benefit-cost ratios for these options followed in the same order. By component, the direct costs associated with the Planned Retreat with Easements option are just over $5 million, which is slightly more than the Business as Usual /Base Case option, while generating indirect costs of $26 million, compared to $69 million for the Base Case.

Under the Easement scenario, the owners are likely to relocate to another community after acquisition, where they can continue to enjoy beachfront living. The community loses the potentially higher incomes associated with these households, their contribution to support of municipal services and rates, and eventually some of the most expensive properties. At the same time, the community has the potential to retain its beach-related commerce, surf break, and enjoy a more orderly transition of the shoreline to its natural state.

The report describes the parameters assessed, assumptions applied, and sensitivity analyses conducted to test the effects of various discount rates and time periods. Coastal erosion scenarios affect many communities in NSW and Australia, and future research would be warranted in a number of areas for consistent ongoing analysis of these issues, including the following:

- Identification of appropriate hazard lines for use. Hazard lines indicate the composite likelihood of shoreline changes attributable to sea level rise, storms, tides and waves. In this case study, two hazard lines were evaluated.
- The evaluation of non-structural options requires a degree of engineering investigation. Understanding the geology of the area is critical to determine the extent to which non-structural options may affect outcomes over time. While the inclination is to expend public monies over a potential design area only, to minimize costs, further geotechnical investigation for preliminary analysis of coastal planning options may warrant broadening the investigation area.
- As previously mentioned, adaptive management considerations that "buy time" allow future administrations and citizenry to revisit decisions which will have multi-generational impacts. In some cases, property purchases that eliminate immediate risk may profoundly alter the course of subsequent decisions, and options available to the community in future. It appears that new alternatives for financing coastal erosion responses are needed; existing financial vehicles link funding to capital projects exclusively. The ability to incur debt, assess special levies, or otherwise issue instruments that recognise broader impacts on the community would provide flexibility that currently does not exist, and warrants investigation.

I. Background to the Study

The community of Old Bar faces difficult and challenging decisions due to coastal erosion. The community's reliance on its proximity to the coast, continued costs and hazards of ongoing erosion, and costs associated with the alternatives available for dealing with the erosion require careful analysis to underpin critical decisions. Substantial engineering judgment has informed Greater Taree City Council of the options that appear to be most feasible from a physical perspective.

The Office of Environment and Heritage (OEH) commissioned the analysis contained herein, which considers the social, economic, and environmental implications of 4 options under consideration by the Council. The objective of the socio-economic analysis is to provide sufficient information to allow a rational and robust comparison of these options for responding to the problem of shoreline recession at Old Bar. Old Bar has experienced variable rates of landward migration of the shoreline over the past several decades. While sand accretion may occur seasonally, the net impact has been one of steady erosion of the beach/dune system, the loss of several beachfront homes and increasing risks to those that remain.

The project involved two main tasks: a Socio-economic profile of the Old Bar community (included as Appendix D), and the Cost Benefit Analysis. Task 1, preparation of the Socioeconomic Profile, involved the collation of relevant data from publicly available sources, including socio-economic data from the Australian Bureau of Statistics, population projections (Planning NSW), employment data and industry values. The objective for the Profile, which is attached as Appendix D to this report, was to provide a rational basis for evaluating and understanding the impacts of the different options considered by this Cost-Benefit Analysis.

The cost-benefit analysis (CBA) was performed to consider the social, economic and environmental costs and benefits of the coastal protection options, along with the implications of the Base Case (or "Business as Usual" Option). The CBA provides the basis for a distributional analysis to identify those stakeholders that are positively and/or negatively impacted and identifies the social impacts of options in terms of local tourism, housing, jobs, population, supporting industries and the long term viability of Old Bar as a community.

The time horizons for the cost benefit analysis were established as 20 years and 60 years. The uncertainties and risks (defined by particular "hazard lines") and project design considerations were established by agreement between OEH and Royal Haskoning DHV project engineers. The environmental impacts of each option as identified by technical reports prepared by Royal HaskoningDHV (2013) and WorleyParsons (2013) were taken as givens. Finally, the CBA was to quantify real values and discounted future values at 7 percent as per NSW Treasury Guidelines (2007). A sensitivity analysis was also performed to assess the impacts of using 4% (minus three percent) and 10% (plus three percent) discount rates.

II. Background to Study Region

From the Socio-economic Profile, Old Bar is a fairly small town (total population of about 9,560 at the 2011 Census), with limited exposure to the beach compared to some other coastal towns. Most residents (69 percent) work outside the town, and a reasonably diverse set of industries support their employment. While coastal and beach amenities are clearly a component of the lifestyle, and the surf break is recognised as sufficiently desirable to attract out-of-town visitors, the town is not as dependent on beach and coastal activity as some beach towns.

As to community demographics, one-person households represent an increasing proportion of Old Bar's older population; most noticeable for those aged 45+ years. With about 3,400 workers, the labour participation rate in Old Bar (51 percent) was higher than in Greater Taree (48 percent), but lower than in NSW (60 percent). More workers in Old Bar are engaged as professionals, technicians and trades workers, and clerical and administrative workers than in the Greater Taree region. However, fewer workers in Old Bar are engaged as managers, sales workers, community and personal service workers, machinery operators and drivers, and labourers. The health care and social assistance, retail trade, education and training, construction, and manufacturing industries employed the largest share of workers in Old Bar. About four percent of workers are in the accommodations and restaurant industries, those sectors closest to coastal tourism. The median household income is about $890 per week, compared to $770 in Greater Taree and about $1,240 in NSW; and loan servicing costs (i.e., mortgage payments) comprise a larger share of household income in Old Bar than elsewhere (40 percent vs 39 percent in Greater Taree and 38 percent in NSW). The majority of homes are single family detached, town houses or free standing homes (97 percent) and at least 72 percent are owned in full or mortgaged; only about 24 percent of homes are rented.

The coastline makes an important economic contribution to Greater Taree and Old Bar. Total beach visits, including non-surfers, to the City of Greater Taree (measured as domestic overnight travel) are estimated at 75,000 visitors per annum, based on the four year annual average prior to 2013. The average per capita spending by out of town visitors is $238.96, per visit, according to Tourism Profiles findings. Spending by local surfers is conservatively estimated at $1,456 per surfer per annum[1]. The various options contemplated by this Cost-Benefit Analysis interact differently with the unique economics and demography of Old Bar: household income, the numbers of affected properties and homes, property values and council rates are among the factors that shape the economic feasibility of each option considered.

[1] Raybould and Lazarow. Economic and Social Values of Beach Recreation on the Gold Coast. Cooperative Research Centre for Sustainable Tourism (AU), 2009.

III. Key Issues Considered in Assessing Options: Analytical Parameters and Constraints

A number of key analytical parameters and constraints were considered in the context of the Cost Benefit Analysis, as described in this section.

Engineering Parameters

The Royal HaskoningDHV and WorleyParsons reports[2] were reviewed and discussed with the Royal HaskoningDHV engineers involved in the preparation of the reports. Several elements of the engineering analysis are pertinent, beyond the revetment design. The design life indicated in the Royal HaskoningDHV Design reports[3] is for 50 years[4] and associated costs were estimated for design conditions predicted at mid-life (2038).[5]

Two recession scenarios were evaluated for each of the options assessed: (1) a likely or best case scenario (labelled "Almost Certain", the Red line in Figure 12 of the Royal Haskoning DHV 2014 Risk report[6]), in which only the houses fronting the shoreline are at risk and are directly impacted during the design life; and (2) a more severe scenario (labelled "Rare", the Aqua line of the same figure), which impacts housing several streets away from the shoreline. **Figure 1** presents the respective hazard lines.

For purposes of analysis, the thorough intersection of a hazard line with a property boundary directed its inclusion in the cost benefit evaluation. A property was not included if either of the hazard lines simply abutted the boundary or intersected a corner.

[2] Royal HaskoningDHV (2013). Old Bar Beach Coastal Protection Structure Design Investigation, 10 December 2013. Royal HaskoningDHV (2014). Risk Assessment to Define Appropriate Development Setbacks and Controls in Relation to Coastline Hazards at Old Bar. WorleyParsons. (2010). Greater Taree Coastline Management Study: Black Head to Crowdy Head. Newcastle East NSW.

[3] Old Bar Coastal Protection Design Investigation (2013).

[4] While the design life was 50 years, the subsequent Risk Assessment (Hazard Definition Study Amendment) considered a 60 year life.

[5] But being satisfied that the structure would not fail for design storm occurring up to and including end-life (2063).

[6] Royal HaskoningDHV (2014)

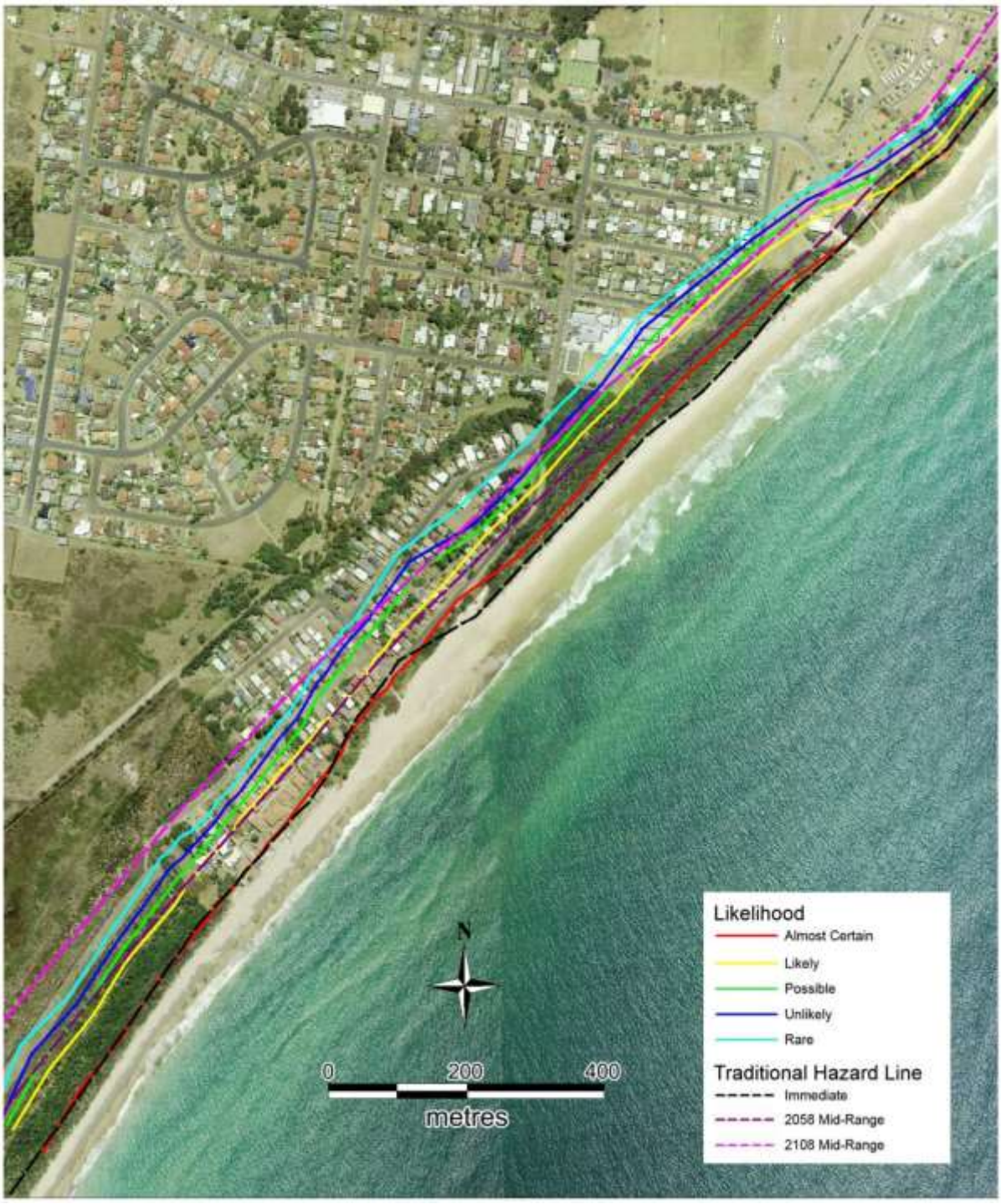

Figure 1. General Locations of Lines for Analysis

"Almost Certain" – Red; "Rare" – Light Blue; and "Possible" – Green. RoyalHaskoningDHV (2014)

Proposed Rock Revetment

Historically in Australia, sea walls are repaired over time and augmented as needed. The proposed rock revetment at Old Bar is designed to "fold down" into the water as recession increases. Consequently, at the end of the design life, some repair, partial replacement, or other activity will be required above and beyond the routine maintenance that is included in existing estimates. This future cost has been estimated at 20% of original construction and installation costs.

The remaining asset value has been incorporated as well, but included only in the 20 year planning horizon, based on a 60-year design life.

Long-term considerations include the increased recession at either end of the structure that would lead to the creation of a headland/peninsula effect over time. While risk assessments were prepared for the design life of the structure, there are effects that will require future discussion when the sea wall reaches the end of its useful life or fails. The loss of beach plus recession means that water may be expected to be at the revetment at the end of its design life. Any replacement of the revetment will need to be designed and built to handle exacerbated and more difficult conditions, presumably at much higher cost. In sum, the current discussion of options for Old Bar will need to be revisited in full at the end of the design life of the revetment.

Natural Coastal Processes

There are alternatives to the deployment of revetment or other structural approaches to reduce coastal erosion. The WorleyParsons 2010 report[7] cites the protective effects of allowing the shoreline properties to return to natural state, thus allowing a buffer that better protects the remaining town from the recession. Ultimately, removal of homes that currently compromise the foredune area may allow natural coastal processes to resume over time. Dunes and beaches dissipate storm wave energy and act as a barrier to storm surges and flooding, protecting landward development and limiting storm wave effects on landward coastal resources.[8] An implied action associated with acquiring properties in the Coastal Hazard Zone is dune restoration. The landward properties of restored areas are, in turn, considered more protected than under existing conditions, which have the foredune compromised by development. However, no quantifiable estimate has been prepared of the area of properties that may be protected under this scenario. A modicum of restoration costs have been included in the planned retreat scenarios.

Other Parameters of Analysis

The cost-benefit analysis was conducted for two time frames; a 20-year time frame, which is common for public works projects, but is not temporally aligned with the current engineering analysis; and a 60-year time frame, which is temporally aligned with the Risk Assessment completed for the seawall. There is inherent uncertainty in the projections of an event which is completely out of anyone's control. The estimates herein incorporate the realisms of financial and economic decisions that consider a 20-year time frame and a 60-year time frame. The reality is that no one can be certain at what point recession may or will accelerate or continue. All of the engineering reports completed for council state that coastal processes in this area are not well understood, and will have uncertainty associated with them, which has been quantified and designed for as best as possible. It is for this reason that cost benefit analysis was conducted using a range of values – the aforementioned hazard lines; value was estimated for all properties seaward of each line using probabilities of impact.

Property values are dynamic in any environment, and coastal erosion can magnify these effects. Beach width has consistently been found to be a significant determinant of property values[9],

[7] WorleyParsons. (2010). Greater Taree Coastline Management Study: Black Head to Crowdy Head. Newcastle East NSW.
[8] O'Connell, Jim (2008) Coastal Dune Protection & Restoration
[9] Kriesel (2005).

and a 2009 study of ten U.S. beach towns with coastal erosion found that property values are more sensitive to changes in beach width when the erosion rate is high.[10] Over time, property values in areas with sea walls have been found to decline, anecdotally, after an initial "honeymoon" period. The analysis does not attempt to capture these real estate dynamics and uses current property values only.

Appendix A provides detailed maps of the properties included in the various scenarios. Properties seaward of the specified hazard lines were identified as either protected or at risk, depending on the scenario. For the "Rare" scenario analysis, property values were weighted based on the governing hazard line; further detail is provided following Table 2.

Development Controls

Council has indicated that under the Stage 1 or Stage 2 Sea Wall scenarios, development controls behind the sea wall would be relaxed, making possible additional development that is reliant on both protection from the sea wall and confidence in long term property values. There is risk to be considered in this approach: additional services to be provided and the rates revenues expected need to be evaluated differently than properties that are not in the sea wall protection zone. The implications for the community are the potential risk of high future costs without the assurance of rates revenues; no attempt has been made to quantify this dynamic. Inflating the benefit of protected properties through support of aggressive development behind the wall contributes bias toward choosing a sea wall option.

Beach Values

The intrinsic value of retaining Old Bar's beach is captured through multiple economic values. The beach has ecological value; several listed species have been identified, and the littoral rainforest vegetation has been identified as having ecological value of significance. Willingness to pay values have been assigned for each, using values from original research either directly in the area or conducted in similar settings and transferred to Old Bar's demographics. Prior reports note the importance of the beach's contribution to the area's natural scenic values; there is no way to confidently assess the impact of the engineered approaches, positive or negative, on this aspect or quantify its monetary equivalent. The value of the beach aesthetics, surf access, and other intangibles to visitors and residents can be estimated through visitor expenditures, published surf values, and published willingness to pay values for residents who do not surf but value the beach, and values have been allocated to each option accordingly.[11] It should be noted that, throughout the analysis, willingness to pay values that are measured per household have been allocated using the Old Bar official household count, and if a larger resident community were perceived to enjoy the benefits, a larger household count would increase the corresponding benefit or cost in a linear fashion.

[10] Gopalakrishnan (2009).
[11] Values and cited reference works are detailed in Appendix D

IV. Options Considered

The analysis herein assesses the social, economic and environmental costs associated with a total of nine options, as shown in **Table 1**. Four basic options were evaluated, with three development alternatives associated with each of the two sea wall construction options (**Options 2 and 3**), and two strategies for planned retreat (**Option 4**). The resulting analysis essentially vets nine alternatives; total and net benefits of each are compared to the Base Case: Business as Usual in the Results section. The Options are as follows:

Option 1: 'Business As Usual' is the Base Case analysis. In this scenario, stabilization occurs as needed for public safety, such as repairs to pipes or roadways left bare due to significant recession events, but otherwise no substantial mitigation activities are undertaken. Impacts to the community include the expected loss of homes consistent with the projected effects of recession over the two planning horizons, and the associated losses of council rates and general economic contribution of household income. Economic impacts of property occupation and loss, changes in beach use and related expenditures, and predicted loss of habitat consistent with the projected recession effects are included.

Option 2: 'Stage 1 Wall (Lewis Street)', which considers the installation of a rock revetment extending from approximately Rose Street south to the end of Lewis Street. The location of Option 2 is depicted in **Figure 2**. Option 2 and Option 3 assume construction in the current year and changes in land use, beach use, etc., thereafter.

Option 3: 'Stage 1 Wall (Lewis Street)' and 'Stage 2 Wall (Pacific Parade)'; considers the installation of the rock revetment in Option 2, as well as an additional rock revetment that extends north from approximately Rose Street to the dune vegetation area near the end of Pacific Parade. This option was also assessed with three development variations, described below. The location of Option 3 is depicted in **Figure 2**.

Option 4: **'**Planned retreat', which assumes that properties would be vacated and demolished in advance of recession events, and basic restoration or stabilisation conducted. Planned Retreat, discussed in further detail below, would provide continued access to the shoreline and residual dune system, despite recession. A variant of Planned Retreat, including the use of easements to compensate property owners was included.

The three development scenarios assessed within Options 2 and 3 are defined as follows:

(a) continued development (reflected as vacant lots converting to development with typical current values)
(b) increased development after sea wall construction (reflected as beachfront properties redeveloping to twice their current values); and
(c) the midpoint of the above two scenarios.

Regarding the development scenarios, Scenario (a) provides for infill of existing vacant lots that are "protected" by the sea wall with housing equivalent in value to the average house and lot value in coastal Old Bar. Scenario (b) provides for redevelopment and a doubling of value for all properties (including currently vacant lots), less homes that exceeded $800,000 in current value (i.e., more than twice the average), as these are unlikely to be redeveloped within the 20 year horizon.

There is anecdotal evidence from coastal communities to indicate that property values may decline following the construction of a sea wall after an initial "honeymoon period". This analysis assumes that given continued market demand for coastal property, infill of vacant lots is expected within the project lifetime and older home sites are likely to be redeveloped at intensities (and assessed values) no less than the current use of these properties. As such, the analysis may be generous in terms of prospective benefits related to protected property values, including Council rates.

Table 1. Summary of Options Considered in Cost Benefit Analysis

1	Option 1	Base Case or 'Business as Usual'
2	Option 2(a)	Stage 1 Wall (Lewis Street) with Current Development Controls
3	Option 2(b)	Stage 1 Wall (Lewis Street) with a Development Scenario Midpoint between Options 2a and 2c
4	Option 2(c)	Stage 1 Wall (Lewis Street) with No Development Controls
5	Option 3(a)	Stage 1 Wall (Lewis Street) and Stage 2 Wall (Pacific Parade) with Current Development Controls
6	Option 3(b)	Stage 1 Wall (Lewis Street) and Stage 2 Wall (Pacific Parade) with Development Scenario Midpoint between Options 3a and 3c
7	Option 3(c)	Stage 1 Wall (Lewis Street) with No Development Controls
8	Option 4(a)	Planned Retreat
9	Option 4(b)	Planned Retreat with Easements

The Options were evaluated individually using the combination of properties, costs and benefits ascribed to that particular Option. For example, the properties protected by the Stage 1 Sea Wall are different than the properties protected by the Stages 1 & 2 Sea Wall (i.e., Stage 1 properties are a subset of the Stage 1 & 2 properties) (Appendix A). **Table 2** summarises the count of properties subject to each of the options.

Table 2. Count of Properties Impacted in each Option

	Option 2 (Stage 1)		Option3 (Stages 1 & 2)		Option 4	
ATTRIBUTE	Certain	Rare	Certain	Rare	Certain	Rare
Number of Easements	15	18	15	41	15	18
Cost of Providing Services	15	43	15	91	15	18
Loss of Council Rate	15	18	15	41	15	18
Value of Protected Properties	15	43	15	91	15	91
Infrastructure	15	43	15	91	15	91
Receipts for Services	15	43	15	91	15	91
Council Rate Paid	15	43	15	91	15	91
Net Contribution of Protected Properties	15	18	15	41	0	0

The probability of a parcel being subject to recession (and therefore the benefit of it being protected, providing a locus for household income, generating Council rates, and paying for utilities) was determined by the hazard lines. For calculations of net present value, Lewis Street neighbourhood properties that front the shoreline were valued at 100% of their current market value (based upon sales information and RPdata). Properties between the red "Almost Certain" line and a mid-point – the green "Possible" line indicated in Figure 1 – were valued at 3% of their current market value, based on the engineer-assigned probability of impacts in this area. Properties between the "Possible" line and the aqua "Rare" line were weighted as 0.03% of their value, also based on the engineer-assigned probabilities.

Figure 2. Locations of Option 2 (Seawall Stage 1) and Option 3 (Seawall Stages 1 & 2)

V. Costs and Benefits Considered in the Analysis

The analysis considered three types of costs to the community: direct, indirect and non-market as characterised as follows.

- Direct costs – cash, council staff time or other direct expenditure, as for construction or maintenance[12]
- Indirect costs – generally, a loss of income due to loss of some activity, etc.
- Nonmarket costs – generally, the value of something that the public values and will no longer have.

Likewise, the analysis considered three types of benefits: community-oriented, recreational, and environmental. The latter categories may include direct expenditures and proxies for value identified by "willingness-to-pay."

- Community benefits – broad, commerce-based benefits that accrue to the community in general, not to a specific party, in addition to the value of protected property[13]
- Recreational and amenity benefits – surfing and beach visitors are reflected here
- Environmental benefits – published values for various ecological assets

The value of each cost or benefit was assigned and estimated independently for each option. Due to the mutually exclusive nature of the options; a value that may be a cost for one option may be a benefit of another option. For example, the stream of revenues associated with Council rates from properties protected by the sea wall is a benefit of Options 2 and 3. Option 1 assumes that properties not protected would cease to be available to produce this stream, so for Option 1 the loss of Council rates is an Indirect Cost. In some cases, values were derived directly from the relevant engineering reports. In other cases, published literature or government statistics were used to quantify impacts. Values for recreational, amenity and environmental benefits were derived from a review of relevant publications and calibrated to local visitor counts, household numbers or demographics. For example, the value of visitor expenditures relating to the beach was derived from estimates by Destination NSW for Greater Taree, which reported a four-year annual average of 75,000 overnight visitors specifically citing the beach as their visit purpose. Hourly counts provided of observed users by volunteers and the SLSC were corroborated by user forums which reported that the 47km of beaches throughout the Council area were all relatively uncrowded; as such, the counts were allocated in a pro rata fashion to Old Bar, with approximately 12% of the visitors specifically accessing the main beach. The Destination NSW study, which is an annual survey, found a weighted average expenditure of approximately $240 per visitor, or roughly $2.3 million annually. Over 20 years, in real terms, this total $34 million in benefits. The sources for literature-based values are provided in the Data Sources, with relevant citations.

Where ranges of values were available, conservative estimates were used for all nonmarket estimates, and should be considered a lower bound. In addition, it should be noted that there is a concept of "special places," threats to which affect individual (and the larger community)

[12] Property valuation data was not provided; historical data for purchases was obtained through RP Data, and used to calculate mean values for properties lacking data. For properties included in the WorleyParsons (WP) Coastline Management Study 2010, the 2010 value was corrected for inflation and used. For properties fronting the shoreline and for which no actual sales data was available, twice the mean was used based on the WP report.

[13] Consistent with NSW Treasury Guidelines, property values reflect willingness to pay through sales data and recent rates of appreciation in value.

wellbeing[14]. For Old Bar, certain intangible aspects of the beach (such as the willingness to pay for beach access), appear to be equal to or greater than activity-based values, such as actual expenditures within the coastal sector of the economy, an indicator that Old Bar may fall into the category of "special places".[15] Intangibles are less likely to be captured well by market quantities, while activity-based values are somewhat easier to capture in market estimates. Hence, the estimates for non-market values herein are considered conservative and represent a lower bound.

A list of costs and benefits that may be associated with each option was generated, as indicated in **Table 3. Table 4** summarises the assignment of various impacts to each option.

Table 3. Cost and Benefits Associated with each Option

Cost or Benefit	Brief Description
Property-related Costs	To purchase land for sea wall or potential easements for retreat options
Construction Costs	For the sea wall
Repair & Maintenance Costs	For the sea wall; may also apply to the costs after a significant recession event of capping pipes, maintaining public safety, etc.
Administrative Costs	To manage public inquiries and oversee orderly transition
Avoided Costs of Municipal Services	For properties that no longer need roadway, water or sewer services
Beach-related Commerce	Indirect effects of direct spending by visitors
Foregone Revenues or Lost Assets	Lost council rates, resident income, or utility revenues due to removal of properties; or lost public assets such as roadway or sewerage pipes
Amenity Values	Values the public either pays (direct expenses by visitors) or is willing to pay for recreational opportunities (surfing) or ecological protection
Demolition and Restoration costs	Costs to restore or stabilize abandoned or acquired lands to natural state
Remaining Asset Value	The remaining value of the sea wall at the end of the analysis period, for the 20-year analysis only
Decommissioning Costs	The cost to decommission the sea wall at the end of its useful life

[14] Devine-White (2010)
[15] Over a 20-year horizon, the WTP for non-surfing beach access was about $34 million versus about $16 million for beach-related commerce.

Table 4. Impact Assignment Table

	Option 1	Option 2	Option 3	Option 4(a)	Option 4(b)
	Base Case: Business as Usual	Stage 1 Wall (Lewis Street)	Stage 1 & 2 Wall (Lewis Street & Pacific Parade)	Planned Retreat	Planned Retreat with Easement Treatment
Construction Costs	X	X	X		
Property Acquisition Costs*		X	X	X	X
Demolition & Restoration Costs	X			X	X
Maintenance & Repair Costs	X	X	X	X	X
Foregone Rate Revenue		X	X	X	X
Avoided Costs of Municipal Services					X
Administrative Costs	X			X	X
Value of Protected Properties		X	X	X	X
Beach-related Economic values (Non-property)			X		X
Recreational Value: Surf	X	X	X	X	X
Amenity Value: Ecological Protection	X	X	X	X	X
Amenity Value: Beach	X	X	X	X	X
Salvage Value		X	X		
*Acquisition costs represent the value of properties at hand; whether compensation occurs or the property owner bears the cost, the cost is incurred. The cost is estimated using current property values for this analysis.					

Table 5 provides the basis for or the method of quantifying the various non-market costs and benefits employed in the analyses. The costs and benefits are derived in part from literature values specific to New South Wales, and its coast, where feasible. Select sources are reinforced by data from studies outside of Australia. The Socio-economic Profile (Appendix D), generated by data from the 2011 Australian Census is the source for household income. Utility and rate information were obtained from Greater Taree Council documents and from regional service providers.

Table 5. Allocation Protocols

Benefit Code	Description Of Method Used And Allocation Protocol
ENVIRONMENTAL BENEFITS – LISTED SPECIES - FAUNA	Willingness-To-Pay (WTP) is considered the best estimate of the public's value of listed species, since the species themselves are not assessed a price in the private market. In Old Bar, the Dune Section identified as Environmental Planning Policy No. 29 is reported as housing listed species. Morrison (2010) identified one-time payment pooled values for NSW for added faunal species; in current dollars, $2.53 per household, applied to 3,983 households in the immediate Old Bar community.
ENVIRONMENTAL BENEFITS - WATERCOURSE	Watercourse Benefits in this case are estimated based on Willingness to Pay conducted by Morrison & Bennett in 2004. The study estimated that NSW households are willing to make a one-time payment of between $1.96 and $2.61 per household to retain a natural flow in watercourse; applied to 3,983 households in the immediate Old Bar community. The proposed revetment will alter the course of the Racecourse creek, albeit nominally for the Stage 1 scenario. The lower bound has been used to recognise the potential or perceived loss of a natural watercourse or flow.
ENVIRONMENTAL BENEFITS – DUNE VEGETATION	Gillespie 2009 WTP per household per ha to avoid damage to native vegetation; Coastal dune vegetation in project area measured as ~6 ha; One-time payment current dollar's value of $2.59.
ENVIRONMENTAL BENEFITS – COASTAL FOREST	Productivity Commission, 2006 data, healthy forests worth between $1.45 to $3.29 per household; onetime payment; used lower bound for littoral rainforest area (separate from native vegetation value)
ENVIRONMENTAL BENEFITS – LISTED SPECIES - WATERBIRDS	Productivity Commission, 2006, per unit increase waterbirds worth between $1.10 and $3.89 per average NSW household; one-time payment. Used lower bound.
COST OF MUNICIPAL AND UTILITY SERVICES	Greater Taree Operational Plan (FY 2013/14): Domestic Waste @ $379/yr; Greater Taree Fees & Charges: greenwaste Bin @ $379, Recycling Bin @ $351, Prorated at 10 yr lifespan; Average usage of 700kW/mo; gas at 26.4 mJ/ mo; Water Use assumed at 292 ltppd, 2 persons per HH yields approx. 54 kl/quarter; rates from Midcoast Water are $45/quarter (minimum) plus $2.57 per kl < 50 plus $2.88/kl > 50.Midcoast rate for sewer is $230/ quarter.
VALUE OF PROTECTED INFRASTRUCTURE	Proxy replacement cost for utility assets equal to 20 year utility costs, times 1.5 to account for roadway maintenance costs. Alternative Approach to Utility Assets: Based on annual value of typical usage and rates for water and sewer (Midcoast), electricity and gas (Energy Australia). See Cost of Services.
VALUE OF BEACH-RELATED COMMERCE	Indirect and Induced economic multiplier effects on Visitor expenditures attributable to beach; Surf Coast Tourism (2012).
WTP FOR SURFING - RESIDENT	Benefit transfer of data developed by Lazarow & Tomlinson (2009) that estimates surf expenditures from $18.67 to $30.36 per session. Used lower bound and an average number of 78 sessions per year.
WTP FOR BEACH AMENITY (NON-SURFING) - RESIDENT	Pitt (1993) Value of Taree residents to maintain beach and dunes; Value updated in 2009 by WorleyParsons; Annual pmt. in current dollars $81.18. This value is separate and distinct from Willingness to Pay for sensitive native vegetation. Apportioned to Old Bar beach length as component of total Taree beach length.
WTP FOR BEACH ACCESS (NON-SURFING) – VISITOR	Estimated average annual beach visits for Greater Taree is 75,000, consistent with estimates of beach use by the 699,000 visitors with a 10% identification of beach use reported by Destination NSW, and a midpoint of observed users by volunteers and the SLSC hourly totals; Weighted expenditures for domestic day and overnight visitors is $240 per visit; pro-rated for Old Bar share of Coastline: Old Bar is 6 km of 47km.
ECONOMIC IMPACT OF DISPLACED PROPERTIES	Based on median income in Old Bar of $889/week; Costs for utilities and rates are deducted to avoid double counting

Costs and Benefits Associated with Each Option

Base Case: Business as Usual

For the Business as Usual or Base Case Scenario, direct costs include costs of demolition and stabilisation of properties; Council would be assumed to adopt a reactive approach to properties that become uninhabitable due to recession. For indirect costs, it is assumed that beachfront inhabitants would relocate from Old Bar to another beachfront town, and the household income associated with the beachfront properties is assumed to be lost. Income was estimated at twice the town median for beachfront households only. Additional indirect costs include the lost value of the

properties themselves; their Council rates; utility revenues which support maintenance and operations of utility infrastructure; and beach-related commerce, based on displacement of beach-specific visitors, using Surf Coast Tourism data[16]. Based on local reports, expectations are that convenient access to the existing main beach may be lost within three to seven years; the assumption used for purposes of analysis was that after five years, visitors would choose alternatives, resulting in displacement of non-surf beach visitors for the remaining time period of evaluation[17]. Nonmarket costs include the loss of Resident and Visitor Willingness to Pay values for dune vegetation and listed species (which are nominal values – totalling less than $40,000), and beach non-surfing activity values (which are significant at about $2.3 million annually[18]). For context, the value of beach-specific spending and recreation for Greater Sydney beaches was recently estimated at $1.1 – 1.6 billion annually.[19]

In the Benefits column, the Base Case: Business as Usual is assumed to maintain some of the surf value in perpetuity; access may be more difficult over time, and the effect of significant erosion events, falling fences, and so forth on an individuals' choice to visit Old Bar for surfing versus a more aesthetically neutral beach is unknown. Conservatively, the analysis assumes that 25% of the surfing is displaced.

Stage 1 Sea Wall

For the Stage 1 Sea Wall scenario, direct costs include construction costs ($8.3 million), operating and maintenance costs ($41,500/yr.), and sand maintenance costs ($20,000 / yr) using the Royal HaskoningDHV estimates.[20] Decommissioning costs discounted from Year 60 to current values were also included. The direct costs of property required to construct the sea walls were calculated using the proportions of lots impacted as estimated by WorleyParsons, rolled forward to current values. Indirect costs include the reduction in Council rates due to property area reductions for construction, and reflecting the Council's formula for assessment of the reduced values, worth about $4.5 million annually. Nonmarket costs include the habitat and vegetation effects previously described, surfing and beach amenity values assuming a 50% displacement of activity (based on occupation of 50% of the shoreline where most recreational activity occurs), and the value of associated commerce/multiplier effects.

Benefits include the value of the properties protected which includes all properties seaward of the relevant hazard line; associated Council rates; continued payment of municipal utilities to support infrastructure maintenance; protection of underlying infrastructure (pipes and roads underlying the protected properties, valued at the replacement cost using average local costs as proxy); and salvage value at the end of the analysis time period based on remaining asset value.

Under the variations on development, property values and associated council rates are incorporated as benefits: for the no development controls, all beachfront properties are assumed to double in value and density; for the existing development controls, vacant lots only are assumed to

[16] Surf Coast Shire Tourism Economic Impact Analysis (2012). Matthew Nichol and Shayne Campi, Compelling Economics Pty Ltd, Victoria

[17] http://www.smh.com.au/environment/climate-change/widespread-beach-erosion-leaves-surf-clubs-in-deep-water-20120102-1pidz.html

[18] And calculated as detailed in the previous section, Costs and Benefits Considered in the Analysis

[19] Sydney Coastal Councils Group (2013)

[20] All costs are presented as Net Present Value in Appendix B.

be improved to the mean of existing property values; and the midpoint of the two is used to represent a middle range scenario. On the costs side, an estimate of the additional municipal servicing cost for new units (at $5,616 per unit, per year) is included, based on average annual utility costs.

Stage 1 & 2 Sea Wall

Under the Stage 1 & 2 Sea Wall scenario, the parallel direct costs to the Stage 1 analysis are included, but adjusted using the RoyalHaskoningDHV cost estimates for the combined Stage 1/Stage 2 construction ($15.3 million), O&M ($76,500/yr), and so forth. The decommissioning costs are estimated in the same way. The indirect costs are likewise applied in the same way, but to all the properties affected by the first and second sea wall area. The nonmarket costs are likewise applied in parallel fashion, adjusted for the expanded area.

On the Benefits side, the value of protected properties is expanded to include the properties behind the Stage 2 Sea Wall. Corresponding council rates for 20 and 60 years, respectively, as described in Stage 1, are included using the same approach.

Planned Retreat

Two scenarios of Planned Retreat were evaluated. In a planned retreat involving property owners removing themselves from the endangered properties and allowing the home to be demolished, the value of the properties was considered a cost; either the property owner bears the cost of property loss, or Council bears the cost of acquisition; either way there is a cost borne equal to the value of the lost property.

An alternative to this approach is a Planned Retreat with Easements or a “shoreline migration rolling easement”. As this is a relatively new concept, explanation is warranted. The term “shoreline migration conservation easement” refers to a rolling easement implemented as a conservation easement, which prohibits shore protection but otherwise does not restrict use of the dry land. In a rolling easement, property owners are compensated for an easement on their property. The easement allows them to remain in the property, but not to rebuild in the event of significant storm damage, or after a time certain; “significant” can be defined locally, as can the time frame under consideration. In this scenario, the resident continues to enjoy the benefits of the beach for as long as it is safe to do so, and once a storm event triggers significant recession – or at some time determined by negotiations or local government rule - the home is demolished.

Under both Planned Retreat scenarios, the property reverts to public ownership. Local government then steps in to demolish the home and perform restoration of the dune system as needed to stabilise the property. The public gains an additional coastal amenity, at least for a few years, and the shoreline gains additional buffer land between remaining homes, further removed from the shore and risk line of recession. While there will be periods of time when access to the beach is disrupted temporarily due to demolition or restoration activities, these are considered intermittent and offset by the presumably longer overall beach access. The challenge is that normally a Planned Retreat or rolling easement approach would allow a reasonably long time period for implementation, which may not be practical at this stage in Old Bar. Nonetheless, the costs are significantly lower than outright purchase and the benefits preserve most of the community’s beach-related values. The contrast with the Base Case: Business as Usual is stark: in the Base Case, properties are lost over time with beach access and benefits. In Planned Retreat, specific homes are

removed from risk, properties restored to public access and natural coastal processes resume with a buffer to remaining homes.

To implement the Planned Retreat with Rolling Easements Option, less-than-Torrens title ownership easements are considered rather than purchase of target properties. Lots included in the analysis are those that were identified within the Coastal Zone Hazard Area.[21] The easements represent a constraint on any future development and a partial interest in the property by the local government or other entity that will ultimately hold title to, and be responsible for the management and disposition of, the land.

If legal and implementable, the easements achieve several objectives. First, they provide partial compensation to owners who will ultimately be displaced. As the compensation is paid at the start of the program, it may function as an annuity and provide income to the owner until the property is taken in full. Second, the easement ensures that no further development (other than routine maintenance) will occur on the subject parcel. Expansion and major reconstruction after a storm or undercutting erosion would not be permitted. The easement reduces further financial exposure to the owner and reduces future public risk for the government. Third, as the property is occupied for some period, the property contributes to generate local council rates, fees and charges are paid to support utilities and services, and the property-owner's income and/or expenditures contribute to the larger economic well-being of the community.[22]

The value of such a constraint on development is conditioned in part by the values of the raw land, the improvements, and the costs for supplying municipal services (including hazards management), rates, and the degree of risk, i.e., how soon a property is likely to be vacated. Experience with rolling easements themselves is limited; it is a relatively new form of conservation easement. However, conservation easements in general have been negotiated and implemented for decades. In the United States such easements have ranged from as little as 10% of the market value of the subject property to as much as 90%. [The latter rates were employed for flowage rights and came under criticism by auditors.] More recent experience finds conservation easements that preclude future development or preserve selected landscape features range between 25% and 40% of the fair market value, with the majority greater than 30%. Lower rates are most often associated with large area easements (many hectares), particularly those that have few to no improvements. For purposes of this benefit-cost analysis of options, a rate of 30% was applied.

Direct costs thus included the cost of the property easement (which vary based on lot value), and demolition or stabilisation costs for the properties or public infrastructure in the area (estimated at $75,000), as one-time costs per lot. Indirect costs include the loss of municipal revenues and rates

[21] WorleyParsons 2010

[22] As Titus (2011) notes in describing how rolling easements are managed, expectations will shift during each decade closer to submergence due to recession:

> *The final decade.* The composition of homes is likely to shift from owner-occupied to rental property. As people die or sell their homes, most homebuyers will not want a home with such a limited lifetime. Investors may be more flexible if there is a profitable opportunity: In resort areas, rentals are generally weekly or seasonal. Few people base a decision to rent a particular house on whether they can return the following year. Even in non-resort areas, leases longer than one year are rare for homes. Therefore, the property value to a landlord-investor should only decline as the present value of future rents declines.

In the case of Old Bar, this may be less relevant, as multiple decades are unlikely to occur before the properties would need to be vacated.

and the incomes of the displaced properties. In the case of Planned Retreat without an easement approach, properties were assumed to be deemed acquired or uninhabitable on a staggered basis, with 15 meter increments from the shoreline dictating which properties were included in five year increments. This is as opposed to assuming that all properties would be affected year one, and that the community would experience the loss of incomes etc. for the entire period under evaluation (20 years or 60 years).

Benefits include the retention of the beach amenity values, both activity-based and non-activity-based; the retention of the (nominal) environmental values, and retention of beach-related commerce values.

VI. Results of the Analysis

As noted, analysis was completed for all scenarios under the two hazard lines. Identical processes were used for each. Results are as follows, by option.

The following tables summarise the outcomes of the analysis, based on a discount rate of 7% and the "Almost Certain" hazard line for the high development scenario. Detailed results of the analyses of each option are included as Appendix B. Under all options, it is recognised that a 60-year time frame for estimating costs or benefits introduces significant uncertainty. Accordingly, values for the 60-year analysis should be considered indicative of future relative outcomes, rather than absolute quantitative estimates.

Tables 6-8 describe the direct, indirect, non-market costs and total costs for the various options at the 20 year and 60 year horizons. Nonmarket impacts represent a significant share of total costs for all options other than planned retreat. Indirect costs (loss of utility receipts, Council rates and household income) comprise the larger share of total costs for the planned retreat alternatives.

Table 6. Costs by Option – 20 Years, Almost Certain Hazard Line

OPTION	Direct Costs	Indirect Costs	Nonmarket Costs	Total Costs
Base Case: Business as Usual	$2,088,113	$45,739,799	$24,443,939	$72,271,850
Seawall Stage Ia	$15,399,679	$3,936,805	$28,514,566	$47,851,050
Seawall Stage Ib	$18,282,050	$3,936,805	$28,514,566	$50,733,421
Seawall Stage Ic	$21,164,421	$3,936,805	$28,514,566	$53,615,792
Seawall Stages I & II (a)	$23,277,045	$3,936,805	$57,029,131	$84,242,981
Seawall Stages I & II (b)	$26,159,416	$3,936,805	$57,029,131	$87,125,352
Seawall Stages I & II (c)	$29,041,787	$3,936,805	$57,029,131	$90,007,724
Planned Retreat	$16,196,175	$12,922,222	$0	$29,118,397
Planned Retreat w/ Easement	$5,167,787	$17,982,145	$0	$23,149,932

At the indicated discount rate (7%) and a twenty year horizon, the lowest direct cost option is Option 1: Base Case or Business as Usual, with direct costs of about $2.1 million and total costs estimated to be nearly $72.3 million.[23] The next lowest direct cost option is Option 4(b): Planned Retreat with Easements, with direct costs of about $5.2 million, but total costs of about $31.3 million, the least among all options. Option 2: the Stage 1 Sea Wall, with an estimated $13.8 million in cash outlays to cover construction and compulsory easements, had direct costs of about $15 million and total costs of $48 million. Option 3: Stages 1 & 2 Sea Walls had direct costs of about $23 million and total costs of $84 million.

Over the 60 year horizon (**Table 7**), the direct costs for either of the Planned Retreat alternatives increased nominally, by about $200,000 and the predicted increase in direct costs for Option 1: Business as Usual was about $1.4 million. However total costs for the Planned Retreat alternatives remain significantly lower than all other options.

[23] All reported estimates of costs and benefits are as Net Present Value, 2014.

Table 7. Costs by Option – 60 years, Almost Certain Hazard Line

OPTION	Direct Costs	Indirect Costs	Nonmarket Costs	Total Costs
Base Case: Business as Usual	$3,420,547	$68,997,526	$49,235,594	$121,653,667
Seawall Stage Ia	$16,747,909	$6,448,897	$46,710,846	$69,907,652
Seawall Stage Ib	$19,630,280	$6,448,897	$46,710,846	$72,790,023
Seawall Stage Ic	$22,512,651	$6,448,897	$46,710,846	$75,672,394
Seawall Stages I & II (a)	$25,603,777	$6,448,897	$93,421,691	$125,474,366
Seawall Stages I & II (b)	$28,486,148	$6,448,897	$93,421,691	$128,356,737
Seawall Stages I & II (c)	$31,368,519	$6,448,897	$93,421,691	$131,239,108
Planned Retreat	$16,313,491	$26,034,996	$0	$42,348,487
Planned Retreat w/ Easement	$5,285,103	$26,034,996	$0	$31,320,099

Table 8 contrasts the two project horizons to better describe the effect of time on the results (data reported as $ millions). Direct costs reflect out-of-pocket expenses to the community, and as such are particularly sensitive.

Table 8. Comparison of Approximate Costs, 20 years and 60 years ($ millions)

	Direct Costs		Indirect Costs		Nonmarket Costs		Total Costs	
OPTION	20 Years	60 Years	20 Years	60 Years	20 Years	60 Years	20 Years	60 Years
Base Case: Business as Usual	$2.09	$3.42	$45.74	$69.00	$24.44	$49.24	$72.27	$121.65
Seawall Stage Ia	$15.40	$16.75	$3.94	$6.45	$28.51	$46.71	$47.85	$69.91
Seawall Stage Ib	$18.28	$19.63	$3.94	$6.45	$28.51	$46.71	$50.73	$72.79
Seawall Stage Ic	$21.16	$22.51	$3.94	$6.45	$28.51	$46.71	$53.62	$75.67
Seawall Stages I & II (a)	$23.28	$25.60	$3.94	$6.45	$57.03	$93.42	$84.24	$125.47
Seawall Stages I & II (b)	$26.16	$28.49	$3.94	$6.45	$57.03	$93.42	$87.13	$128.36
Seawall Stages I & II (c)	$29.04	$31.37	$3.94	$6.45	$57.03	$93.42	$90.01	$131.24
Planned Retreat	$16.20	$16.31	$12.92	$26.03	$0.00	$0.00	$29.12	$42.35
Planned Retreat w/ Easement	$5.17	$5.29	$17.98	$26.03	$0.00	$0.00	$23.15	$31.32

The indirect and nonmarket costs in the first three options (Base Case: Business as Usual; Seawall Stage 1, and Seawall Stages 1 & 2) reflect the loss of income and visitors associated with the beach, and foregone municipal revenues from displaced properties. In the Planned Retreat alternatives, nonmarket costs diminish, due to the lack of detrimental effects on the beach, activities, and/or ecological values. It should be noted that the environmental values recognised throughout are very small – less than $100,000 in all scenarios, and not a deciding factor.

The following two tables (**Tables 9-10**) outline the benefits of the various options.

Table 9. Benefits by Option -20 Years, Almost Certain Hazard Line

OPTION	Community Benefits	Recreational / Aesthetic Benefits	Environmental Benefits	Total Benefits
Base Case: Business as Usual	$0	$1,710,127	$0	$1,710,127
Seawall Stage Ia	$33,735,312	$0	$0	$33,735,312
Seawall Stage Ib	$39,189,051	$0	$0	$39,189,051
Seawall Stage Ic	$44,642,790	$0	$0	$44,642,790
Seawall Stages I & II (a)	$34,338,246	$0	$0	$34,338,246
Seawall Stages I & II (b)	$39,791,984	$0	$0	$39,791,984
Seawall Stages I & II (c)	$45,245,723	$0	$0	$45,245,723
Planned Retreat	$16,605,692	$41,086,613	$38,567	$57,730,871
Planned Retreat w/ Easement	$16,605,692	$41,086,613	$38,567	$57,730,871

Table 10. Benefits by Option – 60 Years, Almost Certain Hazard Line

OPTION	Community Benefits	Recreational / Aesthetic Benefits	Environmental Benefits	Total Benefits
Base Case: Business as Usual	$0	$2,801,366	$0	$2,801,366
Seawall Stage Ia	$50,531,098	$0	$0	$50,531,098
Seawall Stage Ib	$55,984,836	$0	$0	$55,984,836
Seawall Stage Ic	$61,438,575	$0	$0	$61,438,575
Seawall Stages I & II (a)	$50,571,464	$0	$0	$50,571,464
Seawall Stages I & II (b)	$56,025,203	$0	$0	$56,025,203
Seawall Stages I & II (c)	$61,478,942	$0	$0	$61,478,942
Planned Retreat	$26,750,967	$67,304,165	$64,965	$94,120,097
Planned Retreat w/ Easement	$26,750,967	$67,304,165	$64,965	$94,120,097

Recreational benefits attach to the Base Case: Business as Usual option as beach-related uses persist for five years. The distribution of benefits is very different among the various options, with total benefits ranging from a low of $1.7 million to more than $57 million over the 20-year horizon (**Table 9**). For the 60-year horizon (**Table 10**) the range extends from $2.8 million to $94 million. While the community benefits and value of protected property of the various sea wall options exceed that of the planned retreat alternatives (e.g., roughly $50 million versus $27 million over 60 years), the latter alternatives offer the greatest total benefits, regardless of the project horizon.

Regarding community benefits for Options 2 and 3, it must be noted that there is high uncertainty associated with property values behind a revetment with no beach 20 years into the future. In contrast, as noted in the WorleyParsons 2010 report, there is a high degree of confidence associated with the Planned Retreat options, as the assets at risk are removed from storm erosion and coastline recession.

The option with the greatest Benefit to Cost ratio (i.e., the combination of least cost and greatest benefit) is the Planned Retreat with Easement approach, which represents $2.49 in benefits for each $1.00 in Costs, as shown in **Table 11.** None of the sea wall alternatives, nor the Base Case: Business as Usual option exhibited a Benefit Cost ratio greater than 1.0, meaning they would all be deemed economically infeasible as their costs outweigh their respective benefits.

Table 11. Cost-Benefit Summary by Option, Almost Certain Hazard Line – 20 Years

OPTION	Costs	Benefits	Benefit:Cost Ratio
Base Case: Business as Usual	$72,271,850	$1,710,127	0.02
Seawall Stage Ia	$47,851,050	$33,735,312	0.71
Seawall Stage Ib	$50,733,421	$39,189,051	0.77
Seawall Stage Ic	$53,615,792	$44,642,790	0.83
Seawall Stages I & II (a)	$84,242,981	$34,338,246	0.41
Seawall Stages I & II (b)	$87,125,352	$39,791,984	0.46
Seawall Stages I & II (c)	$90,007,724	$45,245,723	0.50
Planned Retreat	$29,118,397	$57,730,871	1.98
Planned Retreat w/ Easement	$23,149,932	$57,730,871	2.49

A Benefit Cost Ratio less than 1.0 implies that costs outweigh benefits

At the 60 year horizon (**Table 12**), the Planned Retreat with Easement option again exhibited the largest benefit cost ratio, at 3.01. Planned Retreat (without consideration of easements) had the second largest ratio at 2.22. As with the 20 year horizon, no sea wall options were feasible and all other benefit cost ratios were less than 1.0: the costs exceeded the benefits, and the net benefits would be less than zero.

Table 12. Cost-Benefit Summary by Option, Almost Certain Hazard Line – 60 Years

OPTION	Costs	Benefits	Benefit:Cost Ratio
Base Case: Business as Usual	$121,653,667	$2,801,366	0.02
Seawall Stage Ia	$69,907,652	$50,531,098	0.72
Seawall Stage Ib	$72,790,023	$55,984,836	0.77
Seawall Stage Ic	$75,672,394	$61,438,575	0.81
Seawall Stages I & II (a)	$125,474,366	$50,571,464	0.40
Seawall Stages I & II (b)	$128,356,737	$56,025,203	0.44
Seawall Stages I & II (c)	$131,239,108	$61,478,942	0.47
Planned Retreat	$42,348,487	$94,120,097	2.22
Planned Retreat w/ Easement	$31,320,099	$94,120,097	3.01

A Benefit Cost Ratio less than 1.0 implies that costs outweigh benefits

Table 13 and **Figure 3** describe the net present value for the Net Benefits of each option, and relative to the Base Case: Business as Usual; comparison of the various alternatives to Business as Usual scenario is straightforward; subtracting the Net Benefits of the Base Case from the Net Benefits of each alternative yields this comparison.

Table 13. Net Benefits Relative to the Base Case: Business as Usual, Almost Certain Hazard Line

	20 Years		60 Years	
OPTION	Net Benefits	Net Benefits Relative to Base Case	Net Benefits	Net Benefits Relative to Base Case
Base Case: Business as Usual	-$70,561,724	----	-$118,852,301	----
Seawall Stage Ia	-$14,115,738	$56,445,986	-$19,376,555	$99,475,746
Seawall Stage Ib	-$11,544,370	$59,017,354	-$16,805,187	$102,047,114
Seawall Stage Ic	-$8,973,002	$61,588,722	-$14,233,819	$104,618,482
Seawall Stages I & II (a)	-$49,904,736	$20,656,988	-$74,902,901	$43,949,399
Seawall Stages I & II (b)	-$47,333,368	$23,228,356	-$72,331,534	$46,520,767
Seawall Stages I & II (c)	-$44,762,000	$25,799,723	-$69,760,166	$49,092,135
Planned Retreat	$28,612,474	$99,174,198	$51,771,610	$170,623,910
Planned Retreat w/ Easement	$34,580,939	$105,142,663	$62,799,998	$181,652,298

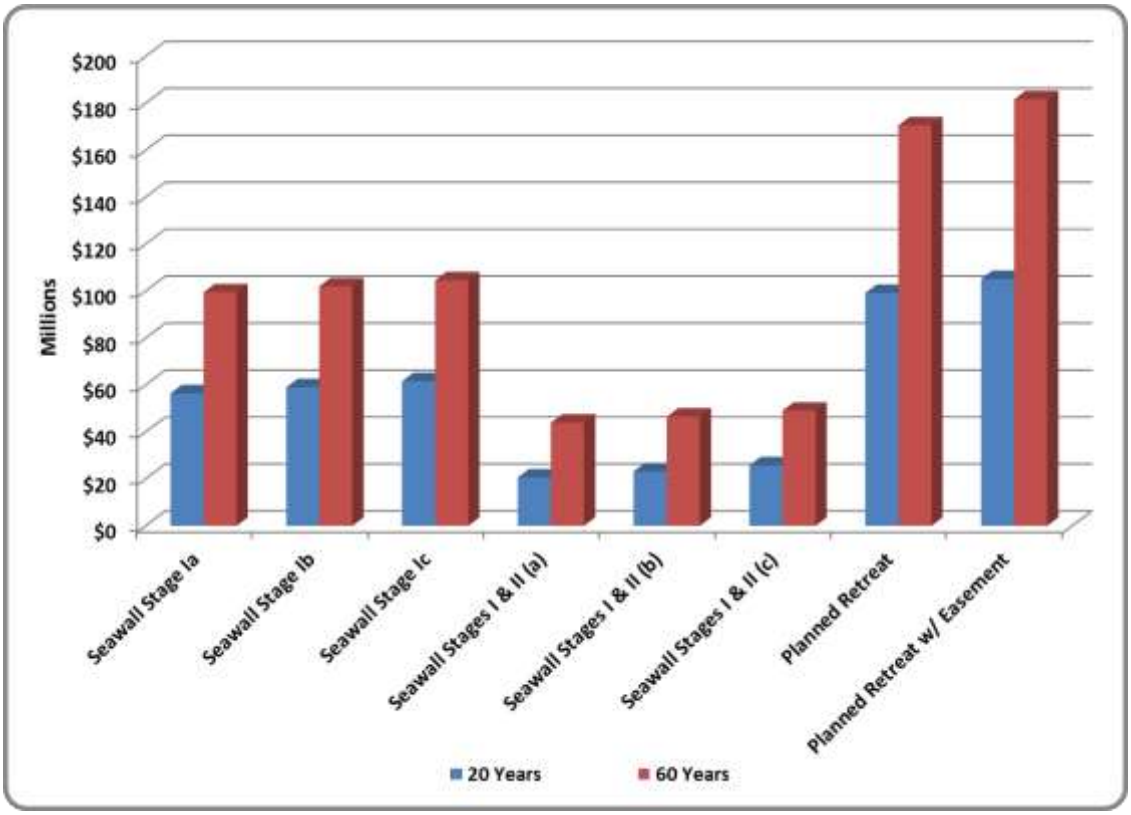

Figure 3. Distribution of Net Benefits Relative to Base Case: Business as Usual, Almost Certain Hazard Line

The above results apply to conditions under the "Almost Certain" hazard line. The following parallel information addresses the key results associated with the "Rare" hazard line. As shown in **Tables 14** and **15**, for the 7% discount rate, Benefit Cost ratios for sea wall options increase significantly over the "Almost Certain" line conditions:

Table 14. Cost-Benefit Summary by Option, Rare Hazard Line – 20 Years

OPTION	Costs	Benefits	Benefit:Cost Ratio
Base Case Business as Usual	$184,679,030	$1,710,127	0.01
Seawall Stage Ia	$47,996,953	$34,316,883	0.71
Seawall Stage Ib	$51,068,232	$44,867,861	0.88
Seawall Stage Ic	$54,050,171	$48,321,479	0.89
Seawall Stages I & II a	$86,236,274	$35,028,241	0.41
Seawall Stages I & II b	$89,903,572	$47,436,969	0.53
Seawall Stages I & II c	$93,377,422	$46,263,434	0.50
Planned Retreat	$31,283,955	$66,291,670	2.12
Planned Retreat w/ Easement	$26,699,733	$66,291,670	2.48

A Benefit Cost Ratio less than 1.0 implies that costs outweigh benefits

Table 15. Cost-Benefit Summary by Option, Rare Hazard Line – 60 Years

OPTION	Costs	Benefits	Benefit:Cost Ratio
Base Case: Business as Usual	$306,391,701	$2,801,366	0.01
Seawall Stage Ia	$70,109,166	$52,550,475	0.75
Seawall Stage Ib	$73,282,242	$65,671,617	0.90
Seawall Stage Ic	$76,308,970	$71,708,968	0.94
Seawall Stages I & II a	$125,074,193	$56,298,067	0.45
Seawall Stages I & II b	$131,724,397	$71,770,293	0.54
Seawall Stages I & II c	$135,181,220	$73,768,260	0.55
Planned Retreat	$47,136,600	$108,594,472	2.30
Planned Retreat w/ Easement	$36,450,923	$108,594,472	2.98

A Benefit Cost Ratio less than 1.0 implies that costs outweigh benefits

While the benefit cost ratios increase with a greater portion of the community deemed at risk, the relative ordering of options remains the same. The same holds true at the 60-year planning horizon.

Distributional Analysis

From a distributional perspective, the options offer different impacts on different groups. Under the Base Case: Business as Usual approach, the community and the landowners closest to the beach lose the most. Under the Seawall Stage 1 and Stage 2 scenarios, the landowners potentially suffer less loss - albeit subjective, given the lack of access to the beach and loss of beach amenity – and the larger community likely gives up most beach access and beach visitor activity, as well as surf break. Under the Planned Retreat scenarios, the landowners closest to the beach are likely to relocate to another community where they can continue to enjoy beachfront living. The community loses the potentially higher incomes associated with these households, their contribution to support of municipal services and rates, and some of the most expensive properties. At the same time, the community has the potential to retain its beach-related commerce, surf break, and enjoy a more orderly transition of the shoreline to its natural state. By removing the assets most at risk and allowing natural coastal processes to resume, without disrupting existing surf conditions, Old Bar potentially gains the benefits of a sea wall approach, over time, without the costs and sacrifice to the community – notwithstanding the reasonably imminent loss to several individual property owners.

All of the options impose substantial costs to the community. The scenarios do not include the relocation of the primary school or the exfiltration ponds, both are expected to add to eventual community costs; the extent of the existing analysis was limited to the area behind the proposed Stage 1 and 2 Sea walls. Development patterns of past decades are now recognised as detrimental to natural processes, with substantial costs to the communities affected. As a long term consideration, the community will need to determine what it most values, and allocate resources – or seek assistance from other financial sources – accordingly.

VII. Ranking of Options

The cost benefit analysis finds that the Planned Retreat with Easement option would be preferred. The following table provides the cost feasible options ranked by benefit cost ratio and by net benefits. Options above the heavy line are deemed economically feasible.

Table 16. Options Ranked by Benefit Cost Ratio, Almost Certain Hazard Line - 20 years

OPTION	Net Benefit Millions	Benefit/Cost Ratio
Planned Retreat w/ Easement	34.6	2.49
Planned Retreat	28.6	1.98
Sea Wall Stage I (c)	-9.0	0.83
Sea Wall Stage I (b)	-11.5	0.77
Sea Wall Stage I (a)	-14.1	0.70
Sea Wall Stages I & II (c)	-44.8	0.50
Sea Wall Stages I & II (b)	-47.3	0.46
Sea Wall Stages I & II (a)	-49.9	0.41
Base Case: Business as Usual	-70.6	0.02

The rankings are identical over the 60-year horizon, the difference being in the relative magnitudes of the net benefits. For the Planned Retreat with Easement option the net benefits rise to $181 million relative to the Base Case, while the net benefits of the Base Case: Business as Usual option decline to –$118 million. The net benefits of the Planned Retreat option (without easements) increased to $170 million relative to the Base Case or Business as Usual. With the longer horizon, both Planned Retreat options have the highest benefit cost ratios and the greatest net returns.

Among the Sea Wall options, the Stage 1 Sea Wall with the highest level of redevelopment (alternative “c”) had the least negative net benefits (i.e., smallest economic costs) and the highest benefit cost ratio, but still yielded a net cost (-$9 million). All of the Sea Wall options, regardless of degree of development of protected properties, had benefit cost ratios smaller than 1.0 and are not considered economically beneficial in the context of Old Bar.

VIII. Discussion

Sensitivity Analysis

Analyses were conducted at discount rates of 4% and 10% (i.e., ±-3%). At both the 20 year and 60 year horizons, the Planned Retreat alternatives maintained benefit cost ratios greater than 1.0, regardless of discount rate. Similarly, for the Base Case: Business as Usual option and the various sea wall options, the benefit cost ratios remained less than 1.0. Higher discount rates decreased the benefit cost ratios, compressing the range of values; a lower discount rate elevated the ratios and expanded the range. At the 60 year horizon, the benefit cost ratio of the Planned Retreat with Easement alternative declined, relative to a 20 year time frame and the ratios of the Planned Retreat (without compensation) increased. The ratios of Options 1-3 were fundamentally unchanged by the extension of analysis from 20 to 60 years. The results for the "**Almost Certain**" hazard line are summarized in **Tables 17-18**. Additional details regarding the benefits and costs associated with the two alternative discount rates assessed are provided in Appendix C.

Table 17. Benefit Cost Ratios at Various Discount Rates, Almost Certain Hazard Line - 20 years

OPTION	4%	7%	10%
Planned Retreat w/ Easement	3.15	2.49	4.93
Planned Retreat	2.14	1.98	1.83
Sea Wall Stage I (c)	0.82	0.83	0.84
Sea Wall Stage I (b)	0.78	0.77	0.77
Sea Wall Stage I (a)	0.73	0.70	0.69
Sea Wall Stages I & II (c)	0.50	0.50	0.51
Sea Wall Stages I & II (b)	0.46	0.46	0.46
Sea Wall Stages I & II (a)	0.42	0.41	0.40
Base Case: Business as Usual	0.02	0.02	0.02

Table 18. Benefit Cost Ratios at Various Discount Rates, Almost Certain Hazard Line - 60 years

OPTION	4%	7%	10%
Planned Retreat w/ Easement	2.90	3.01	3.68
Planned Retreat	2.46	2.22	1.98
Sea Wall Stage I (c)	0.80	0.81	0.82
Sea Wall Stage I (b)	0.78	0.77	0.76
Sea Wall Stage I (a)	0.75	0.72	0.69
Sea Wall Stages I & II (c)	0.45	0.47	0.49
Sea Wall Stages I & II (b)	0.44	0.44	0.44
Sea Wall Stages I & II (a)	0.42	0.40	0.39
Base Case: Business as Usual	0.02	0.02	0.02

Sensitivity analysis of the "**Rare**" hazard line yielded similar results. The options in Table 15 are ordered by their sequence *based on a 7% discount rate*; note that the sequences of sea wall options vary for both 4% and 10% in both the 20 year and 60 year assessments (**Tables 19-20)**:

Table 19. Benefit Cost Ratios at Various Discount Rates, Rare Hazard Line - 20 years

OPTION	4%	7%	10%
Planned Retreat w/ Easement	3.50	2.48	3.49
Planned Retreat	2.25	2.12	1.98
Sea Wall Stage I (c)	0.93	0.89	0.85
Sea Wall Stage I (b)	0.84	0.88	0.44
Sea Wall Stage I (a)	0.75	0.71	0.69
Sea Wall Stages I & II (c)	0.54	0.50	0.45
Sea Wall Stages I & II (b)	0.50	0.53	0.51
Sea Wall Stages I & II (a)	0.45	0.41	0.38
Base Case: Business as Usual	0.01	0.01	0.01

Table 20. Benefit Cost Ratios at Various Discount Rates, Rare Hazard Line - 60 years

OPTION	4%	7%	10%
Planned Retreat w/ Easement	3.37	2.98	3.57
Planned Retreat	2.48	2.30	2.11
Sea Wall Stage I (c)	0.92	0.94	0.88
Sea Wall Stage I (b)	0.83	0.90	0.52
Sea Wall Stage I (a)	0.75	0.75	0.71
Sea Wall Stages I & II (c)	0.61	0.55	0.48
Sea Wall Stages I & II (b)	0.55	0.54	0.52
Sea Wall Stages I & II (a)	0.50	0.45	0.40
Base Case: Business as Usual	0.01	0.01	0.01

In sum, under the "Rare" hazard line assessment, the sea wall options with maximum redevelopment are not economically feasible, regardless of discount rate.

Additional analyses were conducted that included redevelopment of all shoreline properties on Pacific Parade, disregarding the fact that those homes do not currently enjoy an unimpeded view of the beach and shoreline. Despite the "upgrading" of coastal properties not at risk, the resulting benefit cost ratios yielded higher values for the planned retreat alternatives and below 1.0 for alternative Stage 1 (c), the maximum development ratios option (with least cost among sea wall scenarios).

The purpose of the sensitivity analysis is to test assumptions embedded in the analysis, such as the discount rate or the properties subject to review. Depending upon when investments are undertaken and when benefits accrue, the net present values of alternatives (or select components therein) may change. In the case of Old Bar, the model of costs and benefits was stable and only marginally affected by modification of key assumptions about the "time value of money." The consistency of the benefit cost ratios under varying scenarios provides a stronger degree of confidence in the findings and conclusion.

Timing and Implementation of Options

To the extent that recession remains a current problem at Old Bar, the various benefits and costs outlined above are applicable for a limited time, perhaps only a few years before further impacts to beachfront homes accelerate: a decision needs to be made at some point. In addition, the

lifespan of the proposed revetment is a deferment of decisions about coastal management as the same questions will arise in 50-60 years. Further, any sea wall option with negative benefits (a benefit cost ratio smaller than 1.0) represents a decision to subsidise existing development.

Planned Retreat, with or without the use of easements resolves part of the above concerns. The associated community benefits and avoided costs (which were conservatively estimated) imply that the coastal resources of Old Bar may continue to generate public revenues and private value in excess of the losses tied to the eventual removal of a number of homes. If the rate of shoreline recession is low, the losses are put off into the future and community revenue persist; if the rate of recession increases, property losses affect the community more quickly (and at a greater present worth), but the significant costs of the sea wall (either stage) and its maintenance are avoided. Planned retreat also leaves open the possibility of sea wall implementation in future should the economics of the situation evolve.

Implementation of a Planned Retreat option may be handled by various means. The costs of (eventual) home removal and site restoration need to be funded, whether by the property owner at the time, the Council, or the State. Property rights considerations suggest the costs belong to the owner. However, were the property to be abandoned then either a lien holder (e.g., mortgager) or the community at large becomes responsible to ensure safety, removal of hazardous items, closure of utilities, etc. Similarly, the costs of site improvement, whether for safety, access, or ecological value (e.g., dune revegetation) would attach to a lien holder or to the community.

Public safety must be a consideration for all options. The community has an interest in maintaining its coastal population and their various economic contributions. Most councils have the authority to condemn property that is no longer safe for habitation or occupation, whether because of fire, a lapse in upkeep of critical supporting structure, etc. Once their foundations have been undercut and exposed, coastal homes would be subject to the same authority. Property poised to fall is a risk to the resident, adjacent residents, the utilities, and of course beach users.

Funding of Options

Regardless of the Option selected, allocation of costs must also be decided. As noted above, the direct costs are immediate and “out-of-pocket” for the affected parties and as such are more sensitive. Planned Retreat options bear several aspects of cost: compensation to ensure orderly retreat, either for direct purchase or for agreement to vacate in future, would need to be managed, as well as costs to stabilize and restore dunes for public use once immediately adjoining properties are vacated. Costs of the Base Case: Business as Usual option are not immediate and depend upon the rate of shoreline recession and the vacation of properties; costs of demolition may be borne by the property owner and the other impacts or costs are borne by the community. The Sea Wall options present opportunities for sharing of direct costs, if the Town, Council and State see mutual advantages for doing so. The community currently enjoys benefits indirectly by visitor and resident expenditures, maintained or increased property values, utility usage, etc. – if lost, a share of community income is lost which could otherwise contribute to funding.

In the US, funding options available to local governments include the capacity to levy special assessments, or to establish a special taxing district (municipal benefit services or taxing units) that are single purpose, in this case paying the costs of structure removal. These approaches may warrant consideration.

The Planned Retreat with Easement option offers a compromise to the circumstances where all costs are borne by either the public or by the private sector. An easement could include conditions that in addition to restrictions on new development or redevelopment after damage may require the grantor of the easement (the homeowner) to address the removal costs. Such easements are legally enforceable, so that abandonment may not offer relief. Part(or all) of the value of the easement, whether a one-time payment or a revenue stream, could be banked or placed into escrow to ensure the availability of funds at the time needed. Any surplus would be a net return to the homeowner.

Recognising that there are public costs regardless of coastal protection option pursued opens the door to identify solutions where all parties benefit to a degree and continue to have a financial stake. The analysis conducted herein set the costs for easements at 30% of the real property value (land and buildings). This starting point allows continued flow of (reduced) Council rate, utility revenues, and general contribution of homeowners to the local economy, but still imposes costs to the property owner for the eventual loss of remaining property value and demolition and abandonment.

IX. Recommendations for Improvement

Future research would be productive in a number of areas to further refine quantitative estimates of the social, environmental and economic trade-offs inherent in the policy choices available to the Old Bar Community. Following are several, in no particular order:

- Identification of appropriate hazard lines for use. In this case study, two hazard lines were evaluated; they were chosen in consultation with OEH and RoyalHaskoningDHV. Another Council could choose a more conservative line, or another engineering firm may model a more or less severe line. The approach used to model the hazard lines, and the lines chosen for consideration in analysis of the socioeconomic aspects of policy decisions, may be an appropriate area for adoption of consistent guidelines. Consistency would bolster confidence in results of the analysis, and reduce scrutiny based on scepticism of bias or distortion.
- The evaluation of non-structural options requires a degree of engineering investigation. Understanding the geology of the area to determine the extent to which non-structural options may affect outcomes over time is critical. While the inclination is to expend public monies over a potential design area only, to minimize costs, broadening the investigation area for preliminary analysis of coastal planning options may warrant further geotechnical investigation. In this case, bore holes outside the immediate design area were identified from work completed in very limited areas in 1981, but provided insufficient information to form judgments about whether resumption of natural coastal processes would provide any future protection from significant recession.
- As previously mentioned, adaptive management considerations that "buy time" allow future administrations and citizenry to revisit decisions which will have multi-generational impacts. In some cases, property purchases that eliminate immediate risk may profoundly alter the course of subsequent decisions, and options available to the community in future. It appears that new alternatives for financing coastal erosion responses are needed; existing financial vehicles link funding to capital projects exclusively. The ability to incur debt, assess special levies, or otherwise issue instruments that recognise broader impacts on the community would provide flexibility that currently does not exist, and warrants investigation.
- Cost benefit studies are improved with more data. While current project engineering reports can yield reliable short-term estimates for construction costs, operations and maintenance expenditures as well as potential decommissioning costs remain less certain (with estimates ranging from 20% - 80% of installation costs according to marine civil engineers). Inquiries pointed to UK and Belgium for better estimates of end of life costs, which would have different environments than Australia and may not be readily transferrable.

X. Conclusions

The Cost Benefit Analysis and Socioeconomic Profile conducted herein assessed the Old Bar options for dealing with drastic coastal erosion and recession. The Socio-economic Profiles emphasises that the economy of Old Bar is not dominated by coastal resources and does not exhibit the characteristics of a community with high coastal tourism activity. Consequently, the cost-benefit analysis of Old Bar relies more upon the intangible values of the beach, related environmental values, and the relationship of property values to the shoreline.

Comparing the options of Base Case: Business as Usual, the various combinations of sea wall installations or Planned Retreat, a Planned Retreat with Easement is the preferred alternative. The retreat option retains the beach amenity for the larger community, and extends the period during which beachfront owner can safely stay in their homes as long as possible without creating irreversible fiscal constraints for decades to come. The retreat with easement alternative also accommodates an Adaptive Management approach that allows decisions to be revisited in a future period, without eliminating options for future generations. Options 2 and 3 (sea walls) present a degree of irreversibility and potential (financial) commitment beyond the scheduled project life of 50-60 years. Once in place, replacement or major structural rehabilitation would be expected to ensure continuity of property protection. While this is ultimately a generational issue, it should be recognized that for Old Bar the sea wall option likely represents “permanent” commitment of resources until such time as replacement or expansion/elevation (to address higher sea levels) is practically infeasible.

Aside from the Base Case: Business as Usual option, Planned Retreat had smaller direct costs and therefore the least immediate impact to the parties funding the project. The benefits – community, recreational and environmental – of all of the options (except the Business as Usual option) were of comparable magnitudes over the 20 year horizon. At 60 years, however, the relative differences among benefits of the options diverged.

The Balmoral Group Australia emphasizes that the recommended option is unique to Old Bar. Substantive changes to any of the following may result in a different ranking and recommendation:

- Socio-economics of the community;
- Engineering design, cost and project lifespan;
- Number and the values of properties affected;
- Development controls;
- Degree of risk;
- Presence of sensitive or significant environmental resources; and
- Character and magnitude of commercial and recreational use of shoreline.

All of the above factors were considered in the analysis and may be expected to be different in other coastal communities. In particular, the socio-economic profile supports the conclusion that Old Bar is not dominated by beach-related economic activity. Consequently, the community benefits to a larger degree upon the numerous intangible values of beach. The conclusions for Old Bar may not be transferable and a similar analysis, reflecting the circumstances and conditions in any other community considering a sea wall, is warranted.

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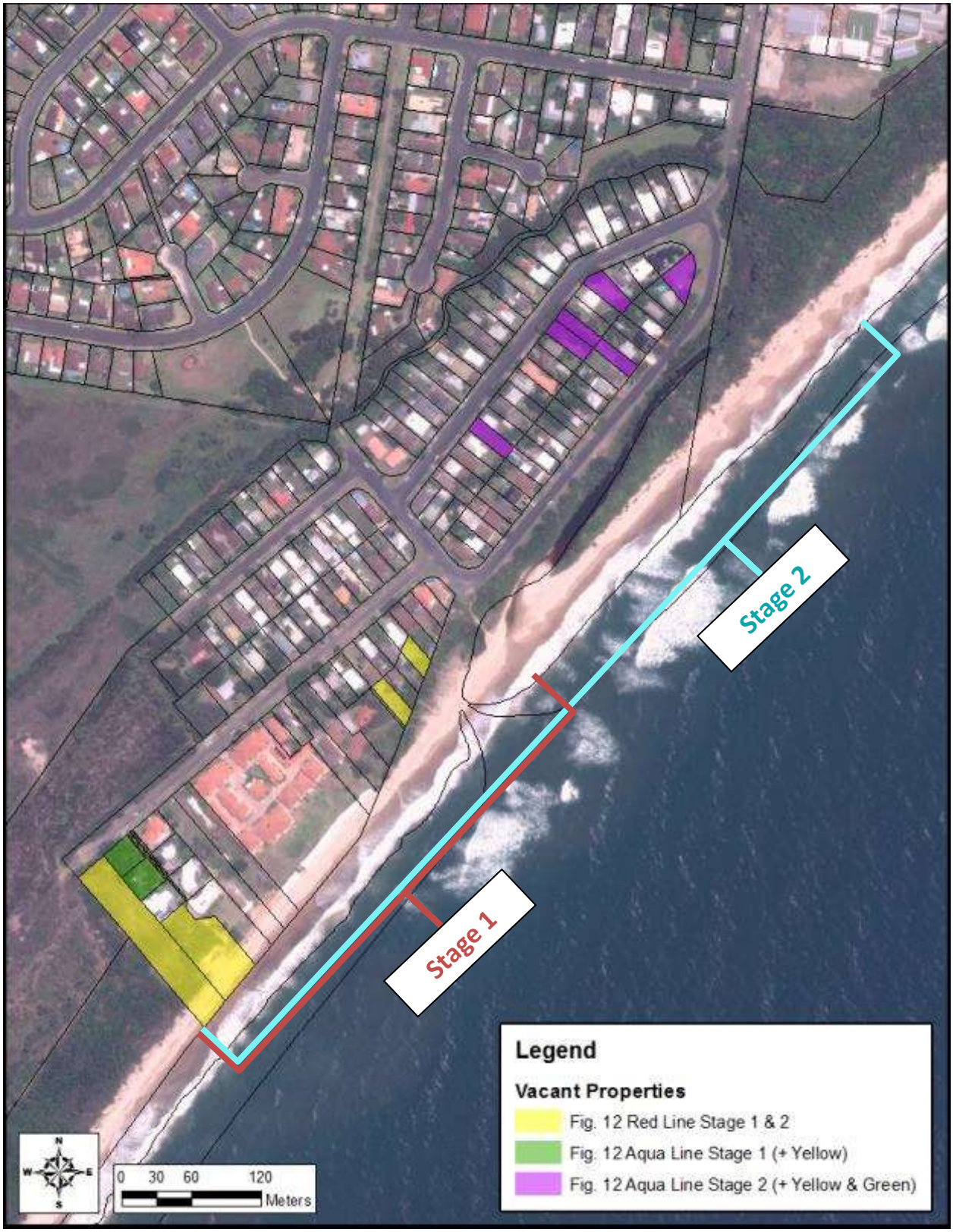
Appendix A. Properties Subject to Analysis

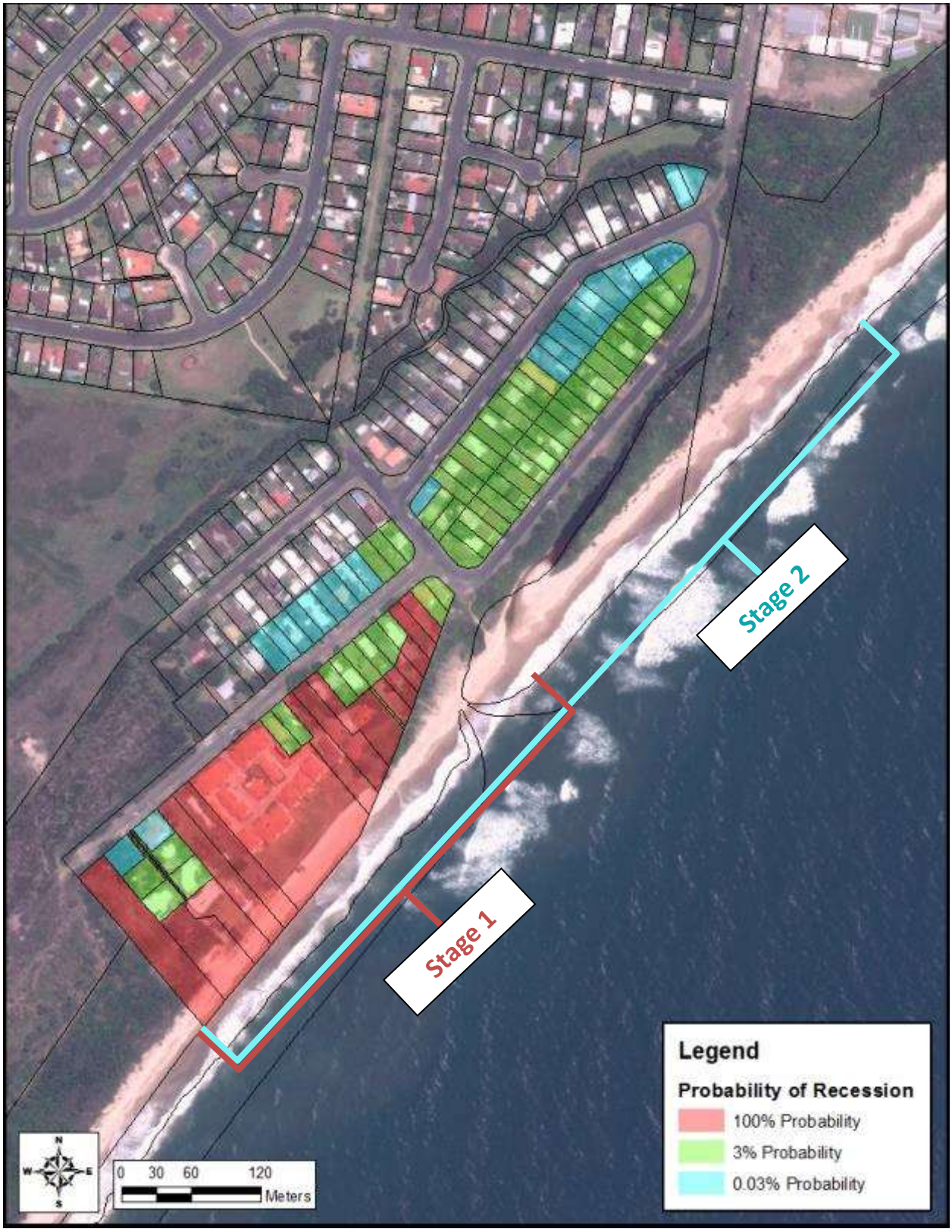
"Almost Certain", Stage 1 Properties

"Rare", Stage 1 Properties

"Rare", Stages 1 & 2 Properties



Vacant Properties Subject to Infill



Properties Subject to Impact under Three Probabilities of Recession

Appendix B. Summaries of Analyses of Options

Option 1. Base Case: Business as Usual

Benefit:Cost Analysis Summary

Business As Usual; 7%; Almost Certain Hazard Line

			20 Year Horizon		60 Year Horizon		
			Cost		Cost		
Direct Costs	Units	Quantity	One Time/ Annual Cost	Total Cost	One Time/ Annual Cost	Total Cost	Comments
Staff Costs: Professional	Per Hour	384	$12,480	$183,850	$12,480	$301,166	20% of One Staff Members time @$32.50 hourly, with salary & benefits, 20 year
Maintenance, Repair, Demolition costs for infrastructure		15	$126,951	$1,904,262	$207,959	$3,119,381	Maintenance costs related to and lost capital value of sewerage pipes, roads, etc. using proxy values of foregone utilities revenue over 20 years for protected properties
Direct Cost Sub-Total:				$2,088,113		$3,420,547	
			Cost		Cost		
Indirect Costs	Units	Quantity	One Time/ Annual Cost	Total Cost	One Time/ Annual Cost	Total Cost	Comments
Lost Revenues of Municipal / Utility Services	Per Household	15	$91,140	$1,367,106	$149,298	$2,239,463	Based on Annual Utility Costs per Household
Values of properties expected to be lost	Per Lot	15		$15,193,527		$15,193,527	Property values for properties within design life
Value of lost Council Rate	Per Lot	15	$574,691	$8,466,116	$574,691	$13,868,383	NPV of Rate
Value of Beach-Related Commerce (with multipliers)				$9,998,932		$20,145,309	Assumes displacement of activity after 5 years
Net economic contribution of displaced properties	Per Household	15	$1,369,823	$10,714,118	$2,243,913	$17,550,844	Lose residents from directly affected houses and their expenditures; larger effect with economic impact multiplier; based on reported income of $889/wk (from Profile), NPV over 20 years
Indirect Cost Sub-Total:				$45,739,799		$68,997,526	
			Cost		Cost		
Non-Market Costs	Units	Quantity	One Time/ Annual Cost	Total Cost	One Time/ Annual Cost	Total Cost	Comments
Loss of Streamside Habitat	Per Household	3,983	$2.48	$9,865	$4.17	$16,618	Impacts to terminus of Racecourse Creek
Predicted Loss of Listed Species	Per Household	3,983	$5.90	$23,491	$9.93	$39,570	Habitat Value for Listed Species
Direct Loss of Coastal Forest	Per Household	3,983	$1.31	$5,211	$2.20	$8,777	Displacement of dune ecosystem
Willingness-to-Pay for Beach Amenity (Resident Non-Surfing)	Per Household	3,983	$752	$2,994,383	$1,515	$6,032,922	Displacement of beach activity after 5 years
Willingness-to-Pay for Beach Amenity (Visitor Non-Surfing)				$21,410,990		$43,137,707	Displacement of activity after 5 years; per Greater Taree beach visitor data direct expenditure
Non-Market Cost Sub-Total:				$24,443,939		$49,235,594	
Costs Total:				$72,271,850		$121,653,667	

			Benefit		Benefit		
Community Benefits	Units	Quantity	Unit Price	Total Benefit	Unit Price	Total Benefit	Comments
None Assumed							
Change in Community Benefits Sub-Total:				$0		$0	
			Benefit		Benefit		
Recreational / Aesthetic Benefits	Units	Quantity	Unit Price	Total Benefit	Unit Price	Total Benefit	Comments
Willingness-to-Pay for Surfing	Per Surfer	100	$22,802	$1,710,127	$37,352	$2,801,366	Displacement of 25% beach activity
Recreational / Aesthetic Benefits Sub-Total:				$1,710,127		$2,801,366	
			Benefit		Benefit		
Environmental Benefits	Units	Quantity	Unit Price	Total Benefit	Unit Price	Total Benefit	Comments
None Assumed		-		$0		$0	
Environmental Benefits Sub-Total:				$0		$0	
Benefits Total:				$1,710,127		$2,801,366	

Results		
Net Benefits:	-$70,561,724	-$118,852,301
Benefit:Cost Ratio:	0.02	0.02

Option 2(a). Stage 1 Sea Wall

Benefit:Cost Analysis Summary

Stage 1 Sea Wall (Ia)

			20 Year Horizon		60 Year Horizon		
			Cost		Cost		
Direct Costs	Units	Quantity	One Time/ Annual Cost	Total Cost	One Time/ Annual Cost	Total Cost	Comments
Construction Costs (Assume Option 2)		-	$8,300,000	$8,300,000	$8,300,000	$8,300,000	From Royal Haskoning
Property Acquisition Costs (Easements)	Per Lot	15		$5,764,742		$5,764,742	ROW costs
O&M - Sand maintenance	Per 1,000 m^3	20	$20,000	$294,632	$20,000	$482,638	Royal Haskoning estimate
Decommissioning				$428,944		$28,718	
O&M - Non-sand	Per Revetment System	-	$41,500	$611,361	$166,000	$2,171,811	Royal Haskoning, assumes 0.5% per annum costs for first 20 years; 2.0% per annum years 21-60
Direct Cost Sub-Total:				$15,399,679		$16,747,909	
			Cost		Cost		
Indirect Costs	Units	Quantity	One Time/ Annual Cost	Total Cost	One Time/ Annual Cost	Total Cost	Comments
Cost of Providing Municipal Services	Per Lot	15	$80,842	$1,212,623	$132,427	$1,986,404	Cost for Residential Service, less Return on Investment
Loss of Council Rate due to ROW Easements	Per Lot	15	$184,921	$2,724,181	$184,921	$4,462,494	Property values with WP easement % applied
Indirect Cost Sub-Total:				$3,936,805		$6,448,897	
			Cost		Cost		
Non-Market Costs	Units	Quantity	One Time/ Annual Cost	Total Cost	One Time/ Annual Cost	Total Cost	Comments
Loss of Streamside Habitat	Per Household	3,983	$2.48	$4,933	$4.17	$8,309	Impacts to terminus of Racecoarse Creek; changes to natural flow will occur but are minor; WTP to preserve natural watercourse
Predicted Loss of Vegetation at Ends of Revetment	Per Household	3,983	$2.53	$5,041	$4.26	$8,491	Habitat value for Listed Species; WTP for preservation of waterbird habitat
Direct Loss of Coastal Forest	Per Household	3,983	$5.90	$11,745	$9.93	$19,785	Impact to dune ecosystem; WTP for preserved sensitive habitat
Willingness-to-Pay for Surfing	Per Surfer	100	$22,802	$1,140,084	$37,352	$1,867,577	Displacement of 50% beach activity
Willingness-to-Pay for Beach Amenity (Resident Non-Surfing)	Per Household	3,983	$1,195	$2,380,651	$1,958	$3,899,755	Displacement of 50% activity; per Greater Taree beach visitor data direct expenditure
Willingness-to-Pay for Beach Amenity (Visitor Non-Surfing)	Per Visitor			$17,022,571		$27,884,749	Allows for displacement of 50% activity; per Greater Taree beach visitor data direct expenditure
Value of Beach Related Commerce				$7,949,541		$13,022,178	Economic impact from direct expenditures; displacement of 50% activity
Non-Market Cost Sub-Total:				$28,514,566		$46,710,846	
Costs Total:				$47,851,050		$69,907,652	

			Benefit		Benefit		
Community Benefits	Units	Quantity	Unit Price	Total Benefit	Unit Price	Total Benefit	Comments
Values of protected properties	Per Lot	15		$10,658,353		$10,658,353	Blue line properties, less properties acquired
Values of protected public infrastructure	Per Lot	15	$126,951	$1,904,262	$207,959	$3,119,381	Proxy for replacement costs of sewerage pipes, roads, etc. using foregone utilities revenue over 20 years for protected properties
Value of continued municipal services	Per Household	15	$91,140	$1,367,106	$149,298	$2,239,463	Protected revenue streams for council services
Value of continued council rate (less that for easements)	Per Year	15	$333,645	$4,915,121	$333,645	$8,051,482	Rates from protected properties adjusted for ROW reduction
Salvage				$714,907		$47,863	
Net economic contribution of protected properties	Per Household	15	$945,037	$14,175,562	$1,760,970	$26,414,556	Do not lose 100% of income from beachfront properties; less municipal services accounted for elsewhere
Community Benefits Sub-Total:				$33,735,312		$50,531,098	
			Benefit		Benefit		
Recreational / Aesthetic Benefits	Units	Quantity	Unit Price	Total Benefit	Unit Price	Total Benefit	Comments
None Assumed; Reduction in Receation addressed above		-		$0		$0	
Recreational / Aesthetic Benefits Sub-Total:				$0		$0	
			Benefit		Benefit		
Environmental Benefits	Units	Quantity	Unit Price	Total Benefit	Unit Price	Total Benefit	Comments
None Assumed; Reduction in Environment addressed above		-		$0		$0	
Environmental Benefits Sub-Total:				$0		$0	
Benefits Total:				$33,735,312		$50,531,098	

Results			
Net Benefits:		-$14,115,738	-$19,376,555
Benefit:Cost Ratio:		0.71	0.72

Option 2(b). Stage 1 Sea Wall

Benefit:Cost Analysis Summary

Stage 1 Sea Wall (lb)

			20 Year Horizon		60 Year Horizon		
			Cost		Cost		
Direct Costs	Units	Quantity	One Time/ Annual Cost	Total Cost	One Time/ Annual Cost	Total Cost	Comments
Construction Costs (Assume Option 2)		-	$8,300,000	$8,300,000	$8,300,000	$8,300,000	From Royal Haskoning
Property Acquisition Costs (Easements)	Per Lot	15		$8,647,113		$8,647,113	ROW costs
O&M - Sand maintenance	Per 1,000 m ^{3}	20	$20,000	$294,632	$20,000	$482,638	Royal Haskoning estimate
Decommissioning				$428,944		$28,718	
O&M - Non-sand	Per Revetment System	-	$41,500	$611,361	$166,000	$2,171,811	Royal Haskoning, assumes 0.5% per annum costs for first 20 years; 2.0% per annum years 21-60
Direct Cost Sub-Total:				$18,282,050		$19,630,280	
			Cost		Cost		
Indirect Costs	Units	Quantity	One Time/ Annual Cost	Total Cost	One Time/ Annual Cost	Total Cost	Comments
Cost of Providing Municipal Services	Per Lot	15	$80,842	$1,212,623	$132,427	$1,986,404	Cost for Residential Service, less Return on Investment
Loss of Council Rate due to ROW Easements	Per Lot	15	$184,921	$2,724,181	$184,921	$4,462,494	Property values with WP easement % applied
Indirect Cost Sub-Total:				$3,936,805		$6,448,897	
			Cost		Cost		
Non-Market Costs	Units	Quantity	One Time/ Annual Cost	Total Cost	One Time/ Annual Cost	Total Cost	Comments
Loss of Streamside Habitat	Per Household	3,983	$2.48	$4,933	$4.17	$8,309	Impacts to terminus of Racecoarse Creek; changes to natural flow will occur but are minor; WTP to preserve natural watercourse
Predicted Loss of Vegetation at Ends of Revetment	Per Household	3,983	$2.53	$5,041	$4.26	$8,491	Habitat value for Listed Species; WTP for preservation of waterbird habitat
Direct Loss of Coastal Forest	Per Household	3,983	$5.90	$11,745	$9.93	$19,785	Impact to dune ecosystem; WTP for preserved sensitive habitat
Willingness-to-Pay for Surfing	Per Surfer	100	$22,802	$1,140,084	$37,352	$1,867,577	Displacement of 50% beach activity
Willingness-to-Pay for Beach Amenity (Resident Non-Surfing)	Per Household	3,983	$1,195	$2,380,651	$1,958	$3,899,755	Displacement of 50% activity; per Greater Taree beach visitor data direct expenditure
Willingness-to-Pay for Beach Amenity (Visitor Non-Surfing)	Per Visitor			$17,022,571		$27,884,749	Allows for displacement of 50% activity; per Greater Taree beach visitor data direct expenditure
Value of Beach Related Commerce				$7,949,541		$13,022,178	Economic impact from direct expenditures; displacement of 50% activity
Non-Market Cost Sub-Total:				$28,514,566		$46,710,846	
Costs Total:				$50,733,421		$72,790,023	

			Benefit		Benefit		
Community Benefits	Units	Quantity	Unit Price	Total Benefit	Unit Price	Total Benefit	Comments
Values of protected properties	Per Lot	15		$16,112,092		$16,112,092	Midpoint properties, less properties acquired ; .5(NPV low +NPV high)
Values of protected public infrastructure	Per Lot	15	$126,951	$1,904,262	$207,959	$3,119,381	Proxy for replacement costs of sewerage pipes, roads, etc. using foregone utilities revenue over 20 years for protected properties
Value of continued municipal services	Per Household	15	$91,140	$1,367,106	$149,298	$2,239,463	Protected revenue streams for council services
Value of continued council rate (less that for easements)	Per Year	15	$333,645	$4,915,121	$333,645	$8,051,482	Rates from protected properties adjusted for ROW reduction
Salvage				$714,907		$47,863	
Net economic contribution of protected properties	Per Household	15	$945,037	$14,175,562	$1,760,970	$26,414,556	Do not lose 100% of income from beachfront properties; less municipal services accounted for elsewhere
Community Benefits Sub-Total:				$39,189,051		$55,984,836	
			Benefit		Benefit		
Recreational / Aesthetic Benefits	Units	Quantity	Unit Price	Total Benefit	Unit Price	Total Benefit	Comments
None Assumed; Reduction in Receation addressed above		-		$0		$0	
Recreational / Aesthetic Benefits Sub-Total:				$0		$0	
			Benefit		Benefit		
Environmental Benefits	Units	Quantity	Unit Price	Total Benefit	Unit Price	Total Benefit	Comments
None Assumed; Reduction in Environment addressed above		-		$0		$0	
Environmental Benefits Sub-Total:				$0		$0	
Benefits Total:				$39,189,051		$55,984,836	

Results		
Net Benefits:	-$11,544,370	-$16,805,187
Benefit:Cost Ratio:	0.77	0.77

Option 2(c). Stage 1 Sea Wall

Benefit:Cost Analysis Summary

Stage 1 Sea Wall (Ic)

			20 Year Horizon		60 Year Horizon		
			Cost		Cost		
Direct Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost**	**One Time/ Annual Cost**	**Total Cost**	**Comments**
Construction Costs (Assume Option 2)		-	$8,300,000	$8,300,000	$8,300,000	$8,300,000	From Royal Haskoning
Property Acquisition Costs (Easements)	Per Lot	15		$11,529,484		$11,529,484	ROW costs
O&M - Sand maintenance	Per 1,000 m^3	20	$20,000	$294,632	$20,000	$482,638	Royal Haskoning estimate
Decommissioning				$428,944		$28,718	
O&M - Non-sand	Per Revetment System	-	$41,500	$611,361	$166,000	$2,171,811	Royal Haskoning, assumes 0.5% per annum costs for first 20 years; 2.0% per annum years 21-60
Direct Cost Sub-Total:				#########		#########	
			Cost		Cost		
Indirect Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost**	**One Time/ Annual Cost**	**Total Cost**	**Comments**
Cost of Providing Municipal Services	Per Lot	15	$80,842	$1,212,623	$132,427	$1,986,404	Cost for Residential Service, less Return on Investment
Loss of Council Rate due to ROW Easements	Per Lot	15	$184,921	$2,724,181	$184,921	$4,462,494	Property values with WP easement % applied
Indirect Cost Sub-Total:				$3,936,805		$6,448,897	
			Cost		Cost		
Non-Market Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost**	**One Time/ Annual Cost**	**Total Cost**	**Comments**
Loss of Streamside Habitat	Per Household	3,983	$2.48	$4,933	$4.17	$8,309	Impacts to terminus of Racecoarse Creek; changes to natural flow will occur but are minor; WTP to preserve natural watercourse
Predicted Loss of Vegetation at Ends of Revetment	Per Household	3,983	$2.53	$5,041	$4.26	$8,491	Habitat value for Listed Species; WTP for preservation of waterbird habitat
Direct Loss of Coastal Forest	Per Household	3,983	$5.90	$11,745	$9.93	$19,785	Impact to dune ecosystem; WTP for preserved sensitive habitat
Willingness-to-Pay for Surfing	Per Surfer	100	$22,802	$1,140,084	$37,352	$1,867,577	Displacement of 50% beach activity
Willingness-to-Pay for Beach Amenity (Resident Non-Surfing)	Per Household	3,983	$1,195	$2,380,651	$1,958	$3,899,755	Displacement of 50% activity; per Greater Taree beach visitor data direct expenditure
Willingness-to-Pay for Beach Amenity (Visitor Non-Surfing)	Per Visitor			$17,022,571		$27,884,749	Allows for displacement of 50% activity; per Greater Taree beach visitor data direct expenditure
Value of Beach Related Commerce				$7,949,541		$13,022,178	Economic impact from direct expenditures; displacement of 50% activity
Non-Market Cost Sub-Total:				$28,514,566		$46,710,846	
Costs Total:				$53,615,792		$75,672,394	

			Benefit		Benefit		
Community Benefits	**Units**	**Quantity**	**Unit Price**	**Total Benefit**	**Unit Price**	**Total Benefit**	**Comments**
Values of protected properties	Per Lot	15		$21,565,831		$21,565,831	Blue line properties, less properties acquired
Values of protected public infrastructure	Per Lot	15	$126,951	$1,904,262	$207,959	$3,119,381	Proxy for replacement costs of sewerage pipes, roads, etc. using foregone utilities revenue over 20 years for protected properties
Value of continued municipal services	Per Household	15	$91,140	$1,367,106	$149,298	$2,239,463	Protected revenue streams for council services
Value of continued council rate (less that for easements)	Per Year	15	$333,645	$4,915,121	$333,645	$8,051,482	Rates from protected properties adjusted for ROW reduction
Salvage				$714,907		$47,863	
Net economic contribution of protected properties	Per Household	15	$945,037	$14,175,562	$1,760,970	$26,414,556	Do not lose 100% of income from beachfront properties; less municipal services accounted for elsewhere
Community Benefits Sub-Total:				$44,642,790		$61,438,575	
			Benefit		Benefit		
Recreational / Aesthetic Benefits	**Units**	**Quantity**	**Unit Price**	**Total Benefit**	**Unit Price**	**Total Benefit**	**Comments**
None Assumed; Reduction in Receation addressed above		-		$0		$0	
Recreational / Aesthetic Benefits Sub-Total:				$0		$0	
			Benefit		Benefit		
Environmental Benefits	**Units**	**Quantity**	**Unit Price**	**Total Benefit**	**Unit Price**	**Total Benefit**	**Comments**
None Assumed; Reduction in Environment addressed above		-		$0		$0	
Environmental Benefits Sub-Total:				$0		$0	
Benefits Total:				$44,642,790		$61,438,575	

Results			
Net Benefits:		-$8,973,002	-$14,233,819	
Benefit:Cost Ratio:		0.83	0.81	

Option 3(a). Stages 1 & 2 Sea Walls

Benefit:Cost Analysis Summary

Stage 2 Sea Wall (IIa)

			20 Year Horizon		60 Year Horizon		
			Cost		Cost		
Direct Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost**	**One Time/ Annual Cost**	**Total Cost**	**Comments**
Construction Costs (Assume Option 2)		-	$15,300,000	$15,300,000	$15,300,000	$15,300,000	From Royal Haskoning
Property Acquisition Costs (Easements)	Lots	15		$5,764,742		$5,764,742	ROW costs
O&M - Sand maintenance	Per 1,000 m^3	20	$20,000	$294,632	$20,000	$482,638	Royal Haskoning estimate
Decommissioning				$790,704		$52,938	
O&M - Non-sand	Per Revetment System	-	$76,500	$1,126,967	$306,000	$4,003,459	Royal Haskoning, assumes 0.5% per annum costs for first 20 years; 2.0% per annum years 21-60
Direct Cost Sub-Total:				$23,277,045		$25,603,777	
			Cost		Cost		
Indirect Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost**	**One Time/ Annual Cost**	**Total Cost**	**Comments**
Cost of Providing Municipal Services	Per Lot	15	$80,842	$1,212,623	$132,427	$1,986,404	Cost for Residential Service, less Return on Investment
Loss of Council Rate due to Easements	Lots	15	$184,921	$2,724,181	$184,921	$4,462,494	Property values with WP easement % applied
Indirect Cost Sub-Total:				$3,936,805		$6,448,897	
			Cost		Cost		
Non-Market Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost**	**One Time/ Annual Cost**	**Total Cost**	**Comments**
Loss of Streamside Habitat	Per Household	3,983	$2.48	$9,865	$4.17	$16,618	Impacts to terminus of Racecourse Creek; changes to natural flow will occur but are minor; WTP to preserve natural watercourse
Predicted Loss of Vegetation at Ends of Revetment	Per Household	3,983	$2.53	$10,082	$4.26	$16,982	Habitat value for Listed Species; WTP for preservation of waterbird habitat
Direct Loss of Coastal Forest	Per Household	3,983	$5.90	$23,491	$9.93	$39,570	Impact to dune ecosystem; WTP for preserved sensitive habitat
Willingness-to-Pay for Surfing	Per Surfer	100	$22,802	$2,280,169	$37,352	$3,735,155	Displacement of beach activity
Willingness-to-Pay for Beach Amenity (Resident Non-Surfing)	Per Household	3,983	$1,195	$4,761,302	$1,958	$7,799,511	Displacement of activity; per Greater Taree beach visitor data direct expenditure
Willingness-to-Pay for Beach Amenity (Visitor Non-Surfing)	Per Visitor			$34,045,142		$55,769,499	Allows for displacement of 50% activity; per Greater Taree beach visitor data direct expenditure
Value of Beach Related Commerce				$15,899,081		$26,044,356	Economic impact from direct expenditures; displacement of activity
Non-Market Cost Sub-Total:				$57,029,131		$93,421,691	
Costs Total:				$84,242,981		$125,474,366	

			Benefit		Benefit		
Community Benefits	**Units**	**Quantity**	**Unit Price**	**Total Benefit**	**Unit Price**	**Total Benefit**	**Comments**
Values of protected properties	Per Lot	15		$10,658,353		$10,658,353	Blue line properties, less properties acquired
Values of protected public infrastructure	Per Lot	15	$126,951	$1,904,262	$207,959	$3,119,381	Proxy for replacement costs of sewerage pipes, roads, etc. using foregone utilities revenue over 20 years for protected properties
Value of continued municipal services	Per Household	15	$91,140	$1,367,106	$149,298	$2,239,463	Protected revenue streams for council services
Value of continued council rate (less that for easements)	Per Year	15	$333,645	$4,915,121	$333,645	$8,051,482	Rates from protected properties adjusted for ROW reduction
Salvage				$1,317,840		$88,230	
Net Economic contribution of protected properties	Per Household	15	$945,037	$14,175,562	$1,760,970	$26,414,556	Do not lose 100% of income from beachfront properties; less municipal services accounted for elsewhere
Community Benefits Sub-Total:				$34,338,246		$50,571,464	
			Benefit		Benefit		
Recreational / Aesthetic Benefits	**Units**	**Quantity**	**Unit Price**	**Total Benefit**	**Unit Price**	**Total Benefit**	**Comments**
None Assumed; Reduction in Receation addressed above		-					
Recreational / Aesthetic Benefits Sub-Total:				$0		$0	
			Benefit		Benefit		
Environmental Benefits	**Units**	**Quantity**	**Unit Price**	**Total Benefit**	**Unit Price**	**Total Benefit**	**Comments**
None Assumed; Reduction in Environment addressed above		-		$0		$0	
Environmental Benefits Sub-Total:				$0		$0	
Benefits Total:				$34,338,246		$50,571,464	

Results			
Net Benefits:		-$49,904,736	-$74,902,901
Benefit:Cost Ratio:		0.41	0.40

Option 3(b). Stages 1 & 2 Sea Walls

Benefit:Cost Analysis Summary

Stage 2 Sea Wall (IIb)

			20 Year Horizon		60 Year Horizon		
			Cost		Cost		
Direct Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost**	**One Time/ Annual Cost**	**Total Cost**	**Comments**
Construction Costs (Assume Option 2)		-	$15,300,000	$15,300,000	$15,300,000	$15,300,000	From Royal Haskoning
Property Acquisition Costs (Easements)	Lots	15		$8,647,113		$8,647,113	ROW costs
O&M - Sand maintenance	Per 1,000 m^3	20	$20,000	$294,632	$20,000	$482,638	Royal Haskoning estimate
Decommissioning				$790,704		$52,938	
O&M - Non-sand	Per Revetment System	-	$76,500	$1,126,967	$306,000	$4,003,459	Royal Haskoning, assumes 0.5% per annum costs for first 20 years; 2.0% per annum years 21-60
Direct Cost Sub-Total:				$26,159,416		$28,486,148	
			Cost		Cost		
Indirect Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost**	**One Time/ Annual Cost**	**Total Cost**	**Comments**
Cost of Providing Municipal Services	Per Lot	15	$80,842	$1,212,623	$132,427	$1,986,404	Cost for Residential Service, less Return on Investment
Loss of Council Rate due to Easements	Lots	15	$184,921	$2,724,181	$184,921	$4,462,494	Property values with WP easement % applied
Indirect Cost Sub-Total:				$3,936,805		$6,448,897	
			Cost		Cost		
Non-Market Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost**	**One Time/ Annual Cost**	**Total Cost**	**Comments**
Loss of Streamside Habitat	Per Household	3,983	$2.48	$9,865	$4.17	$16,618	Impacts to terminus of Racecourse Creek; changes to natural flow will occur but are minor; WTP to preserve natural watercourse
Predicted Loss of Vegetation at Ends of Revetment	Per Household	3,983	$2.53	$10,082	$4.26	$16,982	Habitat value for Listed Species; WTP for preservation of waterbird habitat
Direct Loss of Coastal Forest	Per Household	3,983	$5.90	$23,491	$9.93	$39,570	Impact to dune ecosystem; WTP for preserved sensitive habitat
Willingness-to-Pay for Surfing	Per Surfer	100	$22,802	$2,280,169	$37,352	$3,735,155	Displacement of beach activity
Willingness-to-Pay for Beach Amenity (Resident Non-Surfing)	Per Household	3,983	$1,195	$4,761,302	$1,958	$7,799,511	Displacement of activity; per Greater Taree beach visitor data direct expenditure
Willingness-to-Pay for Beach Amenity (Visitor Non-Surfing)	Per Visitor			$34,045,142		$55,769,499	Allows for displacement of 50% activity; per Greater Taree beach visitor data direct expenditure
Value of Beach Related Commerce				$15,899,081		$26,044,356	Economic impact from direct expenditures; displacement of activity
Non-Market Cost Sub-Total:				$57,029,131		$93,421,691	
Costs Total:				$87,125,352		$128,356,737	

			Benefit		Benefit		
Community Benefits	**Units**	**Quantity**	**Unit Price**	**Total Benefit**	**Unit Price**	**Total Benefit**	**Comments**
Values of protected properties	Per Lot	15		$16,112,092		$16,112,092	Midpoint properties, less properties acquired ; .5(NPV low +NPV high)
Values of protected public infrastructure	Per Lot	15	$126,951	$1,904,262	$207,959	$3,119,381	Proxy for replacement costs of sewerage pipes, roads, etc. using foregone utilities revenue over 20 years for protected properties
Value of continued municipal services	Per Household	15	$91,140	$1,367,106	$149,298	$2,239,463	Protected revenue streams for council services
Value of continued council rate (less that for easements)	Per Year	15	$333,645	$4,915,121	$333,645	$8,051,482	Rates from protected properties adjusted for ROW reduction
Salvage				$1,317,840		$88,230	
Net Economic contribution of protected properties	Per Household	15	$945,037	$14,175,562	$1,760,970	$26,414,556	Do not lose 100% of income from beachfront properties; less municipal services accounted for elsewhere
Community Benefits Sub-Total:				$39,791,984		$56,025,203	
			Benefit		Benefit		
Recreational / Aesthetic Benefits	**Units**	**Quantity**	**Unit Price**	**Total Benefit**	**Unit Price**	**Total Benefit**	**Comments**
None Assumed; Reduction in Receation addressed above		-					
Recreational / Aesthetic Benefits Sub-Total:				$0		$0	
			Benefit		Benefit		
Environmental Benefits	**Units**	**Quantity**	**Unit Price**	**Total Benefit**	**Unit Price**	**Total Benefit**	**Comments**
None Assumed; Reduction in Environment addressed above		-		$0		$0	
Environmental Benefits Sub-Total:				$0		$0	
Benefits Total:				$39,791,984		$56,025,203	

Results			
Net Benefits:	-$47,333,368	-$72,331,534	
Benefit:Cost Ratio:	0.46	0.44	

Option 3(c). Stages 1 & 2 Sea Walls

Benefit:Cost Analysis Summary

Stage 2 Sea Wall (IIc)

			20 Year Horizon		60 Year Horizon		
			Cost		Cost		
Direct Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost**	**One Time/ Annual Cost**	**Total Cost**	**Comments**
Construction Costs (Assume Option 2)		-	$15,300,000	$15,300,000	$15,300,000	$15,300,000	From Royal Haskoning
Property Acquisition Costs (Easements)	Lots	15		$11,529,484		$11,529,484	ROW costs
O&M - Sand maintenance	Per 1,000 m^3	20	$20,000	$294,632	$20,000	$482,638	Royal Haskoning estimate
Decommissioning				$790,704		$52,938	
O&M - Non-sand	Per Revetment System	-	$76,500	$1,126,967	$306,000	$4,003,459	Royal Haskoning, assumes 0.5% per annum costs for first 20 years; 2.0% per annum years 21-60
Direct Cost Sub-Total:				$29,041,787		$31,368,519	
			Cost		Cost		
Indirect Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost**	**One Time/ Annual Cost**	**Total Cost**	**Comments**
Cost of Providing Municipal Services	Per Lot	15	$80,842	$1,212,623	$132,427	$1,986,404	Cost for Residential Service, less Return on Investment
Loss of Council Rate due to Easements	Lots	15	$184,921	$2,724,181	$184,921	$4,462,494	Property values with WP easement % applied
Indirect Cost Sub-Total:				$3,936,805		$6,448,897	
			Cost		Cost		
Non-Market Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost**	**One Time/ Annual Cost**	**Total Cost**	**Comments**
Loss of Streamside Habitat	Per Household	3,983	$2.48	$9,865	$4.17	$16,618	Impacts to terminus of Racecourse Creek; changes to natural flow will occur but are minor; WTP to preserve natural watercourse
Predicted Loss of Vegetation at Ends of Revetment	Per Household	3,983	$2.53	$10,082	$4.26	$16,982	Habitat value for Listed Species; WTP for preservation of waterbird habitat
Direct Loss of Coastal Forest	Per Household	3,983	$5.90	$23,491	$9.93	$39,570	Impact to dune ecosystem; WTP for preserved sensitive habitat
Willingness-to-Pay for Surfing	Per Surfer	100	$22,802	$2,280,169	$37,352	$3,735,155	Displacement of beach activity
Willingness-to-Pay for Beach Amenity (Resident Non-Surfing)	Per Household	3,983	$1,195	$4,761,302	$1,958	$7,799,511	Displacement of activity; per Greater Taree beach visitor data direct expenditure
Willingness-to-Pay for Beach Amenity (Visitor Non-Surfing)	Per Visitor			$34,045,142		$55,769,499	Allows for displacement of 50% activity; per Greater Taree beach visitor data direct expenditure
Value of Beach Related Commerce				$15,899,081		$26,044,356	Economic impact from direct expenditures; displacement of activity
Non-Market Cost Sub-Total:				$57,029,131		$93,421,691	
Costs Total:				$90,007,724		$131,239,108	

			Benefit		Benefit		
Community Benefits	**Units**	**Quantity**	**Unit Price**	**Total Benefit**	**Unit Price**	**Total Benefit**	**Comments**
Values of protected properties	Per Lot	15		$21,565,831		$21,565,831	Blue line properties, less properties acquired
Values of protected public infrastructure	Per Lot	15	$126,951	$1,904,262	$207,959	$3,119,381	Proxy for replacement costs of sewerage pipes, roads, etc. using foregone utilities revenue over 20 years for protected properties
Value of continued municipal services	Per Household	15	$91,140	$1,367,106	$149,298	$2,239,463	Protected revenue streams for council services
Value of continued council rate (less that for easements)	Per Year	15	$333,645	$4,915,121	$333,645	$8,051,482	Rates from protected properties adjusted for ROW reduction
Salvage				$1,317,840		$88,230	
Net Economic contribution of protected properties	Per Household	15	$945,037	$14,175,562	$1,760,970	$26,414,556	Do not lose 100% of income from beachfront properties; less municipal services accounted for elsewhere
Community Benefits Sub-Total:				$45,245,723		$61,478,942	
			Benefit		Benefit		
Recreational / Aesthetic Benefits	**Units**	**Quantity**	**Unit Price**	**Total Benefit**	**Unit Price**	**Total Benefit**	**Comments**
None Assumed; Reduction in Receation addressed above		-					
Recreational / Aesthetic Benefits Sub-Total:				$0		$0	
			Benefit		Benefit		
Environmental Benefits	**Units**	**Quantity**	**Unit Price**	**Total Benefit**	**Unit Price**	**Total Benefit**	**Comments**
None Assumed; Reduction in Environment addressed above		-		$0		$0	
Environmental Benefits Sub-Total:				$0		$0	
Benefits Total:				$45,245,723		$61,478,942	

Results		
Net Benefits:	-$44,762,000	-$69,760,166
Benefit:Cost Ratio:	0.50	0.47

Option 4(a). Planned Retreat

Benefit:Cost Analysis Summary

Planned Retreat

			20 Year Horizon		60 Year Horizon		
			Cost		Cost		
Direct Costs	Units	Quantity	One Time/ Annual Cost	Total Cost	One Time/ Annual Cost	Total Cost	Comments
Staff Costs: Professional	Per Hour	384	$12,480	$183,850	$12,480	$301,166	20% of One Professional Staff Members time @$32.5, with salary & benefits
Property Acquisition Costs (plus Stamp Duty)	Lots	15		$15,848,405		$15,848,405	Based on 20-year schedule of shoreline erosion
Maintenance & Restoration costs for acquired parcels	Per Hectare	15	$88,920	$88,920	$88,920	$88,920	Restoration costs to return acquired properties to natural state; $2400/ac US costs for similar habitat; 1.2km x 60m area
Demolition of public infrastructure	Per Lot	15	$75,000	$75,000	$75,000	$75,000	Demo costs for acquired properties
Direct Cost Sub-Total:				$16,196,175		$16,313,491	
			Cost		Cost		
Indirect Costs	Units	Quantity	One Time/ Annual Cost	Total Cost	One Time/ Annual Cost	Total Cost	Comments
Lost Revenues of Municipal / Utility Services	Per Household	15	$57,318	$859,773	$115,482	$1,732,225	Foregone revenue years 6-20
Value of Lost Council Rate	Per Lot	15	$361,423	$5,421,346	$444,523	$6,667,851	Foregone revenue years 6-20
Economic contribution of displaced properties	Per Household	15	$861,481	$6,641,103	$1,735,666	$17,634,921	Lose residents and their expenditures; effect with economic impact multiplier years 6-20; assumes twice median income of $889/wk for shorefront properties
Indirect Cost Sub-Total:				$12,922,222		$26,034,996	
			Cost		Cost		
Non-Market Costs	Units	Quantity	One Time/ Annual Cost	Total Cost	One Time/ Annual Cost	Total Cost	Comments
None Assumed; Non-market values retained							
Non-Market Cost Sub-Total:				$0		$0	
Costs Total:				$29,118,397		$42,348,487	

			Benefit		Benefit		
Community Benefits	Units	Quantity	Unit Price	Total Benefit	Unit Price	Total Benefit	Comments
Value of Beach-Related Commerce (with multipliers)				$15,899,081		$26,044,356	Retains Beach Value
Values of protected public infrastructure	Per Lot	15	$47,107	$706,611	$47,107	$706,611	Proxy for replacement costs of sewerage pipes, roads, etc. using foregone utilities revenue over 20 years for protected properties
Change in Community Benefits Sub-Total:				$16,605,692		$26,750,967	
			Benefit		Benefit		
Recreational / Aesthetic Benefits	Units	Quantity	Unit Price	Total Benefit	Unit Price	Total Benefit	Comments
Willingness-to-Pay for Surfing	Per Surfer	100	$22,802	$2,280,169	$37,352	$3,735,155	Retains Surf Value
Willingness-to-Pay for Beach Amenity (Resident Non-Surfing)		3,983	$1,195	$4,761,302	$1,958	$7,799,511	Retains Beach Value
Willingness-to-Pay for Beach Amenity (Visitor Non-Surfing)				$34,045,142		$55,769,499	Retains Beach Value
Recreational / Aesthetic Benefits Sub-Total:				$41,086,613		$67,304,165	
			Benefit		Benefit		
Environmental Benefits	Units	Quantity	Unit Price	Total Benefit	Unit Price	Total Benefit	Comments
Protection of Streamside Habitat	Per Household	3,983	$2.48	$9,865	$4.17	$16,618	Avoids Impacts to terminus of Racecourse Creek; changes to natural flow will occur but are minor; WTP to preserve natural watercourse
Preserved Habitat of Listed Species	Per Household	3,983	$1.31	$5,211	$2.20	$8,777	Retains Habitat value for Listed Species; WTP for preservation of waterbird habitat
Preserved Sensitive Coastal Forest	Per Household	3,983	$5.90	$23,491	$9.93	$39,570	Avoids Impact to dune ecosystem; WTP for preserved sensitive habitat
Environmental Benefits Sub-Total:				$38,567		$64,965	
Benefits Total:				$57,730,871		$94,120,097	

Results			
Net Benefits:	$28,612,474	$51,771,610	
Benefit:Cost Ratio:	1.98	2.22	

Option 4(b). Planned Retreat with Easements

Benefit:Cost Analysis Summary

Planned Retreat with Easements

			20 Year Horizon		60 Year Horizon		
			Cost		Cost		
Direct Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost**	**One Time/ Annual Cost**	**Total Cost**	**Comments**
Staff Costs: Professional	Per Hour	384	$12,480	$183,850	$12,480	$301,166	20% of One Professional Staff Members time @$32.5, with salary & benefits
Property Acquisition Costs (Easement, not Buy Out)	Lots	15		$4,820,017		$4,820,017	30% for Properties in Coastal Hazard Zone
Maintenance & Restoration costs for acquired parcels	Per Hectare	15	$88,920	$88,920	$88,920	$88,920	Restoration costs to return acquired properties to natural state; $2400/ac US costs for similar habitat; 1.2km x 60m area
Demolition of public infrastructure		15	$75,000	$75,000	$75,000	$75,000	Demo costs for acquired properties
Direct Cost Sub-Total:				$5,167,787		$5,285,103	
			Cost		Cost		
Indirect Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost**	**One Time/ Annual Cost**	**Total Cost**	**Comments**
Lost Revenues of Municipal / Utility Services	Per Household	15	$57,318	$859,773	$115,482	$1,732,225	Foregone revenue years 6-20
Value of Lost Council Rate		15	$361,423	$5,421,346	$444,523	$6,667,851	Foregone revenue years 6-20
Economic contribution of displaced properties	Per Household	15	$861,481	$11,701,026	$1,735,666	$17,634,921	Lose residents and their expenditures years 6-20; effect with economic impact multiplier; assumes twice median income of $889/wk for shorefront properties
Indirect Cost Sub-Total:				$17,982,145		$26,034,996	
			Cost		Cost		
Non-Market Costs	**Units**	**Quantity**	**One Time/ Annual Cost**	**Total Cost**	**One Time/ Annual Cost**	**Total Cost**	**Comments**
None Assumed; Non-market values retained				$0		$0	
Non-Market Cost Sub-Total:				$0		$0	
Costs Total:				$23,149,932		$31,320,099	

			Benefit		Benefit		
Community Benefits	**Units**	**Quantity**	**Unit Price**	**Total Benefit**	**Unit Price**	**Total Benefit**	**Comments**
Value of Beach-Related Commerce (with multipliers)				$15,899,081		$26,044,356	Retains Beach Value
Values of protected public infrastructure	Per Lot	15	$47,107	$706,611	$47,107	$706,611	Proxy for replacement costs of sewerage pipes, roads, etc. using foregone utilities revenue over 20 years for protected properties
Change in Community Benefits Sub-Total:				$16,605,692		$26,750,967	
			Benefit		Benefit		
Recreational / Aesthetic Benefits	**Units**	**Quantity**	**Unit Price**	**Total Benefit**	**Unit Price**	**Total Benefit**	**Comments**
Willingness-to-Pay for Surfing	Per Surfer	100	$22,802	$2,280,169	$37,352	$3,735,155	Retains Surf Value
Willingness-to-Pay for Beach Amenity (Resident Non-Surfing)	Per Household	3,983	$1,195	$4,761,302	$1,958	$7,799,511	Retains Beach Value
Willingness-to-Pay for Beach Amenity (Visitor Non-Surfing)				$34,045,142		$55,769,499	Retains Beach Value
Recreational / Aesthetic Benefits Sub-Total:				$41,086,613		$67,304,165	
			Benefit		Benefit		
Environmental Benefits	**Units**	**Quantity**	**Unit Price**	**Total Benefit**	**Unit Price**	**Total Benefit**	**Comments**
Protection of Streamside Habitat	Per Household	3,983	$2.48	$9,865	$4.17	$16,618	Avoids Impacts to terminus of Racecourse Creek; changes to natural flow will occur but are minor; WTP to preserve natural watercourse
Preserved Habitat of Listed Species	Per Household	3,983	$1.31	$5,211	$2.20	$8,777	Retains Habitat value for Listed Species; WTP for preservation of waterbird habitat
Preserved Sensitive Coastal Forest	Per Household	3,983	$5.90	$23,491	$9.93	$39,570	Avoids Impact to dune ecosystem; WTP for preserved sensitive habitat
Environmental Benefits Sub-Total:				$38,567		$64,965	
Benefits Total:				$57,730,871		$94,120,097	

Results			
Net Benefits:	$34,580,939	$62,799,998	
Benefit:Cost Ratio:	2.49	3.01	

Appendix C. Sensitivity Analysis

20 Year Horizon Costs and Benefits, 4% Discount Rate, "Almost Certain" Hazard Line

BCA Summary

Options to Protect Old Bar from Coastal Erosion

20 Year Horizon

OPTION	Costs	Benefits	Benefit:Cost Ratio
Business as Usual	$90,922,183	$2,217,071	0.02
Seawall Phase Ia	$59,180,191	$42,957,372	0.73
Seawall Phase Ib	$62,063,483	$48,267,182	0.78
Seawall Phase Ic	$64,946,775	$53,576,991	0.82
Seawall Phases I & II (a)	$104,448,487	$44,022,305	0.42
Seawall Phases I & II (b)	$107,331,779	$49,332,115	0.46
Seawall Phases I & II (c)	$110,215,072	$54,641,925	0.50
Planned Retreat	$34,866,364	$74,674,077	2.14
Planned Retreat w/ Easement	$23,690,635	$74,674,077	3.15

60 Year Horizon Costs and Benefits, 4% Discount Rate, "Almost Certain" Hazard Line

BCA Summary

Options to Protect Old Bar from Coastal Erosion

60 Year Horizon

OPTION	Costs	Benefits	Benefit:Cost Ratio
Business as Usual	$235,169,873	$5,376,390	0.02
Seawall Phase Ia	$125,179,660	$94,349,229	0.75
Seawall Phase Ib	$128,062,952	$99,659,039	0.78
Seawall Phase Ic	$130,946,244	$104,968,848	0.80
Seawall Phases I & II (a)	$226,423,155	$94,571,129	0.42
Seawall Phases I & II (b)	$229,306,447	$99,880,939	0.44
Seawall Phases I & II (c)	$232,189,739	$105,190,748	0.45
Planned Retreat	$73,163,888	$180,008,478	2.46
Planned Retreat w/ Easement	$61,988,159	$180,008,478	2.90

20 Year Horizon Costs and Benefits, 10% Discount Rate, “Almost Certain” Hazard Line

CBA Summary

Options to Protect Old Bar from Coastal Erosion

20 Year Horizon

OPTION	Costs	Benefits	Benefit:Cost Ratio
Base Case: Business as Usual	$57,846,508	$1,365,561	0.02
Seawall Phase Ia	$40,674,418	$27,906,392	0.69
Seawall Phase Ib	$43,556,988	$33,471,664	0.77
Seawall Phase Ic	$46,439,559	$39,036,936	0.84
Seawall Phases I & II (a)	$71,067,855	$28,253,125	0.40
Seawall Phases I & II (b)	$73,950,425	$33,818,397	0.46
Seawall Phases I & II (c)	$76,832,995	$39,383,670	0.51
Planned Retreat	$25,296,473	$46,204,697	1.83
Planned Retreat w/ Easement	$9,761,720	$48,154,720	4.93

60 Year Horizon Costs and Benefits, 10% Discount Rate, “Almost Certain” Hazard Line

CBA Summary

Options to Protect Old Bar from Coastal Erosion

60 Year Horizon

OPTION	Costs	Benefits	Benefit:Cost Ratio
Base Case: Business as Usual	$77,108,451	$1,791,154	0.02
Seawall Phase Ia	$49,106,401	$34,074,104	0.69
Seawall Phase Ib	$51,988,972	$39,639,376	0.76
Seawall Phase Ic	$54,871,542	$45,204,648	0.82
Seawall Phases I & II (a)	$86,907,911	$34,081,804	0.39
Seawall Phases I & II (b)	$89,790,481	$39,647,076	0.44
Seawall Phases I & II (c)	$92,673,052	$45,212,348	0.49
Planned Retreat	$30,456,234	$60,399,621	1.98
Planned Retreat w/ Easement	$17,156,464	$63,163,813	3.68

20 Year Horizon Costs and Benefits, 4% Discount Rate, "Rare" Hazard Line

BCA Summary

Options to Protect Old Bar from Coastal Erosion

20 Year Horizon

OPTION	Costs	Benefits	Benefit:Cost Ratio
Base Case: Business as Usual	$241,232,080	$2,217,071	0.01
Seawall Stage Ia	$59,363,384	$44,292,272	0.75
Seawall Stage Ib	$62,481,953	$52,470,009	0.84
Seawall Stage Ic	$65,484,699	$60,643,538	0.93
Seawall Stages I & II a	$105,960,954	$47,395,654	0.45
Seawall Stages I & II b	$109,507,948	$54,366,011	0.50
Seawall Stages I & II c	$113,054,942	$61,293,191	0.54
Planned Retreat	$38,149,011	$85,931,510	2.25
Planned Retreat w/ Easement	$24,582,750	$85,931,510	3.50

60 Year Horizon Costs and Benefits, 4% Discount Rate, "Rare" Hazard Line

BCA Summary

Options to Protect Old Bar from Coastal Erosion

60 Year Horizon

OPTION	Costs	Benefits	Benefit:Cost Ratio
Base Case: Business as Usual	$572,977,112	$5,376,390	0.01
Seawall Stage Ia	$125,540,746	$93,960,608	0.75
Seawall Stage Ib	$128,954,035	$107,619,568	0.83
Seawall Stage Ic	$132,086,454	$121,406,545	0.92
Seawall Stages I & II a	$228,328,098	$114,844,883	0.50
Seawall Stages I & II b	$231,940,501	$128,608,443	0.55
Seawall Stages I & II c	$235,552,904	$142,641,514	0.61
Planned Retreat	$84,038,110	$208,386,692	2.48
Planned Retreat w/ Easement	$61,911,983	$208,386,692	3.37

20 Year Horizon Costs and Benefits, 7% Discount Rate, “Rare” Hazard Line

BCASummary

Options to Protect Old Bar from Coastal Erosion

20 Year Horizon

OPTION	Costs	Benefits	Benefit:Cost Ratio
Base Case Business as Usual	$184,679,030	$1,710,127	0.01
Seawall Stage Ia	$47,996,953	$34,316,883	0.71
Seawall Stage Ib	$51,068,232	$44,867,861	0.88
Seawall Stage Ic	$54,050,171	$48,321,479	0.89
Seawall Stages I & II a	$86,236,274	$35,028,241	0.41
Seawall Stages I & II b	$89,903,572	$47,436,969	0.53
Seawall Stages I & II c	$93,377,422	$46,263,434	0.50
Planned Retreat	$31,283,955	$66,291,670	2.12
Planned Retreat w/ Easement	$26,699,733	$66,291,670	2.48

60 Year Horizon Costs and Benefits, 7% Discount Rate, “Rare” Hazard Line

BCA

Options to Protect Old Bar from Coastal Erosion

60 Year Horizon

OPTION	Costs	Benefits	Benefit:Cost Ratio
Base Case: Business as Usual	$306,391,701	$2,801,366	0.01
Seawall Stage Ia	$70,109,166	$52,550,475	0.75
Seawall Stage Ib	$73,282,242	$65,671,617	0.90
Seawall Stage Ic	$76,308,970	$71,708,968	0.94
Seawall Stages I & II a	$125,074,193	$56,298,067	0.45
Seawall Stages I & II b	$131,724,397	$71,770,293	0.54
Seawall Stages I & II c	$135,181,220	$73,768,260	0.55
Planned Retreat	$47,136,600	$108,594,472	2.30
Planned Retreat w/ Easement	$36,450,923	$108,594,472	2.98

20 Year Horizon Costs and Benefits, 10% Discount Rate, “Rare” Hazard Line

BCA Summary

Options to Protect Old Bar from Coastal Erosion

20Year Horizon

OPTION	Costs	Benefits	Benefit:Cost Ratio
Base Case : Business as Usual	$148,383,179	$1,365,631	0.01
Seawall Stage Ia	$40,815,618	$28,067,430	0.69
Seawall Stage Ib	$43,854,760	$19,380,206	0.44
Seawall Stage Ic	$46,901,213	$39,968,525	0.85
Seawall Stages I & II a	$72,849,508	$27,555,381	0.38
Seawall Stages I & II b	$76,483,772	$32,170,100	0.42
Seawall Stages I & II c	$80,125,412	$36,124,999	0.45
Planned Retreat	$26,725,465	$52,945,346	1.98
Planned Retreat w/ Easement	$15,187,997	$52,945,346	3.49

60 Year Horizon Costs and Benefits, 10% Discount Rate, “Rare” Hazard Line

BCA Summary

Options to Protect Old Bar from Coastal Erosion

60Year Horizon

OPTION	Costs	Benefits	Benefit:Cost Ratio
Base Case: Business as Usual	$164,930,973	$1,791,154	0.01
Seawall Stage Ia	$49,271,678	$34,758,392	0.71
Seawall Stage Ib	$52,350,515	$27,212,016	0.52
Seawall Stage Ic	$55,438,942	$48,965,137	0.88
Seawall Stages I & II a	$88,855,995	$35,143,995	0.40
Seawall Stages I & II b	$92,531,755	$41,175,259	0.44
Seawall Stages I & II c	$96,217,189	$46,588,819	0.48
Planned Retreat	$32,907,453	$69,443,954	2.11
Planned Retreat w/ Easement	$19,476,281	$69,443,954	3.57

Appendix D. Socio-Economic Profile: Old Bar

COST-BENEFIT ANALYSIS OF OPTIONS TO PROTECT OLD BAR FROM COASTAL EROSION:

Socioeconomic Profile

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Old Bar Socio-Economic Profile

Economic Services and Reform Section

This profile is prepared in support of a cost benefit analysis, and is intended to identify socioeconomic data that is available to support such an analysis, particularly in the context of coastal erosion issues. Old Bar is a coastal community in the Greater Taree Local Government Area (LGA) region of New South Wales with a resident population of 9,559 at the time of the 2011 Census.

The data used for this regional profile was obtained from the most recent Census of Population & Housing for Old Bar, at the SA2 level (Statistical Area 2). The main dataset used was the Basic Community Profile (based on place of usual residence) and was collected in August 2011.

To identify wider regional socio-economic trends the SA2 of Old Bar was compared with the wider Greater Taree (LGA) region, and the State of NSW.

Population

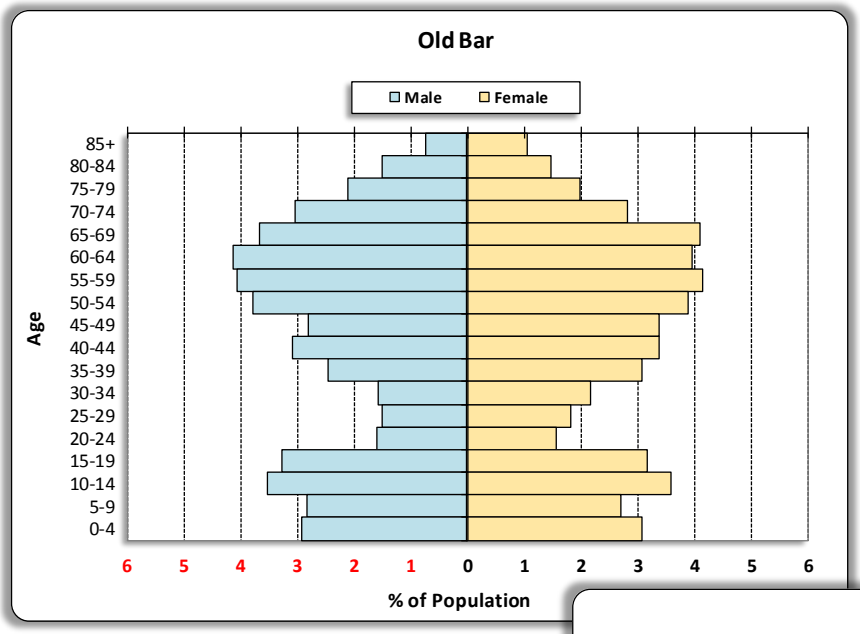
Table 1 shows that the median age of Old Bar residents is slightly higher than in the wider Greater Taree region, as well as for the state overall. Old Bar has about the same percentage of its population over the age of 60 as the Greater Taree region, but a much higher percentage than NSW. The average household size in both Old Bar and Greater Taree is slightly smaller than the state average, which is consistent with an older population.

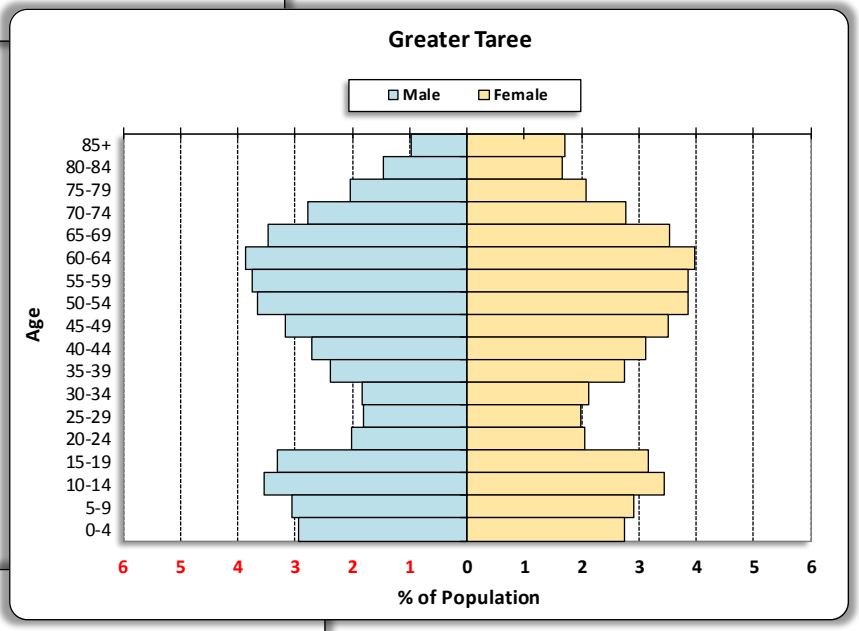
Table 1: Basic statistics

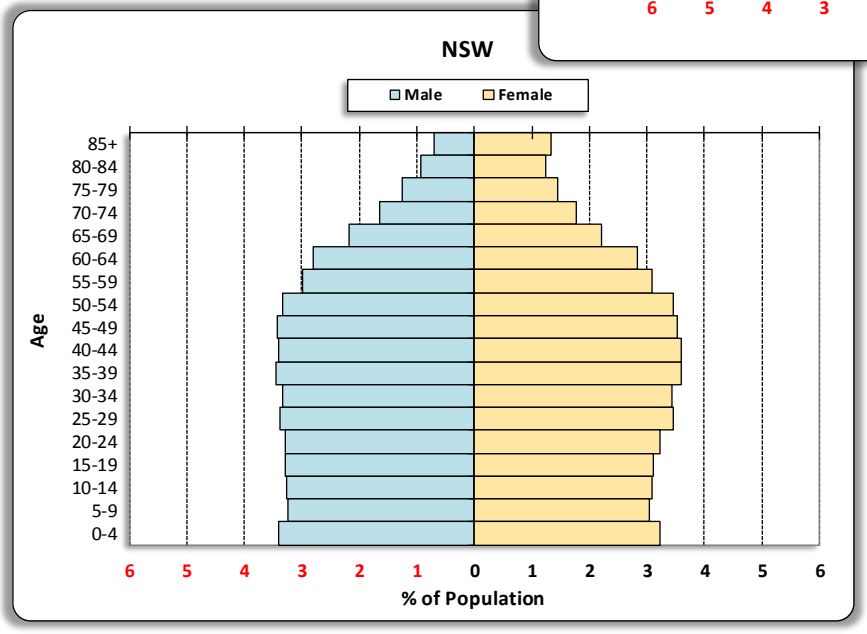
Name	Old Bar	Greater Taree	NSW
Type	SA2	LGA	State
Median age of persons	47	46	38
Proportion of males to total population	48.6%	48.7%	49.3%
Proportion of females to total population	51.4%	51.3%	50.7%
Over 60 as a proportion of total population	30.6%	30.3%	20.4%
Average household size	2.4	2.4	2.6

Figure 1 shows the age-profile of residents in Old Bar, the wider Greater Taree region and for NSW as a whole. The population in both Old Bar and the Greater Taree region have a significant proportion of very young residents and older residents aged 50-84 years. Both communities have gaps in the younger working age population: 20-34 year olds. Old Bar's population spikes in 10-19 year olds and 50-64 year olds, and is likely to have relatively more families with teenage dependent children than NSW as a whole.

Figure 1: Population by Age



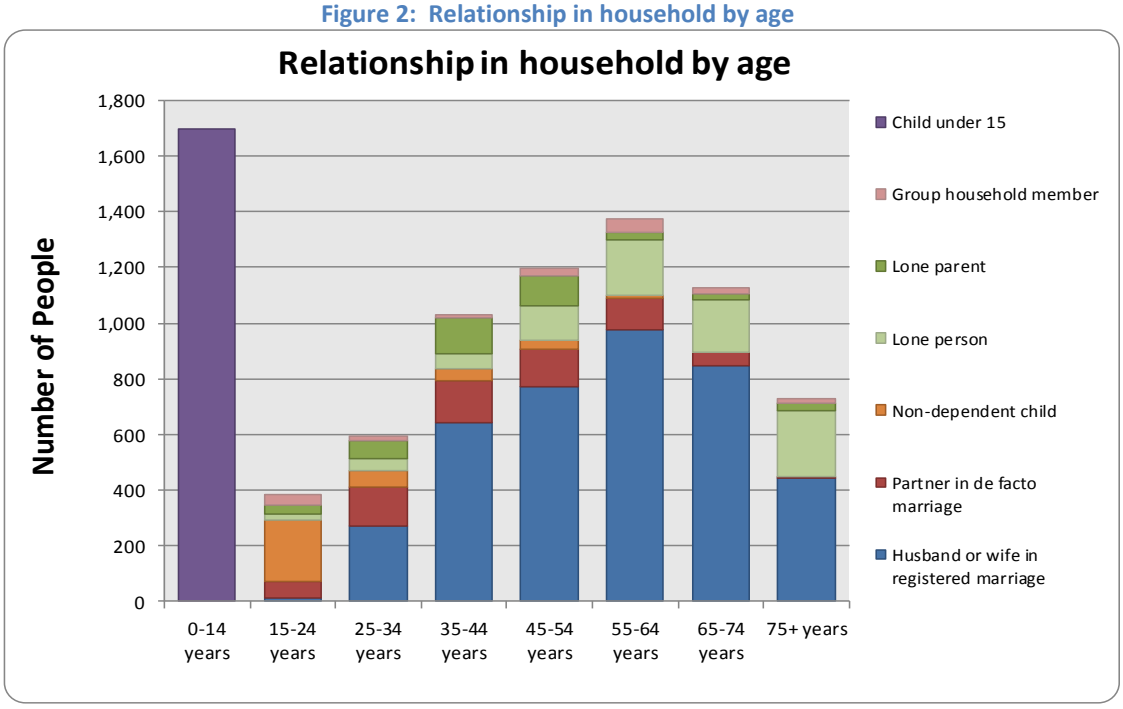




Household Structure

Figure 2 shows household types by age in Old Bar. It is clear that coupled partners with or without children dominate younger households, and that lone-person households represent an increasing proportion of the older population; most noticeable for those aged 45+ years.

Figure 2: Relationship in household by age



Note: to improve clarity the table omits 'other related individuals' and 'dependent students aged 15-24'.

Employment

Table 2 shows that in 2011, Old Bar's unemployment rate (7.4%) was considerably higher than the NSW average (5.9%), however lower than Greater Taree (9.3%). **Figure 3** shows that in 2011, the proportion of Old Bar residents in the labour force is steady from 20 to 54 years of age, but quickly declines after age 54. About half of younger participants (15-19) had joined the labour force in 2011, higher than Greater Taree or NSW.

Table 2: Labour Force Statistics

	Name	Old Bar	Greater Taree	NSW
	Type	SA2	LGA	State
Employed full-time (number)		2,001	9,106	2,007,925
Employed part-time (number)		1,393	6,150	939,464
Unemployed (number)		294	1,673	196,526
Total labour force (number)		3,950	18,071	3,334,857
Not in the labour force (number)		3,509	17,840	1,933,275
Unemployment rate (unemployed as a % of labour force)		7.4%	9.3%	5.9%
Participation rate (labour force as % of persons aged 15+)		50.8%	47.7%	59.7%
Employment rate (no. employed as % of persons aged 15+)		46.3%	42.3%	54.9%
Employed full-time (as % of total employed)		55.6%	56.8%	65.5%
Employed part-time (as % of total employed)		38.7%	38.4%	30.6%

Note: this table excludes employed persons who did not work any hours in the week prior to Census Night and employed persons who did not state their hours worked. This table excludes all residents aged 0-14 years

Overall, the participation rate in Old Bar (50.8%) was higher than in Greater Taree (47.7%), but lower than in NSW (59.7%). Since higher participation rates are usually associated with periods of strong job growth, the economy in Old Bar in 2011 appears to have been relatively stagnant. While at first glance this might indicate a stagnation concentrated in tourism, Old Bar's devotion to tourism is not as significant as expected. **Figure 4** shows that the proportion of Old Bar residents who are working or actively seeking work is consistently higher than for Greater Taree for all age groups under 65 years. Old Bar's participation rate is competitive with NSW's in ages under 65. Similar order is preserved in terms of income (Fig. 7); Greater Taree has a greater proportion of residents with lower incomes compared to Old Bar while Old Bar has a greater proportion of residents with lower incomes when compared to the entire state. NSW leads in higher income, followed by Old Bar and Greater Taree, in that order. With higher gross family incomes (Fig. 8), NSW appears to have the highest labor force participation rate *within* family units as well. Figure 4 shows that Old Bar residents typically have an early retirement age, which could further contribute to economic stagnation.

Figure 3: Labour Force Participation vs. Population in That Age Group

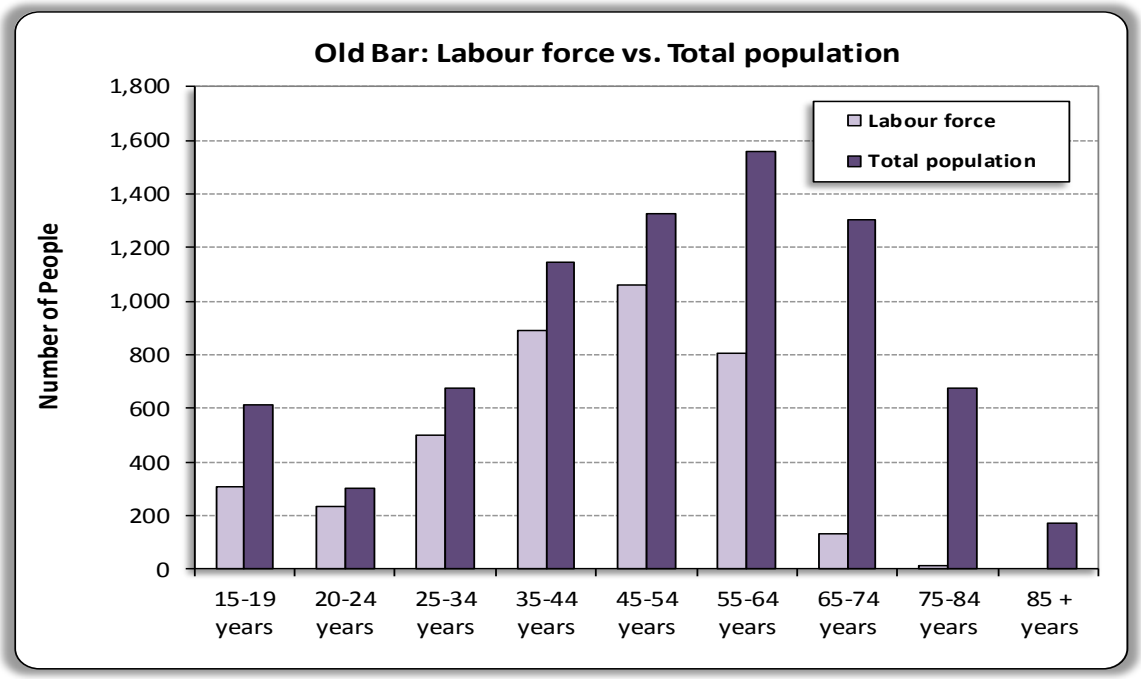


Figure 4: Labour Force Participation by Age

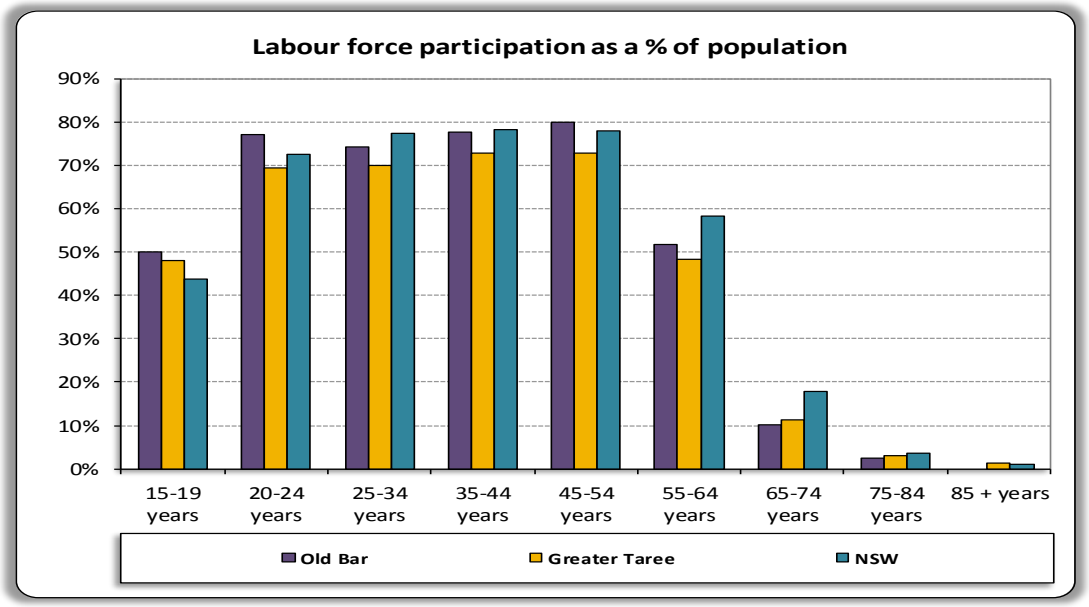
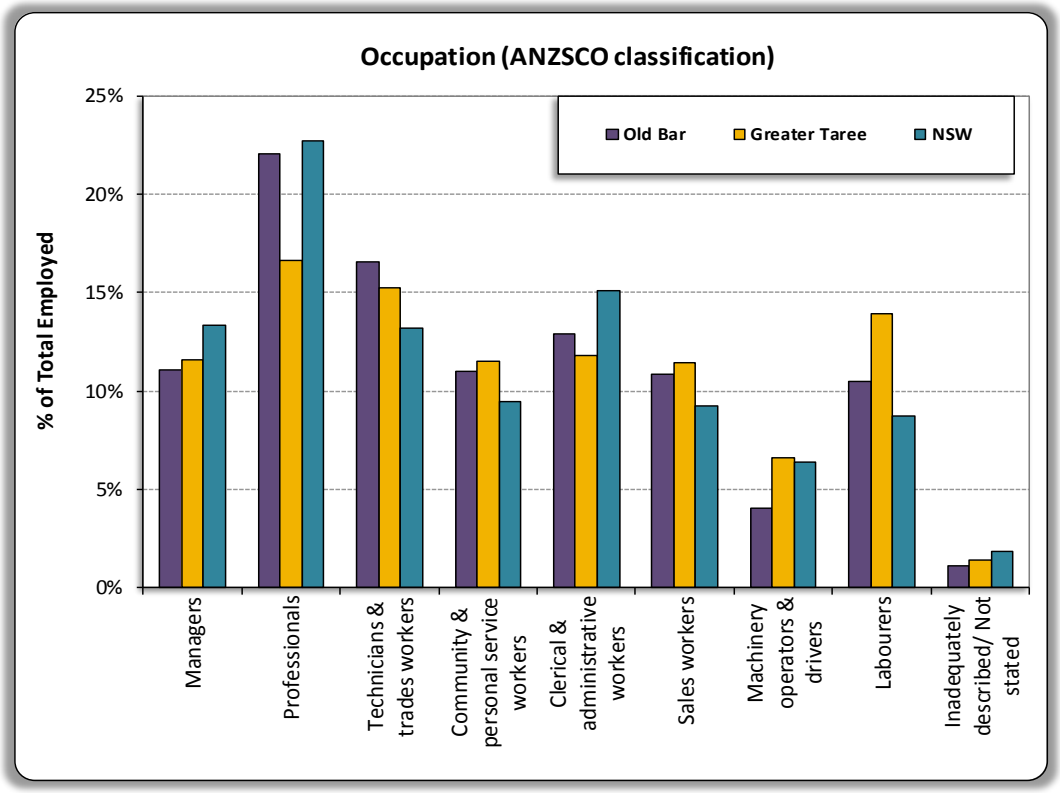


Figure 5 compares the relative share of workers in each occupation for Old Bar, Greater Taree and for NSW as a whole. In 2011, more workers in Old Bar were engaged as professionals, technicians and trades workers, and clerical and administrative workers than in the wider Greater Taree region. Meanwhile, relatively fewer workers in Old Bar were engaged as managers, sales workers, community and personal service workers, machinery operators and drivers, and labourers. As Old Bar exceeds Greater Taree's labor force participation by professionals, technicians and trade workers, while lagging behind its participation by machinery operators and labourers; Old Bar appears to employ a higher-skill workforce.

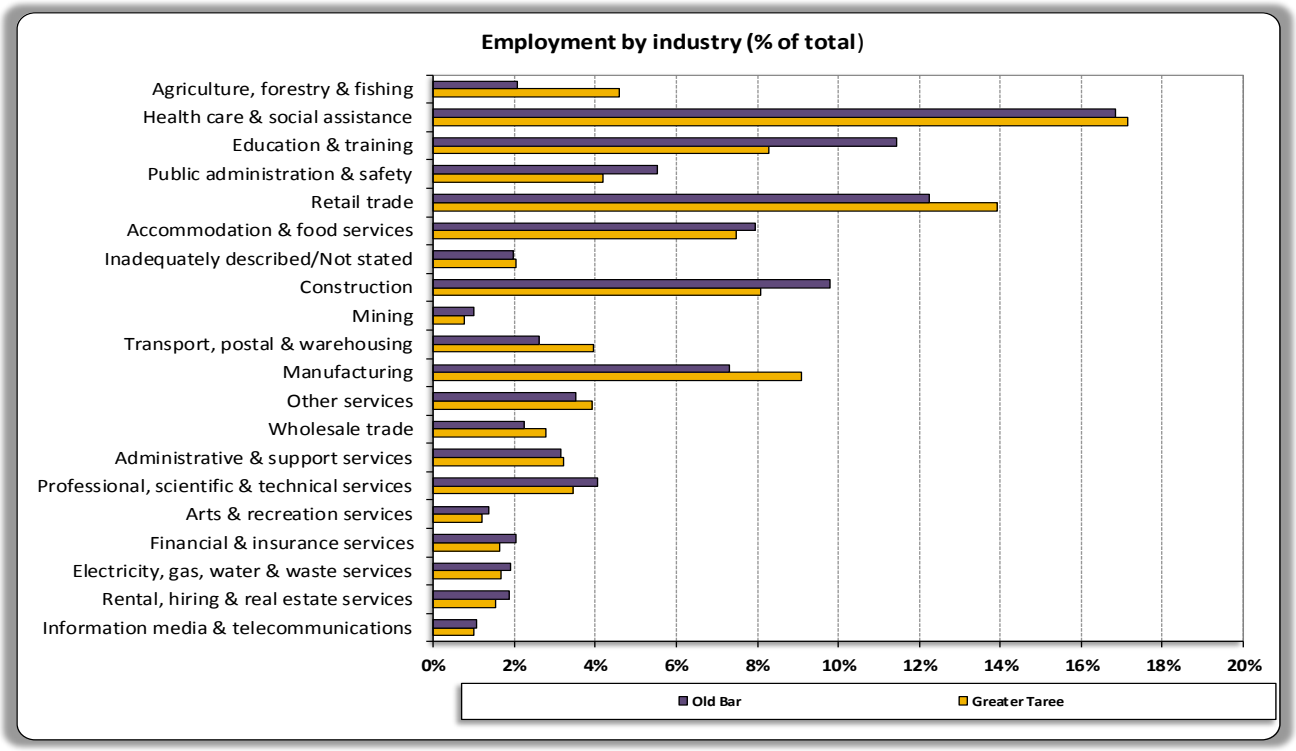
Figure 5: Employment by occupation



Industry

Figure 6 compares the proportion of workers employed in each industry for Old Bar and Greater Taree. Compared with Greater Taree, relatively more workers in Old Bar are employed in education, training and construction, while less are employed in agriculture, forestry, fishing and manufacturing. The health care and social assistance, retail trade, education and training, construction, and accommodation and food services industries employed the largest share of workers in Old Bar.

Figure 6: Employment by Industry



Job opportunities in Old Bar are not as diverse as across the whole of NSW. This trend can be expected, as larger populations need to draw on more services, generating demand for a wider pool of industries. Similarly, for a beach town, hospitality and leisure-related items such as accommodations, food services, rental, and retail will typically comprise a larger share of total employment. Whilst the tourism-related sectors are represented, the sectors comprise a smaller overall share of employment than might be expected. The relative lack of employment dependence on tourism has potential implications for the cost-benefit analysis.

Table 3 shows the ten largest employer groups in Old Bar and Greater Taree broken-down into more specific industry groups than those shown in Figure 5. The 10 largest industries in Old Bar employ 29% of workers, and 5 of these are related to the health care or education industries. The 10 largest industries in Greater Taree employ only 27% of workers, but include agricultural industries.

Table 3: Top 10 Employers

	Name	Old Bar		Name	Greater Taree	
	Type		SA2	Type		LGA
	Industry*	Number Employed	% Total	Industry*	Number Employed	% Total
1	Hospitals, except Psychiatric Hospitals	177	5%	Hospitals, except Psychiatric Hospitals	804	5%
2	Secondary Education	141	4%	Aged Care Residential Services	613	4%
3	Primary Education	127	3%	Supermarket and Grocery Stores	566	3%
4	Supermarket and Grocery Stores	122	3%	Takeaway Food Services	438	3%
5	Aged Care Residential Services	101	3%	Primary Education	434	3%
6	House Construction	87	2%	Secondary Education	410	3%
7	Takeaway Food Services	83	2%	Other Social Assistance Services	309	2%
8	Accommodation	77	2%	Road Freight Transport	302	2%
9	Local Government Administration	69	2%	Meat Processing	292	2%
10	Other Social Assistance Services	61	2%	Beef Cattle Farming, Specialised	288	2%
	Other industries	2,610	71%	*Other industries*	11,942	73%
Total Employed Old Bar		**3,655**		**Total Employed Greater Taree**	**16,398**	

* ANZSIC (2011) full classification

The relative profitability margins of important sectors in the local economy may affect the implications of alternative scenarios considered in the cost benefit analysis. **Table 4** provides a relative margin ladder for the ten largest industry sectors, based on information tracked by ABS at the Industry level.

Table 4. Relative Profit Margin and Labour intensity by industry sector

	Industry Sector	Number Employed	% Total of Employed	Average Employees	Labour Intensity*	Average Margin
1	**Hospitals, except Psychiatric Hospitals**	177	5%	23	44%	27%
2	**Secondary Education**	141	4%	40	54%	4%
3	**Primary Education**	127	3%	40	54%	4%
4	**Supermarket and Grocery Stores**	122	3%	13	11%	2%
5	**Aged Care Residential Services**	101	3%	23	44%	27%
6	**House Construction**	87	2%	11	24%	7%
7	**Takeaway Food Services**	83	2%	24	25%	2%
8	**Accommodation**	77	2%	24	25%	2%
9	**Local Government Administration**	69	2%	N/A	N/A	N/A
10	**Other Social Assistance Services**	61	2%	9	42%	35%
	Other Industries	2,610	71%	N/A	N/A	N/A
	Total Employed	3,655				

**% of Turnover expended on Labour*

Income

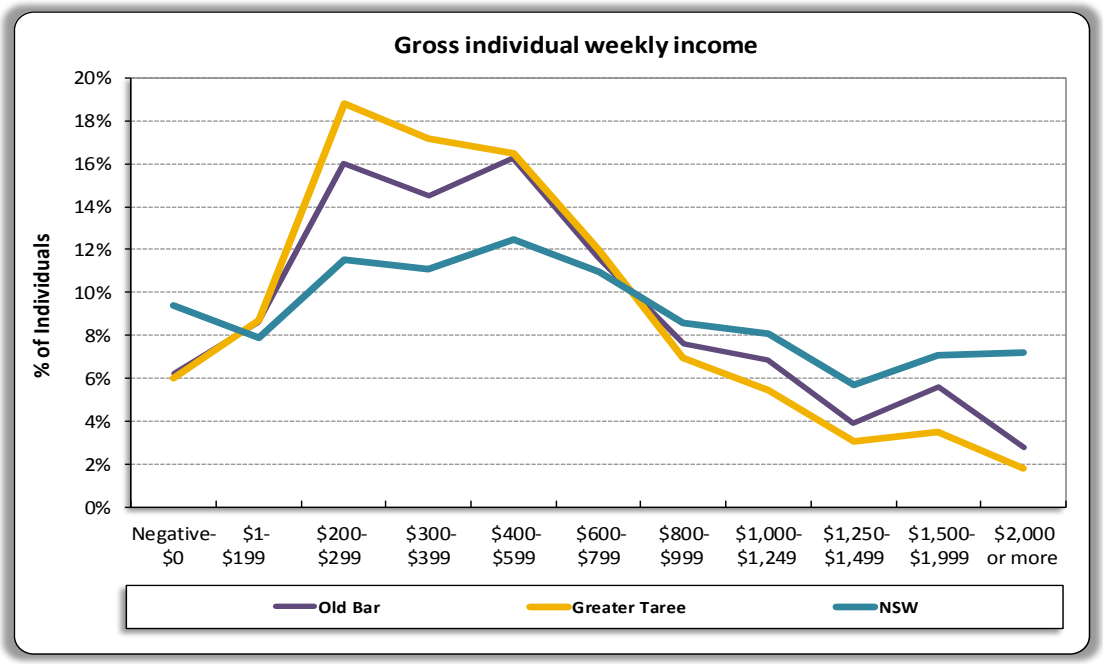
Table 5 shows that both individual and family incomes in Old Bar were higher than in Greater Taree, but lower than in NSW. The median individual income in Old Bar is 16% higher than in the Greater Taree region and 19% lower than for NSW as a whole. Meanwhile, median household income in Old Bar is 15% higher than in the Greater Taree region and 28% lower than that across NSW. However, living costs in Old Bar and Greater Taree are also slightly higher. Median mortgage payments in Old Bar are 17% higher than in the Greater Taree region and median rents are 25% higher. This is broadly consistent with the trend in regional incomes and housing costs for those living in a coastal community.

Table 5: Weekly Income in 2011

Name	Old Bar	Greater Taree	NSW
Type	SA2	LGA	State
Median individual income ($/week)	457	395	561
Median family income ($/week)	1,042	930	1,477
Median household income ($/week)	889	770	1,237
Median home-loan repayment ($/week)	354	303	465
Median rent ($/week)	250	200	300
Loan-servicing costs (% of HH income)	40%	39%	38%

Figure 7 shows the distribution of individual incomes across the working age population of Old Bar, the Greater Taree region and across all NSW in 2011. 45% of all Old Bar residents earn less than $400 per week, while 58% earn a gross income of between $200 and $799. There is a significant peak in Old Bar earnings at $200-599 per week, which is similar for residents in the wider Greater Taree region, although much more pronounced for Old Bar. A smaller number of Old Bar residents, compared to NSW, earn a high income; only 19% of individuals in Old Bar earn more than $1,000 per week. As previously noted Old Bar is consistently ahead of Greater Taree on the income spectrum, with lower rates of low weekly income and higher rates of high income after a threshold of approximately $800 per week. However, in turn, residents in NSW enjoy higher rates of high incomes and lower rates of low incomes than Old Bar, also transitioning near the $800 per week mark.

Figure 7: Distribution of individual weekly Income in 2011



Note: Figure excludes people who did not state their income.

Figure 8 compares *family income* in Old Bar, the Greater Taree region and across NSW as a whole. Combined family incomes in Old Bar are higher than in the Greater Taree region, as is the peak in higher incomes. Twenty-eight percent of families in Old Bar earn more than $1,500 per week compared to 23% in Greater Taree, and 44% across NSW.

Figure 8: Gross weekly family income in 2011

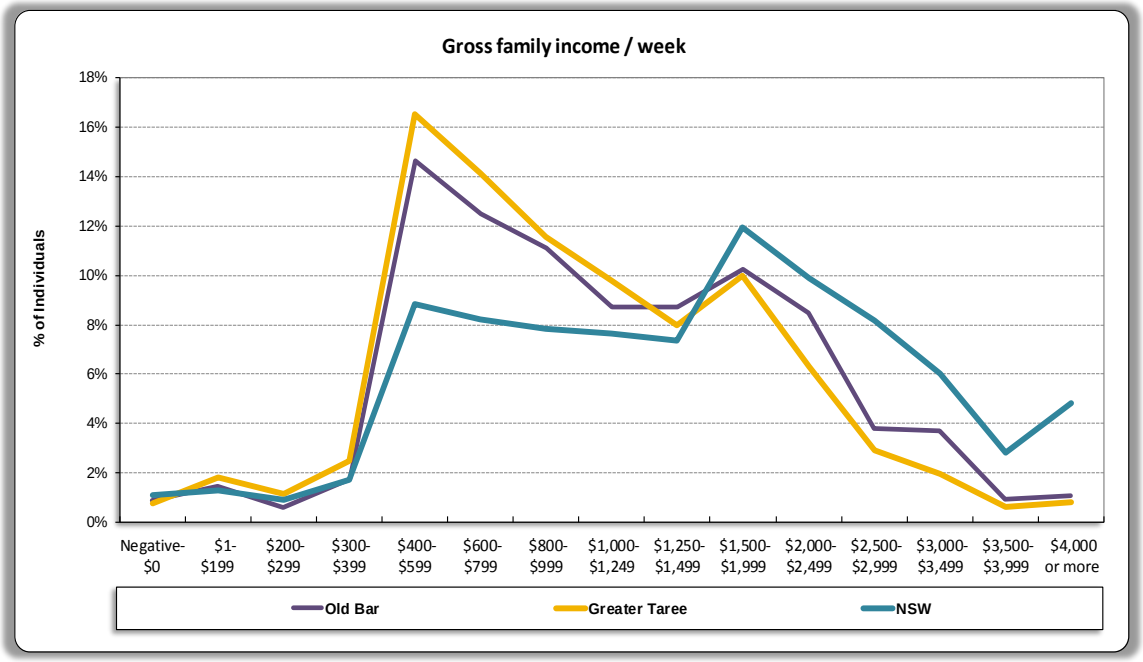
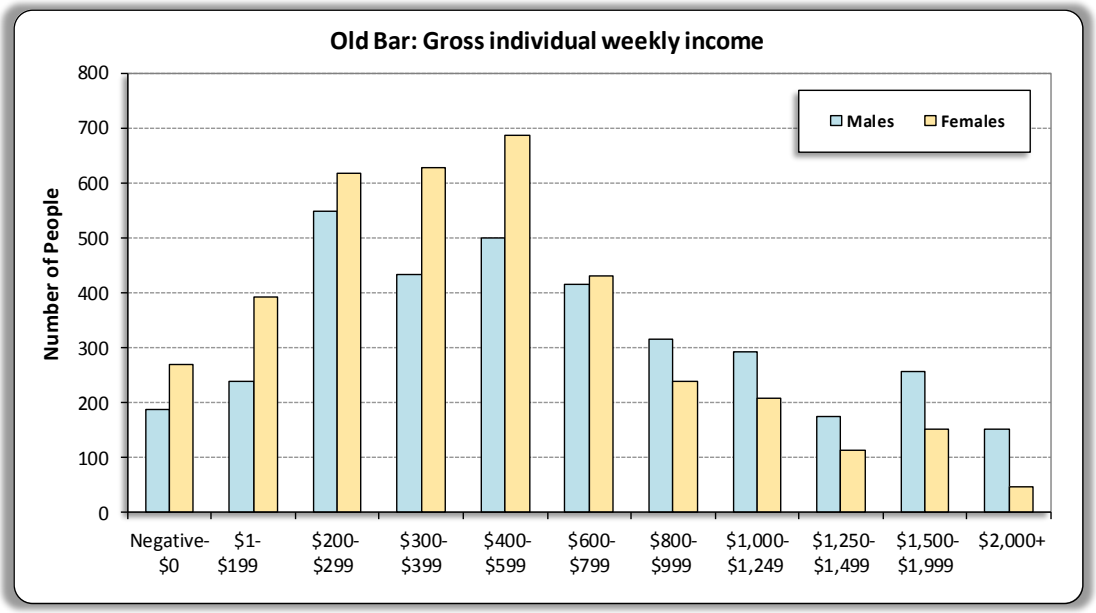


Figure 9 shows that males in Old Bar earn consistently higher incomes than females, which is likely to be caused by the higher proportion of males in full-time jobs (69%) compared to females (42%). Similarly, a higher proportion of females work part-time (52%) compared to

males (26%), a disparity which helps explain the overrepresentation of females in lower-income brackets.

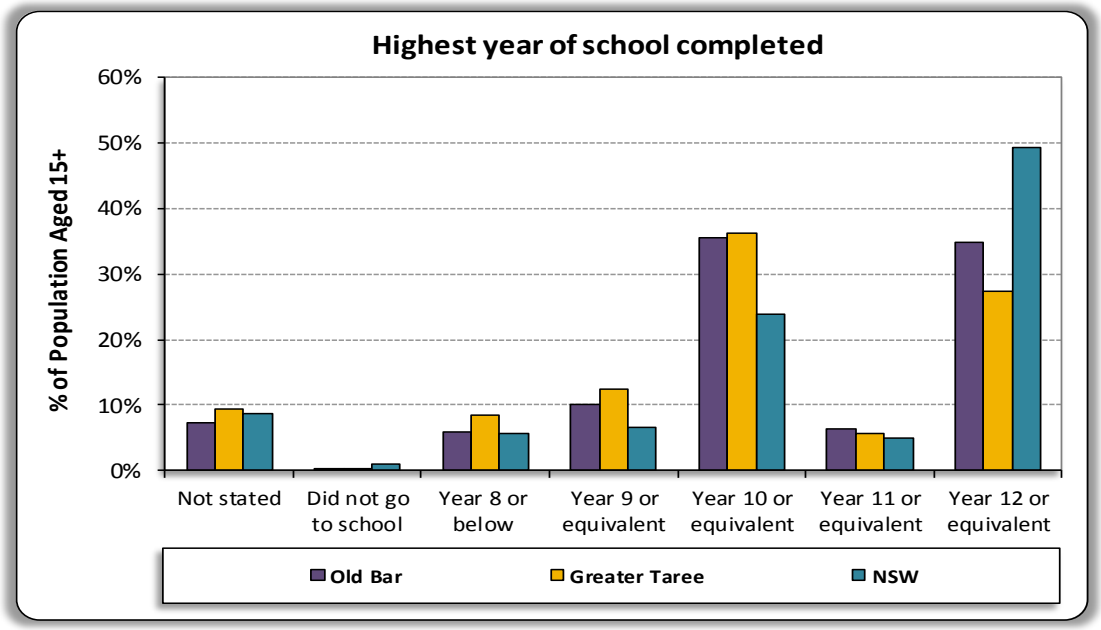
Figure 9: Distribution of weekly income by gender



Education

Figure 10 shows the highest level of school education attained by Old Bar residents aged 15 and over in 2011. More than half of Old Bar residents over the age of 15 have not received schooling beyond the equivalent of Year 10. Much fewer residents have completed year 12 schooling in Old Bar (35%) and the Greater Taree region (27%) compared to the average for NSW (49%).

Figure 10: Highest Level of Schooling Completed



Although males in Old Bar earn (on average) higher wages than females, the opposite is true for education: women are more likely to achieve higher schooling than men. ***Figure 11***

highlights the level of year 12 schooling across different age groups in Old Bar. Particularly striking is that women age 45-54 have a higher year 12 completion rate than men in the same age group, but men have higher completion rates than women for all age groups over 54. This suggests that older generations likely did not grow up with educational opportunities on par with what is available to women today.

Figure 11: Proportion of Population with Year 12 Equivalent Education

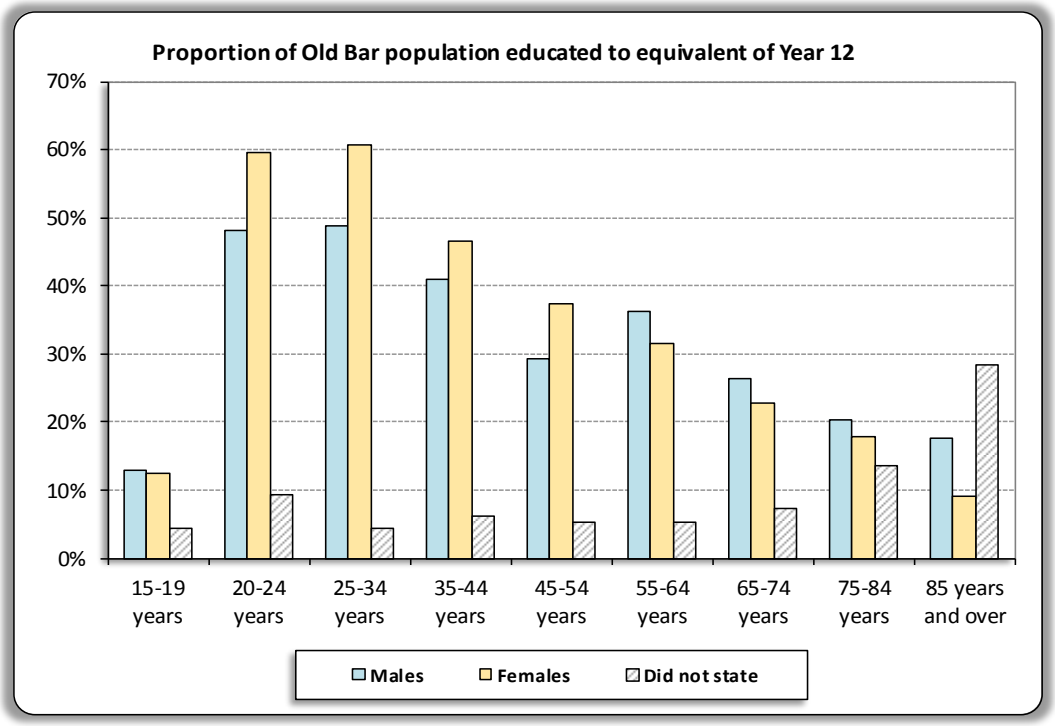


Table 6 shows non-school qualifications held by residents of Old Bar, Greater Taree and NSW. As expected from the industries and jobs available in both Old Bar and the Greater Taree in 2011 (Figure 5 & 6), the most common forms of qualifications held are Diplomas and Certificates. Nearly a quarter (23%) of residents in Old Bar hold a university degree, and educational attainment in Old Bar is much higher than in the wider Greater Taree LGA. This may be due to the relatively high share of education and health care relative to total employment, which may, in turn, have implications in the cost benefit analysis.

Table 6: Qualifications achieved

Name	Old Bar		Greater Taree		NSW	
Type	SA2		LGA		State	
Non-school Qualifications	Persons	%	Persons	%	Persons	%
Postgraduate Degree	115	1%	354	1%	238,851	4%
Graduate Diploma & Graduate Certificate	110	1%	395	1%	82,617	1%
Bachelor Degree	771	10%	2,417	6%	787,336	14%
Bachelor's Degree and Above		13%		8%		20%
Advanced Diploma & Diploma	694	9%	2,454	6%	462,059	8%
Certificate Level	1,931	25%	8,695	23%	986,704	18%
Diploma or Certificate		34%		29%		26%

Note: percentages relate to the population aged 15+

Housing

The vast majority of residents in Old Bar reside in houses (as opposed to units or terraces), as seen in **Table 7.** Home ownership is much higher in Old Bar and Greater Taree compared to the wider state of NSW. Renting is significantly more common in the state as a whole. Old Bar exceeds Greater Taree and NSW in proportion of residents that fully own their homes, increasing the relevance of coastal erosion risks in Old Bar, which will have implications in the cost benefit analysis.

Sales data for housing transactions over the past twenty years was obtained from RP data. Complete data is available for 129 sales of single family residences or strata units that closed during the past three years within Old Bar suburb; 15 were strata units and the remainder houses. The minimum sale price reported is $100,000 and the maximum is $855,000; the mean reported value was $314,000, with strata units selling for approximately $50,000 less than houses, all other factors being equal. Analysis of the premium or risk associated with proximity to the 100-year storm line is being conducted using hedonic modelling and will be included in the cost benefit analysis.

Table 7: Housing types

Name	Old Bar	Greater Taree	NSW
Type	SA2	LGA	State
Proportion of residents by dwelling type			
Separate house	88%	91%	76%
Semi-detached, row, terrace, townhouse etc.	9%	4%	9%
Flat, unit or apartment	2%	4%	14%
Caravan, cabin, houseboat	1%	1%	0%
House or flat attached to a shop, office, etc.	0%	0%	0%
Proportion of residents by dwelling tenure			
Fully owned	44%	42%	33%
Being purchased	28%	28%	33%
Rented	24%	27%	30%
Other / not stated	3%	3%	3%

Beach Valuation

A variety of previous studies have estimated Australian values for beach visits and surfing. The number of surfers visiting the beach on a daily or annual basis is an important factor in estimating value. Surf spending was estimated to be roughly $1,950 per surfer per annum on the Gold Coast; while this region is distinct from Old Bar, it can provide helpful context for putting numbers to valuation in Old Bar. The estimated surf spending of $18.67 - $30.36 per surf session can be multiplied by the total number of surfers visiting the area to approximate a willingness to pay. Total beach visits, including non-surfers, to the City of Greater Taree (domestic overnight travel) is estimated at 75,000 visitors per annum, based

on the four year annual average to the year ending September 2013[1]. The average spend of a visitor visiting the beach is $238.96. Additional research is underway to confirm the number of surfers and surf sessions per annum for more exact calculations, in addition to non-use values. Beach valuation data can be used to compare the effects of different options; for example, if travel distance required for surfing increases, and if there are competing tourist destinations nearby that could divert revenue streams, this could be viewed as a cost when considering options that limit the ability to attract tourists. Housing amenity values may in turn be affected, and may change depending on how beach views and open spaces are affected.

Socio-Economic Indexes for Areas (SEIFA) Analysis

SEIFA Analysis was performed for Old Bar/Manning SA2 using data from ABS. To get a comparison of both advantages and disadvantages, the SEIFA Index for Advantage and Disadvantage (IRSAD) is most appropriate in this analysis. Using the IRSAD scale, lower IRSAD values indicate more socio-economic disadvantage and higher IRSAD values indicate more socio-economic advantage (with a mean SA2 SEIFA value of approximately 1000). The SEIFA IRSAD index for Old Bar is 975.26. This indicates that, for the range of all Australia SA2 geographic areas, Old Bar is slightly disadvantaged with respect to economic opportunity. However, **Figure 11** below shows SEIFA IRSAD index, ranked by decile, for all SA 2s in Australia (with zoom around Old Bar area). As can quickly be seen, Old Bar is in the middle of the distribution of economic advantage/disadvantage. However, nearby SA 2s have varying index rankings, with immediately adjacent SA 2s having clear economic disadvantage. Overall, Greater Taree LGA has a SEIFA IRSAD value of 906, indicating that Old Bar has more economic advantage than the Greater Taree LGA as a whole.

Figure 12 below shows the distribution of SEIFA IRSAD index for SA 1s with a focus/zoom around Old Bar SA 2. Interestingly, while the distribution of SA 1s in the entire Old Bar SA2 have a socio-economic make-up that is consistent with the entire Old Bar SA 2 (on average, neither strong disadvantage or advantage), most of the SA 1s within the city of Old Bar lean towards economically disadvantaged.

[1] Tourism Profiles for Local Government Areas in Regional Australia New South Wales, City of Greater Taree, Summary of International and Domestic Travel to Local Government Area

Figure 11. SEIFA IRSAD index ranked by decile for all SA 2s in Australia

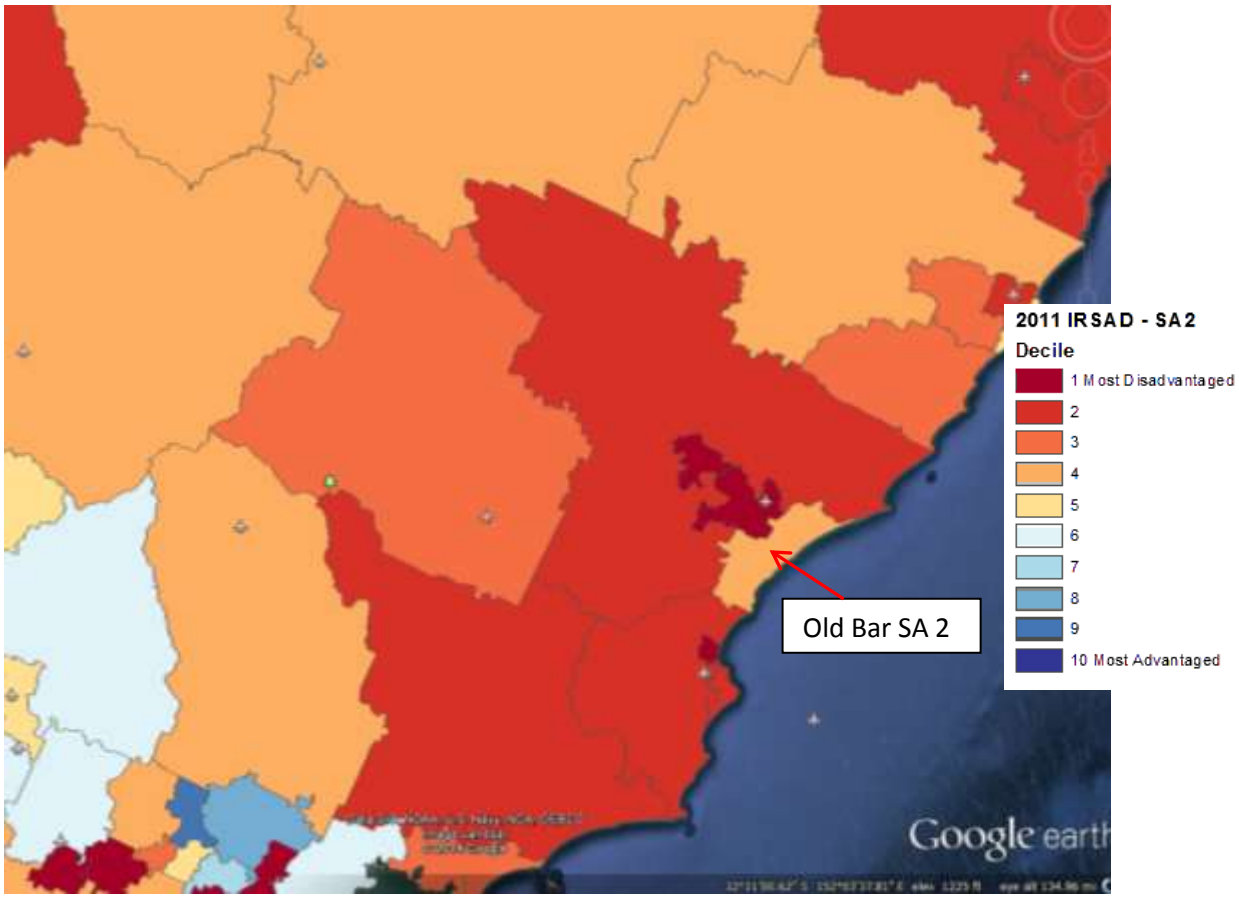
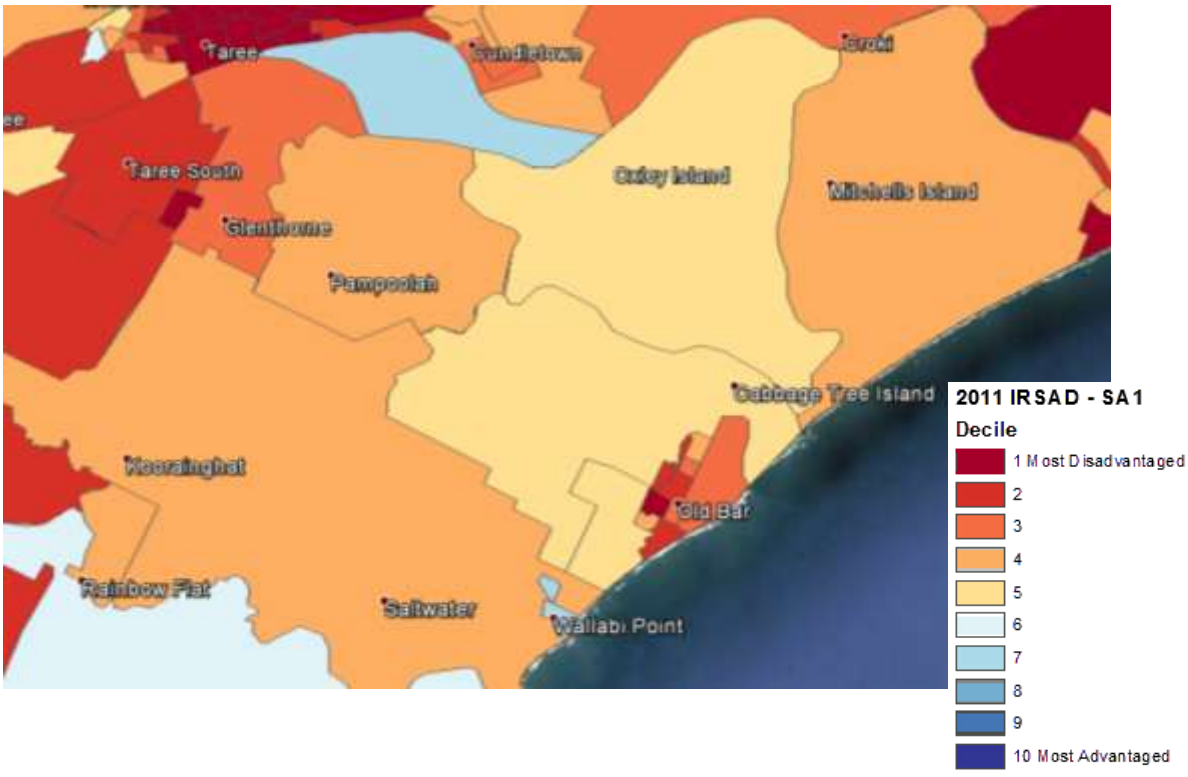


Figure 12. Distribution of SEIFA IRSAD index for SA 1s



Other Data

Estimates of traffic counts or detailed land use data were not available from the NSW Dept. of Planning and Infrastructure (DPI) and the Dept. of Roads and Maritime Services (RMS).

Engineering Costs

Engineering costs for the sea wall options were gleaned from the RHDHV and WP reports. Salient parameters are captured by project type below.

Seawall Option

Proposed costs for the crib seawall option are approximately $2 million (with extents of the proposed structure not yet known). The rock seawall option with a wall crest at 2013 embankment crest (stage 1 option 1) is estimated to cost about $17,900 per meter of wall, with a total cost estimate of $8,018,000. The most landward rock seawall option (stage 1 option 2) would cost $18,500 per meter, with a total estimated cost of $8,290,000. Stage 2 of the rock seal is estimated to cost $16,500 per meter or $6,982,000 in total.

Preliminary capital cost estimates for various project stages range between $15,200/m and $18,500/m (excluding maintenance, sand placement, and property acquisition costs).

Consequence descriptors categorise the intensity of cost scenarios. Major consequences include damages with costs between 40 and 100% of the structure; minor consequences range between 1 and 10%. Catastrophic costs result in costs greater than 100% of the structure cost. These scenarios include large scale damage requiring additional engineering for stabilisation. Detailed impacts on overall project costs are provided within the reports.

Artificial Reef/Geotextile containers

Sand-filled geotextile containers have been proposed to construct two reefs; these could cost between $6.9 and 7.9 million. These translate to a volumetric cost of $210/m3 to $240/m3, compared to typical volumetric cost rates for all submerged constructed offshore reefs worldwide, where suitable information was available as reported in 2013, ranging between $50 and $550/m3, with an average of $370/m3 (seven projects costed with average capital cost $2.3 million). Proposed staged rock revetment or sea wall options to protect the same length of shoreline could cost $23.8 million in total – over three times the cost estimate for the reefs.

The “rough order” cost estimated by ASR for the Old Bar project ($240-$270/m3) would seem to be low compared to other completed geotextile container reef projects (average $352/m3).

Beach Renourishment

The total cost to implement such a nourishment scheme is estimated at $147 million. With massive nourishment, a revetment would not be required. For context, all up sand nourishment rates at Jimmys Beach, Port Stevens and Ettalong Beach, Brisbane Water, inclusive of design and other preliminaries, range between $15 and $20/m3.

A prospective nourishment project at the main part of Old Bar Beach in front of the SLSC, involving small placement quantities to allow some profile losses, placed over 200-250 m of beach centred on the car park, could cost $100,000 per year in annual average terms over a 5-10 year nourishment interval. The size of the beach compartment and the volume of required sand to sustainably nourish the beach in front of a revetment could likely cost $147,000,000; linking nourishment with a revetment is not feasible.

The proposed revetment is costed at between $8.0 and $8.3 million for Stage 1 depending on its cross-shore location, a further $7.0 million for Stage 2 and $8.8 million and $24.2 million respectively for Stages 3N and 3S.

RHDHV has recommended a cost allowance of 0.5% per annum over the first 25 years of the structure, followed by 2% per annum over the second 25 years. Assuming a 3% long-term discount rate, this amounts to an NPV for structure maintenance of $2 million (option 1, stage 1). All of the engineering costs will be considered in the cost benefit analysis.

Conclusions

The importance of the immediate study will have potentially disparate impacts on different socioeconomic groups and neighbourhoods. An understanding of the general socioeconomic and demographic composition of Old Bar is fundamental to assessment of its options in the wake of severe beach recession. Adequate information appears to be available to perform a competent analysis.

Old Bar is a small coastal community. A relatively high share of Old Bar residents are in older age groups, with 31% of the population over the age of 60. Labour force participation appears to be slightly higher across age cohorts than Greater Taree, but comparable to NSW. Schooling rates are low: 35% of the population in 2011 had finished the equivalent of year 12 schooling (even lower for older residents).

As a beach town, the level of visitors that contribute to local economic output is important. Tourism data reported by Tourism Australia indicates that nearly 8 beachgoers visit the town for every resident. Atypical perhaps for a coastal community is the relatively small share of Old Bar employment supported by accommodation and food services (8%), and real estate/rentals services (2%). While in line with NSW averages, a beach town may be expected to show more reliance on hospitality and tourism-driven industry than average. The lower relative employment in these sectors may indicate a contribution at the lower end of visitor expenditures compared to beachgoer/surfer averages. Industry in Old Bar is predominantly health care-based, with retail employing the 2nd largest share, followed by education, construction and manufacturing. The large share of health care employment probably reflects the higher median age, and the high percentage of older residents. This aspect has bearing on the resiliency of the community.

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