

Feasibility Study of Multi-Purpose Artificial Surf Reefs for Brevard County, Florida (Economic Segment)

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EXECUTIVE SUMMARY

Brevard County is currently exploring the feasibility of constructing an artificial surfing reef to provide both shoreline management and surf amenity benefits. In pursuit of this task, the County commissioned a reconnaissance-level feasibility study to assess the economic and scientific aspects of the proposed project. PRÆCIPPIO EFS, an economic, financial, and statistical consulting firm, has been assigned the responsibility for assessing the recreational benefits associated with the proposed artificial surfing reef.

The recreational benefit assessment estimates the “new dollars” infused into Brevard County due to surf-related tourism, enhancing community income, jobs, and tax receipts. With respect to the recreational benefits associated with the proposed artificial surfing reef, results from this analysis support the following:

1. Exclusive of impacts from specialty events such as a world-class surf competition, the proposed artificial surfing reef is expected to draw an *additional 2,109 surf visit days per year*
2. Expected tourist expenditure per surf visit day amounts to *\$57.80*, of which about *\$19* is spent on lodging
3. Exclusive of impacts from specialty events such as a world-class surf competition, and using an average daily room rate of \$95 per night, this impact supports about *422 room nights per year*
4. Exclusive of impacts from specialty events such as a world-class surf competition, and assuming a 25-year project life, the present value of the recreational benefits provided by the proposed artificial surfing reef amount to *\$920,000*
5. These economic benefits would support, on a yearly basis, about 3 jobs and *\$18,000* in tax revenue – the revenue split would be \$7,000 at Federal level and \$11,000 at the State & Local level
6. With respect to special event benefits, and assuming a 25-year project life, the present value of a sanctioned, 5-star surf competition to be held on the proposed artificial surfing reef is *\$1.68 million*
7. Collectively, and assuming a 25-year project life, the present value of recreational and specialty event benefits associated with project supported surf amenity amounts to *\$2.6 million*

The surf market is a burgeoning industry and artificial surfing reefs are a new and innovative technology and product. Due to the lack of any formal retrospective evaluation on the benefits derived from previous projects of this nature, very little is known about their commercial performance; consequently, expected economic values to be derived from artificial surfing reefs carry significant uncertainty.



1.0 PROJECT SCOPE AND OVERVIEW

Brevard County is currently exploring the feasibility of constructing an artificial surfing reef (ASR), multi-purpose or functional in nature, to provide both shoreline management and surf amenity benefits.¹ In pursuit of this task, the County commissioned a reconnaissance-level feasibility study to assess the economic and scientific aspects of the proposed project, with various responsibilities assigned among five firms comprising the research team.

The engineering firm Coastal Tech serves as the collaborative leader of this project. Coastal Tech is responsible for the compilation and delivery of the final product to be delivered to the Brevard County Board of County Commissioners. PRÆCIPPIO EFS, an economic, financial, and statistical consulting firm, has been assigned the responsibility for assessing the recreational benefits associated with the proposed ASR. While PRÆCIPPIO is a willing and participatory collaborator with the engineering and coastal science firms who are principally devoted to the science-based aspects of this project, its economic report, represented by this document, is solely under its editorial control and will be included in the final assembled report as a stand-alone appended document.

The conceptualization for recreational benefit assessment is easily grasped from Figure 1, owing to Crompton (2006). The County (or Tourism Development Council – TDC), serving as a fiscal agent, utilizes deferred community income (i.e., taxes) to fund activities or projects that attract individuals from outside the community. The purpose is simple: tourists spend “new dollars” which ordinarily would not circulate in the destination community, and thus, enhance community income, jobs, and tax receipts. Comparing the income accrued from the tourism activity with the income deferred to promote the endeavor informs whether the TDC decision was net beneficial.

Recreational benefits are determined first by adjusting aggregate spending (final demand) to ascertain the direct effect. The direct sales effect represents changes in production that occur due to changes (in this case) in recreational surf-visit associated expenditures. Retail purchases, a portion of final demand, must be factored to segment the purchaser price into appropriate retail, wholesale, and transportation margins along with the producer price. In most instances retail items are manufactured elsewhere; consequently, only those margins derived locally are factored into the direct effect. Services represent producer prices and thus need not be margined.

The capture rate describes the percentage of final demand *captured* after margining as direct sales in the region (county). Multiplying the capture rate by aggregate expenditures provides the launch point for a multiplicative process in which direct sales effects lead to secondary effects known as indirect and induced effects. The former are changes in production that occur as backward-linked industries respond to changes in final demand in directly affected industries. For example, surf-visitation increases sales of restaurant meals which triggers production responses from food and beverage vendors who supply eating and

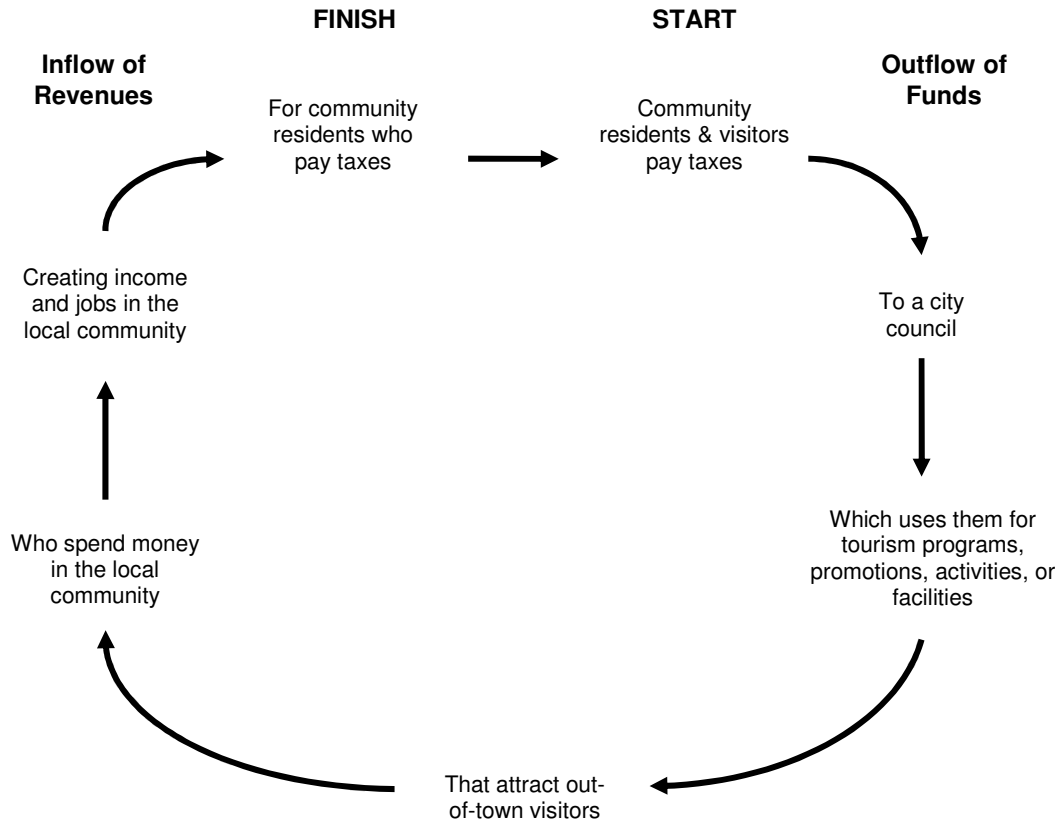
¹ See Black (1999), Black & Mead (2000), Scarfe et al. (2003), and ASR America (2008) for a background primer and ASRs and the science of surfing.



drinking establishments. The latter, induced effects, represent changes in economic activity resulting from income changes accruing directly or indirectly through changes in aggregate spending. In other words, workers supported by surf-visitation expend their earnings on an array of consumer goods and services, much of which occurs locally. This process is simulated through input-output modeling, and in this effort key parameters are obtained through *IMPLAN*, an integrated software and data package used by more than 1,300 academic institutions, federal and state government agencies, and private consulting firms.

The total effect sums both the direct and secondary effects on sales; however, community income is the proper comparison. Value-added describes the payments made by industry to wages, interest, profits, and indirect business taxes, and is a corollary to the gross domestic product or GDP estimate provided in many macroeconomic reports. Accordingly, value-added is the preferred metric by which this analysis conveys recreational benefits. Due to its familiarity usage, however, a tourist sales measure is also offered. Both measures yield somewhat similar dollar values, with no impact on the final result, and it is the latter measure which Coastal Tech utilizes in its broader analysis.

Figure 1: Justification of Recreational Benefits



Crompton, 2006, Journal of Travel Research



Recreational income is itself a subset of total economic value. Other sources of value include but are not limited to shoreline management benefits, enhancement in real estate values, intangible marketing values, use values not captured by the market, and non-use *existence* values. The delineation of project tasks holds Coastal Tech responsible for shoreline management benefits, with PRÆCIPPIO EFS delegated the role of recreational benefit estimation. Other sources of value are briefly touched upon in this report but are not part of its scope of responsibility.

The study is organized in the following manner. A reconnaissance study of the existing artificial surf reefs (hereafter ASRs)² is provided in section 2, where reconnaissance implies a review of the existing literature including and most especially earlier feasibility studies, interviews with surfing and ASR stakeholders, analysis of data, economic impact forecasting, and consultation with team members. What was not funded was primary data gathering, although contemporaneously with this report a graduate student at Florida Institute of Technology was conducting a study of the Brevard County surf market. Some data from that effort was provided to PRÆCIPPIO, and where it is utilized it is cited. Further results from that study will be forthcoming in Brian Kelly's master's thesis.

The reconnaissance review informs this analysis by revealing many of the issues that must be dealt with to formulate a recreational benefit assessment. ASRs are still rare – four have been constructed (excluding Bargara), one is almost complete, and the latest entry, in Bournemouth, England, began construction in late summer. Given that the number of cases is relatively small, an examination of the projections, performance, and outcomes of the earlier versions of the present project, what might fall under the category of reference-class forecasting, is appropriate. The bulk of attention is devoted to Narrowneck, Opunake, and Mount Maunganui. While there are differences – Narrowneck is significantly larger than both Mount Maungauni and Opunake and is multi-functional - they all utilize geotextile sandbags and carry design and modeling work by Amalgamates Solutions and Research, a New Zealand based firm which holds a commanding position in this field.

Section 3 provides details on the estimation of recreational benefits, which includes tourist-related expenditures induced by the proposed ASR as well as prospective special event benefits associated with a world class surfing competition. Since Cocoa Beach currently hosts surfing festivals of regional importance, the value of the ASR lies in its potential to land an event that would not occur in its absence, such as a 5-star or greater Association of Surfing Professionals (ASP) sanctioned competition. There are significant hurdles in promoting such an event which must be recognized in performing this analysis.

The study concludes with bulleted outcomes from the analysis as well some observations from the reconnaissance study. Several calculations are left for appendix sections in an effort to keep the narrative flowing. Additionally, interviews with select stakeholders are provided.

² ASRs can be designed for surf amenity or multi-functional performance (i.e., surf amenity, shoreline management). Due to its familiarity, the acronym ASR is used interchangeably.



2.0 RECONNAISSANCE REVIEW

This background reconnaissance review details the previous ASRs and highlights the uncertain nature of the economic benefits derived from them.

2.1 NARROWNECK, AUSTRALIA (GOLD COAST, QUEENSLAND)

Arguably the two most important economic reports dealing with the prospective benefits associated with ASRs concern the Northern Gold Coast Beach Protection Strategy (NGCBPS). The papers, one, a benefit-cost analysis prepared for the Gold Coast City Council and the second, a refined version published in the academic journal *Tourism Economics*, were authored by the team of Mike Raybould and Trevor Mules (hereafter, R&M) of Griffith University's School of Tourism and Hotel Management. Now a decade old, the results from these studies reported significantly high benefit-cost ratios along with net present values in the hundreds of millions of dollars, utilizing a discount rate of 8 percent (i.e., B/C = 60 and NPV of A\$457 million [R&M 1998]; B/C = 43 and NPV of A\$293 million [R&M 1999]).

These estimates, and in particular, the B/C ratio of 60 to 1, are cited in subsequent feasibility studies, journal articles, newspaper stories and promotion pieces to a degree that they have achieved ubiquity. Ubiquity carries a cost, however, in that while the overall result is transparent to all, the underlying analysis tends to be forgotten. It is imperative that the R&M analysis be understood to better inform future decision makers (and researchers) about the lessons derived from the Narrowneck ASR.

The first insight, which is not necessarily transparent, is that the ASR was part of the overall NGCBPS, and in terms of monetary outlay, comprised a small percent of project expenditures. As detailed by R&M, the proposed program, covering a 15km portion of the Gold Coast beaches at its northern end, carried a present value cost of A\$8 million, of which about 80 percent would be spent on beach nourishment (i.e., sand pumping). The coverage area, though a subset of the Gold Coast, encompassed the tourist mecca of Surfers Paradise, and as reported by R&M, contained at that time about 50 percent of the Gold Coast's tourist lodging. For the local community, preserving those beaches and safeguarding the inflow of tourism dollars was (and still is) of vital concern. R&M cite an earlier piece written by Raybould (1996) in which he estimated about one-quarter of the Gold Coast's gross regional product was derived from tourism expenditures.

The heart of the R&M analysis revolves around the confluence of cyclonic activity, beach erosion, and negative media coverage. In short, the periodic cyclones that impact the Gold Coast precipitate beach erosion, subsequent to which the media, having the tendency to sensationalize the event via coverage and photos, effectively encourages the amendment or postponement of travel plans by prospective tourists. A stabilization program, mitigating storm-related beach erosion and as a result, providing little shoreline damage type fodder for media coverage, abates these negative effects. *And thus the avoided loss of tourism revenues, a benefit derived due to the NGCBPS's shoreline management*



*function, is the primary driver of the R&M analysis and result.*³ This second insight is also not clearly understood.

R&M assess the impact of beach erosion on tourism receipts through a case approach rather than long-term time-series analysis. This is necessitated by limitations due to: i) confounding factors or ii) the lack of available data. In 1996, Cyclones Barry and Ethel precipitated an erosion event designated as a once every five year occurrence. R&M, using 1994-96 tourism data for both the Gold Coast and Queensland,⁴ estimated the degree to which Gold Coast tourism, during the months of July-September, directly under-performed relative to its predicted value. Additionally, R&M assessed the degree to which the Gold Coast indirectly under-performed during those same months as compared to its over-performance earlier in the year.

Their result: “In the case of the 1996 erosion event, the impact on tourism receipts seems to have been approximately 10 percent spread over one quarter. It is recognized that this approximation assumes that the expenditure levels of the lost visitors is the same as visitors as a whole.” [R&M, 1999, p.128]. A similar approach focusing on the events of 1990, i.e., Cyclones Nancy and Ivor, yielded an impact on tourism receipts of 13% spread over one quarter. Taking a conservative approach, and for data reasons, placing greater emphasis on the 1996 case study due to greater reliability, R&M posit an annual impact on tourism receipts of 2 percent (dividing the 10% loss figure by 4 quarters and rounding down), which in 1996 amounted to just under A\$50 million. This constitutes the economic loss of a 1 in 5 year erosion occurrence.

R&M proceeded to establish tourism losses for 1 in 10 year (\$A129), 1 in 25 year (A\$305), and 1 in 50 year (A\$470) occurrences. By factoring in the probability of an erosion event occurring in any one year, and noting that the NGCBPS would protect about half the Gold Coast’s tourist beaches, R&M derived a net present value of A\$457 million, and the now familiar B/C ratio of 60 to 1.⁵ *Interestingly, this result is not driven in any way by recreational benefits, it is solely based on the notion that tourism losses did not occur, because beach erosion, and its negative publicity, was prevented.* Why that is, and more importantly, whether it should be the case that recreational benefits are negligible, informs the conduct of this benefit analysis. It is explored next.

2.11 *Recreational Benefits and the Narrooneck Study*

The R&M *Tourism Economics* article does not directly address the construction of an ASR. The ASR is listed in the paper’s appendix, as part of an overall breakdown of the costs of the NGCBPS program. In the analysis prepared for the Gold Coast City Council, R&M address recreational benefits in section 5, albeit indirectly and succinctly. Since the points made in this brief section carry profound implications for this study, it is repeated here verbatim.

³ R&M also assess the avoided loss of damage to public infrastructure assets. Those benefits, also attributable to the NGCBPS’s shoreline management function, amounted to just under A\$500,000, an irrelevant magnitude in comparison to the avoided loss of tourism revenues. In terms of the R&M analysis, damage losses can be ignored without any loss of generality.

⁴ Queensland data is used to corroborate whether the Gold Coast data trend is merely an extension of a general trend in Queensland tourism or a function of beach erosion.

⁵ As stated to above, the *Tourism Economics* article refined the results from the earlier study.



A feature of the proposed NGCBPS is the construction of an artificial surf reef at Narrowneck. This is expected to have two functions:

- to act as a control point, minimizing beach erosion to the south and extending the life of the re-nourished beach;
- to improve the beach amenity by creating a more reliable and regular surf break.

It is anticipated that this facility would become one of the best surf locations on the Gold Coast. In most respects the effects of this facility will probably be to transfer 'surf tourism' activity from other locations on the Gold Coast to Narrowneck. *As such there would be no net benefit to the region* (italics MHS). However, because of the reliability of the break, i.e., there will be a surfable break at this location when none exists at other locations on the coast, the location would be a desirable one for managers of major surf events. **Availability of this facility is expected to be the catalyst in the Gold Coast securing a major annual competitive surf tournament** (bold MHS). A study by Wills & Allen Leisure Consultants for the Gold Coast City Council of 1997 Billabong Pro event indicated that this event generated a net economic benefit to the region estimated at A\$2,259,800. [R&M, 1998, p.26]

In essence, R&M posit that a perfect substitution effect occurs and that surf activity migrates from one area to another within the Gold Coast. In terms of new money for the community, the net income or value-added created is zero. PRÆCIPPIO EFS, based on experience and judgment, believes this assumption to be unduly restrictive; however, the R&M supposition does require a bit more discovery, particularly in how it lays the groundwork for a future methodology used in this report.

The ASR, and the break produced, is an open-access resource. With no restrictions on usage, congestion failures may ensue, requiring the establishment of social norms to govern the allocation of the resource [Nazer 2004]. In his analysis of the social hierarchy which sometimes emerges in response to the surf breaks' commons problem, Nazer (2004) defines localism as "a diverse and variable set of norms conferring higher status and priority on a group of 'local' surfers." (p. 17) A general consensus that emerged from surfers interviewed for this study, in the United States, Australia, and New Zealand, was that the *best surfers surf the best breaks* and the *better the break, the more localized it was*. Brevard County's Sebastian Inlet break is representative of this point.⁶

With a large population of local surfers, a more reliable break created on the Gold Coast would likely find a large portion of coveted spots in the line-up assumed by local surfers. In fact, in Australia beaches are many times tabbed by the surf clubs and board types which utilize that break. Whether R&M implicitly assumed this in their analysis is speculative; regardless, the introduction into a local surfing community of a new, artificial surf break, particularly one that *fires* consistently, will likely precipitate a realignment of local surfing activity in conjunction with a transition period in which the dimensions Nazer discusses on social hierarchy and norms unfolds.

⁶ Although interestingly, there did appear to be an inverse relationship between surfer status and the degree of localism. In short, the better surfer you were, the smaller the perceived degree of localism.



In short, there will undoubtedly be a substitution effect, but how large? One school of thought holds, in essence, that no new surfing activity occurs in the area. ASRs, as the coastal scientists intone, do not make waves, but rather, accentuate and refine existing conditions. No ASR can compensate for the absence of swell. So if some degree of swell is necessitated for the ASR to fire, it can be argued that that same swell, in the absence of an ASR, would offer some conditions, however minimal, for surfers to utilize. Thus, some local surfers would likely have been on the water on the days the ASR fires even if the ASR did not exist.

As stated above, PRÆCIPPIO EFS believes a complete substitution effect to be an unduly restrictive assumption. While the effect exists, and while it primarily will be composed of local surfers, non-local surfers will be induced to Cocoa Beach by the promise of a better surfing experience. Simply put, these non-locals conduct an internal benefit-cost assessment, comparing the costs, in time and direct expense, with the satisfaction derived from the prospective surf experience. The better the expected experience, the more likely they answer their internal B/C question in the affirmative. Accordingly, non-local surfers will matriculate to Brevard County to surf the ASR, infusing new dollars into the economy and creating increases in community income.

Formulating a methodology for the vital non-local share of capacity in what undoubtedly will be a competitive ASR line-up is an integral part of this analysis. If assuming a complete substitution effect is considered unduly restrictive, designating that a population subset, say for example, “new tourists,” would have unfettered access to the ASR line-up, is quite simply, vacuous. PRÆCIPPIO EFS posits the following supposition: whatever the existing mix of locals and non-local surfers that currently utilize Brevard County breaks, it is assumed that that ratio would exist on the ASR. Admittedly this offers an upward bias, as the better break is also likely to be more localized than the average of breaks, but as will be discussed later in this report, this assumption can be corroborated with local and non-local share rates observed at one of the premiere surfing venues in the United States, at Trestles, California.

2.12 Special Event Benefits and the X-Factor

Emboldened in R&M’s verbatim passage, the notion of landing a premiere surfing competition, is what PRÆCIPPIO describes as the ASR X-factor: the potential difference maker in whether project benefits justify costs.⁷ ASP touring events, specifically 5-star rated and above, would likely produce, as the passage describes, an economic sales impact in the millions. As an example, the O’Neil Sebastian Inlet Pro, an ASP 5-star sanctioned event held in January at Sebastian Inlet, is estimated to generate an economic sales impact of about \$2.6-2.7 million for Brevard County.

The promise of a world-class surfing competition, and the infusion of non-local dollars associated with it, permeates the ASR discussion. Assuredly, most, if not all feasibility studies refer to it, though they may differ in their decision whether

⁷ Technically speaking, the X-factor should be speculative (e.g., what player may be the difference maker in this game?), but as will be discussed later in this report, an elite surfing event is an uncertain outcome.



to explicitly incorporate it or simply acknowledge it. But the point needs to be emphasized that the event must be of sufficient quality to draw in the leading pros which likely requires ASP sanctioning. Indeed, Brevard County hosts regional surfing competitions such as the National Kidney Foundation event (Labor Day weekend) and the Annual Easter Surf Festival, both occurring in Cocoa Beach, which exist and thrive in the absence of an ASR. What the ASR offers is the potential of landing for Cocoa Beach what would not have been possible in its absence: an ASP sanctioned event, similar in magnitude to the O’Neil Sebastian Inlet Pro.

PRÆCIPPIO EFS believes it is essential to include the expected benefits, but do so in a formalized manner that assesses the expected benefits in light of the uncertainty surrounding the event. Positing that the construct of ASR de facto implies that an ASP 5-star sanctioned competition will occur at that site within a specified time period belies the inherent difficulties associated with promoting such an event. Special event benefits must be evaluated within this context, which advances this issue further along than the simple ad-hoc inclusion or mention of such a possibility, which pervades earlier feasibility studies.

2.13 Narrowneck Postscripts

The Narrowneck ASR was constructed during the time period of 1999-2000, at a cost (including design and refurbishment) of A\$2.8 million [Jackson & Corbett 2007]. The engineering firm serving as project manager of the NGCBPS was International Coastal Management (ICM), whose director and principal engineer, Angus Jackson, has served as lead author in several papers (i.e., Jackson et al. 2005; Jackson et al. 2007; Jackson & Corbett 2007) evaluating the performance at Narrowneck as well as other multi-functional ASRs. From Jackson & Corbett (2007), the following select postscripts are offered verbatim:

- The project appears to have achieved the objective of improving surfing conditions when swell, tide, and wind conditions are suitable.
- The reef does provide a quality surf wave at times, but it has not gained a reputation as a great surf spot. Part of the reason for this appears to be that:
 1. Very high expectations and initial media “hype” followed by negative media.
 2. There are a number of world class breaks in the area.
 3. When conditions favour the reef, a number of other local breaks work as well.
 4. The reef takeoff area is about 250m offshore [other natural breaks are closer to the shore].
- Despite a number of storm wave events (Hm up to 12m) coastal protection has been effective [Jackson & Corbett, p.4]

Phone interviews and/or email correspondence were conducted with various stakeholders in Australia including but not limited to: Angus Jackson; John McGrath, Gold City Council; Bobbie Corbett, ICM; Neil Lazarow, Griffith University, Norm Tomlinson, Narrowneck Longboard Club, and others. The essential feedback was consistent with the conclusions offered on the previous page: generally positive reviews related to shoreline stabilization function of the NGCBPS with a measured appraisal of the ASR’s improvement in surf amenity.



The total length of the Narrowneck strip is about 1 kilometer, with the Narrowneck Longboard Club using the southern part of Narrowneck Beach (south carpark) while the North End Boardriders (shortboarders) use the area around the northern carpark. Norm Tomlinson, President of the Narrowneck Longboard Club, offered this assessment: “on the days it works it’s good, but it’s not consistent.” He emphasized that “it does appear to protect the beach but with respect to surfing it hasn’t had that big an impact.” “It was better early on but now the sand has built up and the conditions have to be just right for it to work.” (Tomlinson, telephone conversation)

Mr. Tomlinson also mentioned significant fishing and diving activity out at the ASR, which is consistent with the Jackson et al. (2004, 2007) and Jackson & Corbett (2007) studies documenting marine colonization on the reef. The fact that the reef is a well known spot for fishers and divers, however, tends to reinforce the notion offered on the previous page that the site is not considered one of the premier surf spots on the Gold Coast.

No follow-up economic studies have been performed, so substantiation that the NGCBPS benefits have indeed justified costs is lacking. And this does not even begin to broach the idea of disentangling what shoreline benefits the ASR afforded, separable from the massive beach renourishment effort. Recall R&M’s study analyzed how negative media attention associated with erosion events caused an underperformance of Gold Coast tourism in relation to general Queensland tourism. This result was derived with a relative paucity of data. Some years later, longer time period data sets in conjunction with the timing of storms during the period after the ASR was constructed may corroborate or reject that initial finding. However, quantifying the marginal contribution of the ASR itself would be problematic.⁸

Mike Raybould, lead author of the NGCBPS, was contacted by email; he has apparently moved on to different literature streams and provided a referral to Neil Lazarow, doctoral student at the Australian National University and Project Manager for the Gold Coast Shoreline Management Plan. Along with Chad Nelsen, doctoral student at UCLA and Environmental Director of The Surfrider Foundation (Nelsen’s writing on Pratte’s Reef will be discussed later), Lazarow is a lead researcher in the emerging niche of surf economics. [Lazarow et al. 2007; Nelsen et al. 2007]

As in many of the interviews conducted during the course of this study, the following question was posed to Lazarow: Is there any evidence that the ASR is economically justified (i.e., a benefit-cost ratio greater than one)?

As far as I'm aware this analysis has not been undertaken. Most of the studies that attempt to define the socio-economic (surfing) related benefits of reefs are coarse at best and there is no common method for collecting and therefore comparing cost:benefits. Also scale, purpose and prevailing conditions (incl future conditions) all impact on this.

⁸ To complicate matters even further, if the area in question already falls under a beach renourishment program, then marginal benefit of the ASR would simply be the cost savings at which it can accomplish the task. If the local cost share is zero, the ASR would provide no shoreline benefit from a local frame of reference.



The science is inconclusive. Hard(er) structures e.g. might provide better infrastructure protection but might present significant economic, social and environmental risks.

You must be aware that if this (Cocoa Beach, my insertion) project proceeds, it will be viewed as another test case rather than a sure thing. (emboldened, emphasis mine)

Having said this, if we get the science right and the reef is able to deliver benefits across the board (protection, habitat and amenity) then it may be a good investment. Without knowing more about the local environment and the socio-economic situation in the area it's hard to be more conclusive. [Lazarow, email correspondence]

This perhaps, offers the final and most crucial insight from the Narrowneck experience. Despite the industry's decade of experience, *from a commercial perspective*, artificial surfing reefs are a new and unproven product. For a variety of reasons, the project **may** fail to deliver benefits that would justify costs, even when it performs as technically specified (e.g., due to open-access issues, competing quality breaks, distance to the shoreline, etc.). Without empirical substantiation, the inherent risk associated with this project must be factored by an appropriate risk-adjusted discount rate. More on this point will be offered in a later section.

Finally, as for the X-factor, while the Gold Coast hosts ASP sanctioned competitions (even the elite WCT events), no star-rated tournaments of any level are held at Narrowneck.

2.2 NEW ZEALAND: OPUNAKE & MOUNT MAUNGANUI

Like the NGCBPS program on the Gold Coast, ASR activity in New Zealand also informs this research effort highlighting important lessons for policymakers. ASR construction began at Mount Maunganui in 2005 and Opunake in 2006; the latter still has some final work remaining, which may not occur until 2009, while the former was recently completed during summer 2008. Both projects suffered from construction delays (i.e., new technologies have construction learning curves), adverse weather conditions, and funding issues.⁹ The two New Zealand ASRs are about a tenth of the size of Narrowneck ASR and a fourth of the size of the proposed Cocoa Beach ASR. They are similar in design to the proposed Cocoa Beach ASR as well as Narrowneck in that they utilize sand-filled geotextile containers.¹⁰ Design and construction were handled by Amalgamates Solutions and Research, a New Zealand base firm. For purposes of full disclosure it should be noted that the U.S. branch of Amalgamates Solutions and Research are participants in the broader feasibility study to which this economic report will be appended.

⁹ This is described in a few of the interviews which are appended to this study as well as new articles from New Zealand that are accessible online. In addition, PRÆCIPPIO contacted both contractors (i.e., Rob Campbell, Bay Underwater Services and Mike Sharp, New Plymouth Underwater Services) who worked the early stages of Mount Maunganui and Opunake projects, respectively. Dr. Shaw Mead of Amalgamates Solutions and Research also provided interview comments which are appended.

¹⁰ Unlike Narrowneck and the proposed Cocoa Beach ASR, they are strictly designed for surfing amenity.



2.21 *Opunake*

Though unfinished, the Opunake ASR experience opens this section, specifically to explore Opunake's well-developed feasibility study, which, like the R&M papers, highlights methodologies which will be employed for the Cocoa Beach analysis. The study, entitled "Proposed Artificial Surf Reef, Opunake, South Taranaki: Economic and Social Impact Report," was prepared for the Opunake Artificial Surf Reef Committee and funded by the South Taranaki District Council. It was completed in March 2002 by the consulting firm Tourism Resource Consultants (TRC).

The scope of the feasibility study was straightforward: assess the economic and social impact of proposed dual artificial reefs and associated land-based infrastructure costing NZ\$3.45 million. TRC provided a strong recommendation for the construction of the lesser expensive northern reef and associated infrastructure costing NZ \$1.35 million. A thorough (though tedious) description of how they derived the additional tourist expenditure at the regional and district level is provided in the appendix. The basics of the analysis, however, are the following:

2.22 *TRC Economic Model*

- Eschews possible economic benefits arising from advertising royalties, special events, media coverage, growth of small businesses under the premise that no accepted methodology exists for quantifying such benefits with any degree of certainty and that the inclusion thereof "has tended to overestimate the amount of economic return and has led to a miss-match of expectations and actual performance." [TRC, p. 29]
- 100 ASR surfable days per year with 37 surfers per day (year 1); surfers per day rise to 64 per day by year 5; it is assumed that growth rises by 3% thereafter
- Additional expenditure generated at the Regional level amounts to **\$129,920** in year 1 and **\$288,120** in year 5; a multiplier of 1.75 is employed
- Additional expenditure generated at the District level amounts to **\$197,760** in year 1 and **\$349,450** in year 5; a multiplier of 1.75 is employed
- Economic benefits have been expressed in terms of value-added and are also expected to grow by 3% per year; the step of converting expenditure into net income accruable to the Region or District is implicit
- Payback period for the District is 24 years and for the Region 27 years

The TRC analysis showcases specific fundamentals which are employed in other feasibility studies. Combining a technical measure of how many days the ASR would break (improved surfing condition) with both a demand-based projection on the number of surfers per day and a survey based daily tourist spend figure, new expenditure occurs within the community generating secondary effects through a multiplier process.



As compared to what PRÆCIPPIO will posit for the proposed Cocoa Beach ASR, the TRC stipulates fewer surfers per day but a much larger share of those surfers being non-locals (70-30 split). No rationale is offered for that assumption, but the area is not heavily urbanized, and unlike Brevard County, may not have a significant local surfing base.

2.23 *Opunake Postscripts*

At first glance the Opunake experience, when seen in the light of its feasibility study, offers some apparent contradictions. Project payback periods approximating 25 years indicate substantial risk. Without being privy to the internal discussions among TRC, the Opunake Artificial Surf Reef Committee, and the South Taranaki District Council, it is hard to speculate on the dynamics of this issue.

What is clear is that the South Taranaki District Council understood the “newness” of the technology when they made their decision. Craig Stevenson, Chief Executive of the South Taranaki District Council (a significant financial stakeholder in the project), offered these comments in response to the following question: *Retrospectively, are there any apparent lessons or insights to be garnered from the Opunake ASR project that might drive more favorable benefit-cost ratios at prospective ASRs?*

All parties have learnt many lessons during the development of this ASR but not necessarily ones that might drive a more favourable BC ratio. My personal view is that an ASR could well have genuine economic benefit in the right environment eg ... at an existing tourist mecca (such as yours?) where there are larger numbers of potential users. It is "another reason to come" and until they become commonplace, an ASR still represents a reasonable point of difference.

In summary, our Council made a significant grant (\$1.1million) to a local community group to enable the ASR to be built. It was a calculated gamble made by a courageous Council with a desire to do something that would "make a difference" for the Opunake community and our district. We were aware ASRs were (and still are) reasonably new and experimental and there are a number of unknowns surrounding design, and construction. For two summers the weather thwarted progress and it looked like we had invested in a "white elephant". Happily, progress over the last two months has given cause for renewed optimism.

As stated in the TRC feasibility study, Opunake had suffered job losses of between 200-300 during the previous two decades [TRC, p. ii]. Given what must have been a pressing desire to catalyze economic regeneration, the South Taranaki District Council’s decision to provide funding for this project is more easily understood.

Because the project is not complete, it is impossible and only fair to conclude that it is still too early to tell whether reef commercial performance will disprove TRC’s initial assessment of a 25 year payback. Steve Corkill, the Opunake geographic representative for the TSB Community Trust,¹¹ believes there are still

¹¹ The two New Zealand ASRs were funded by privately established community trusts, of which local governments were significant funders. The TSB Community Trust is a private trust



“subsidence issues mid-reef and that extra bags may be needed to fine tune.” [Corkill, phone Conversation]. Corkill also described that the targeted site was a natural amphitheatre with higher ground surrounding the bay area. Harkening once again to the X-factor, reef placement would then be optimal for the hosting of surf competitions.¹²

Corkill opined that in its current incomplete state, the Opunake ASR could not possibly host a star-level event. Whether it will or not upon completion is speculative, but at the present time, the Opunake experience does not offer any substantiation of commercial success.

2.24 *Mount Maunganui*

The Mount Maunganui ASR began construction in November 2005 and incredibly, construction was to have been completed prior to that year’s end.¹³ In many ways the Mount Reef experience parallels the Opunake experience, or vice-versa given that Mount Reef construction predates Opunake work. Weather related delays, construction issues, and the securing of funding in a timely manner all worked against the timely completion of the project.¹⁴

In March 2008, PRÆCIPPIO contacted Stephen Town, Chief Executive of the Tauranga City Council. In response to our interview questions, he provided the following statements:

I am able to provide the following comments on behalf of Council about the reef project.

- Council is a substantial funder of the reef project.
- Council has been supporting the ongoing fund raising effort to make sure the reef can be completed.
- It was fully understood from the beginning that the reef design was experimental in nature - Council accepted this risk being the first design of its type in NZ.
- The reef is not completed to its design - there is stabilization and bag filling still to complete.
- There is speculation that the performance of the reef will not meet the predicted performance stated in the design.
- Best wishes for your project's success.

established by a bank and dedicated to funding community projects. The TSB Community Trust is, however, not to be confused with Opunake Trust dedicated to funding the ASR. The TSB Community has provided funding for the Opunake ASR in the amount of NZ\$600k.

¹² TRC does discuss the notion of the reef increasing the chances of hosting a national or international surf competition, but as stated earlier, they exclude these possible benefits from their analysis.

¹³ Via David Dunham, Bay of Plenty Times, New Zealand. Dunham provided links to several stories concerning the Mount Reef over the past three years.

¹⁴ See, for example, the Hadfield interview which appends this document.



During summer 2008, when word spread that the Mount Reef might be completed, PRÆCIPPIO re-contacted Stephen Town who provided the following statements:

- Council was of the opinion that the ASR was experimental...and we believe unproven
- Council believes it is finished, with the design modified to address early performance issues
- Council has had concerns about a lack of timely delivery
- Council believes the reef will prove a *modest* surfing experience

The project is most likely complete - the Mount Reef Trust, the private entity dedicated to raising money for the Mount Maunganui ASR, has exhausted its funds, with expenditures having amounted to NZ\$1.45 million according to the trust's Craig Hadfield. Funds were derived primarily from local council and tidal change lottery commission. [Hadfield, email correspondence]

2.25 *Mount Maunganui Postscripts*

PRÆCIPPIO EFS spent significant time interviewing surfing stakeholders in New Zealand, with proportionately more of the focus on Mount Maunganui. It is safe to say that Swiss neutrality is lacking. The growing delay in the project's completion is apparently equally matched with building frustration levels. In short, opinions are strident,¹⁵ attitudes have hardened, and it is fair to question whether the ASR, now that it is complete, will really get a "fair shake" with the public in the event it does transpire to perform consistent with early expectations.

Almost a decade ago a grad student at the University of Waikato, Victoria Hough, completed a directed research project under the supervision of Hamish Rennie of the Department of Geography. It was entitled, "Assessing the Economic Effects of Recreation Facility Development: Proposed Artificial Surfing Reef, Mount Maunganui, New Zealand. Hough (1999) estimated the following benefit fundamentals for the local economy: (i) 50 additional surfers per day; (ii) NZ\$4,575 in extra expenditure per day (about \$65); and, (iii) over NZ\$1.5 million in extra expenditure for the year.

¹⁵ In order to solicit surfer opinion on the Mount Maunganui and Opunake ASRs, the lead author of this report posed the very same interview questions appended to this document on a leading surf website's forum in New Zealand (Surf.co.nz). The sample is non-random, the participants are not necessarily coastal engineers, but they certainly are stakeholders and it was deemed beneficial to acquire the tenor of feeling from the largest selection of people possible. The direct link to the message thread is www.snow.co.nz/cgi-bin/ultimatebb.cgi?ubb=get_topic&f=8&t=006833, and though this has not been verified by PRÆCIPPIO, there have been suggestions that this thread actually posts on search engine requests concerning ASRs. For disclosure purposes one of the more strident forum voices, Roy Stewart, was the conduit for PRÆCIPPIO's discovery of the forum. Mr. Stewart has had (and still has) an outspoken and negative opinion of the ASR and its commercial vendor. His opinion is one of many diverse viewpoints on the thread.



Given Mount Maunganui ASR's construction cost, Hough's study would have estimated project payback within one year. Since the ASR has taken three years to complete, Hough's thesis has not been validated as a predictive device, but her basic approach (additional visitors, daily spends, etc.) is consistent with the TRC study and the methodology that will be employed in section 3 of this study.

As far as the performance of the newly completed ASR, according Mount Reef Trustee Hadfield: "[We] need a good swell (northeasterly) to determine how well the reef will work; final evaluation may have to wait until the upcoming summer." [Hadfield, email correspondence] So, similar to the Opunake experience, no substantiation of economic benefits is afforded at the time this report is being written.

In the Opunake feasibility study TRC (2002, p. 5) stipulated the following lessons had been learnt about ASRs:

1. The technology is relatively new and the expertise in Australasia is found largely within one consulting firm that has developed the technology.
2. The success of the existing reefs is mixed.
3. The economic benefits have not been as much as predicted.

Given that neither of the New Zealand ASRs can be evaluated on economic merits in either their incomplete or recently completed state, those lessons are just as valid today and inform the risk assessment conducted later in this report.

2.3 BARGARA, PRATTE'S REEF, AND CABLES ASRS

Three other artificial reefs have been constructed and are briefly touched upon. **Bargara**, located in Queensland, Australia, was completed in 1997 at a cost of A\$10,000. [Jackson & Corbett 2007]. Given its smaller size, difference in composition (i.e., rock), the lack of modeling employed, and the fact that Bargara's cost is one-eighth the amount of this initial feasibility study for Cocoa Beach, it is hard to see the relevance of Bargara with respect to this project.

Pratte's Reef, named after Tom Pratte, the first Executive Director of Surfrider Foundation, was constructed as mitigation for lost surfing area due to the construction of the "El Segundo Groin" by Chevron. Prior to Chevron's action the area had been considered a prime surfing venue.

The reef was constructed during 2000-01 at a cost \$300,000. [Jackson & Corbett 2007] The post completion monitoring of the reef reported the project as a failure to achieve most of its goals. Firstly, the reef crests were eroded away within months of construction, and by 2003, were no longer capable of significantly affecting swells. Secondly, there was a neutral effect if any on shoreline; it did not prevent erosion of the beaches. [Borrero & Nelsen 2003]



The underperformance as a surf spot was deemed to have been a legacy of design more than anything else. [Borrero & Nelsen 2003]

Monitoring revealed that the reef settled to a position that was smaller than the amplitude of sand bars forming under winter surf conditions and was not shallow enough to cause wave breaking under smaller summer conditions. [Surfrider Foundation ASR White Paper 2008]

Jose Borrero, who co-authored the study detailing the comprehensive monitoring program, put it more succinctly when he offered these comments in response to the following question: *Did the Pratte's Reef ASR significantly improve surfing conditions?*

NO. The design was doomed from the beginning. Pratte's was not designed properly if at all... There were a few days when the reef 'broke', but other sites were as good or better on those same wave conditions.

The 'designer' of Pratte's did not do any numerical modeling, wave climate analysis or beach surveys at the site before designing Pratte's.

In hindsight, Pratte's may have been compromised before the first bag was placed. The Pratte's ASR, as reported by Surflife, ended on October 9, 2008 when the sandbags were removed from the water. [www.surflife.com]. However, in failure, a success, of sorts, occurred in the precedent established: the mitigation agreement which birthed Pratte's Reef de facto recognized the value of surf amenity. [Borrero & Nelsen 2003].

Cables Reef, located off the town of Cottesloe (near Fremantle) in Western Australia, was built in 1998-99 at a cost of A\$1.4 million. Unlike the sand-filled bags utilized at Pratte's, Narrowneck, Mount Maunganui and Opunake, Cables was constructed via rock placement, with a size in cubic meters approximately of that found at Mount Maunganui and Opunake (i.e., 5,000 m³). [Jackson & Corbett 2007].

Pattiaratchi (2003, 2007) details the monitoring of Cables and concludes that wave breaking occurred on about 140 days per year during 1999-2001 and has been sustained. Other studies offer the following assessments.

From Jackson & Corbett (2007), these select postscripts are offered verbatim:

- The location has abundant swells and a low tide variation that are suitable for a surfing reef.
- The project appears to have "improved" surfing conditions when swell, tide and wind conditions are suitable.



- The reef does provide a quality surf wave at times, but it has not gained a reputation as a great surf spot. Part of the reason appears to be that.
 1. There are a number of good surf breaks in the area.
 2. When conditions favour the reef, a number of other local breaks work as well.
 3. The reef takeoff area is about 300m offshore [other natural breaks are closer to the shore].

Rafanelli (2004), in a feasibility study dealing with a proposed ASR at another spot in Western Australia, Geraldton's Mahomet Beach, appears to confirm the Jackson & Corbett outlook when she wrote: "As a result of Cable Stations requiring a minimal level of approximately 1.5 metres of swell which is not always available, the reef functions less effectively than was designed (Norris 2004)." The Norris citation is not listed in Rafanelli's references so no direct confirmation could be afforded.

Another brief assessment is provided by Tourism Resource Consultants, who in their feasibility study for Opunake, simply state: "The reef functions less effectively than was designed." PRÆCIPPIO EFS contacted various stakeholders in Western Australia (e.g., surf industry, life-saving clubs, local newspaper, Western Australia Tourism, etc.) with feedback essentially confirming the outlook that Cables was not a significant tourist impact. An interview with the town of Cottesloe's Manager of Engineering Services, Geoff Trigg, states this point with a minimum of words:

- *Did the Cables ASR significantly improve surfing conditions?*

A. The reef was built in 1998/99. No significant surf improvements are obvious.
- *Did the ASR attract more visitors and economic expenditures in the surrounding region?*

A. Little to none.
- *Is there any evidence that the ASR is economically justified (i.e., a benefit-cost ratio greater than one)?*

A. No.
- *Retrospectively, are there any apparent lessons or insights to be garnered from the Cables ASR project that might drive more favorable benefit-cost ratios at prospective ASRs?*

A. The works were not funded by this town. The site of the works were and are still not near any commercial outlets or activities. There are a number of naturally occurring surf sites in the area which have always been well used.

The artificial reef area is now 'out of site, out of mind'. [Trigg, email correspondence]



This background reconnaissance review highlights PRÆCIPPIO’s fundamental concern over the uncertain nature of the economic benefits associated with ASRs, a relatively new market niche. That uncertainty must be reflected in an appropriate discount rate utilized to value risky net cash flows in present dollar terms. Other methodological concerns have been noted; their treatment and the estimation of recreational benefits are covered in section 3.



3.0 RECREATIONAL BENEFIT ESTIMATION

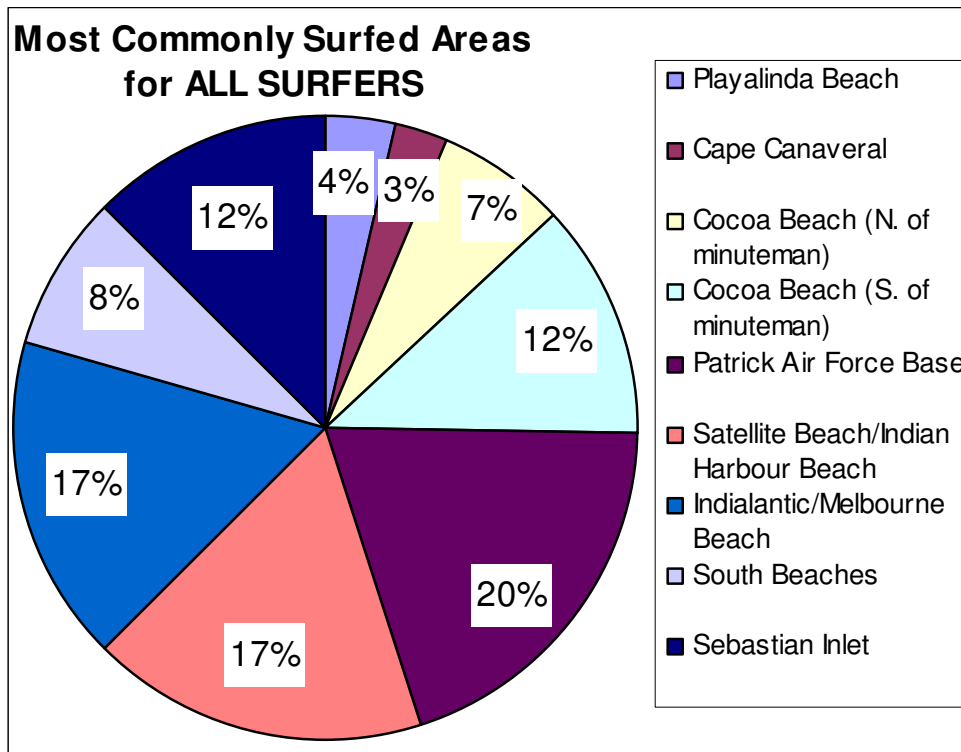
3.1 DESCRIPTIVE STATISTICS ON BREVARD COUNTY SURFING

During spring 2008 Florida Tech master’s student Brain Kelly began collecting data for his thesis. His focus concerns the value of coastal resources and as part of his study data on surfing was collected. Kelly provided PRÆCIPPIO access to a portion of his dataset to provide some local color to the recreational benefit analysis.

Collection, which was internet based, was facilitated by posted notice on popular Brevard County surfing websites (e.g., 2nd light). About 550 surveys were collected, with about 62 percent of respondents local and 38 percent non-local.

Figure 2 highlights the most commonly surfed areas (by percentage) of all surfers utilizing Brevard County. The joint area of Satellite Beach and Patrick Air Force comprises almost 40 percent of the distribution.

Figure 2: Most Commonly Surfed Areas in Brevard County



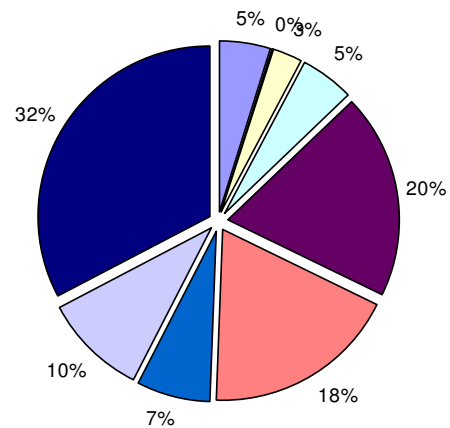
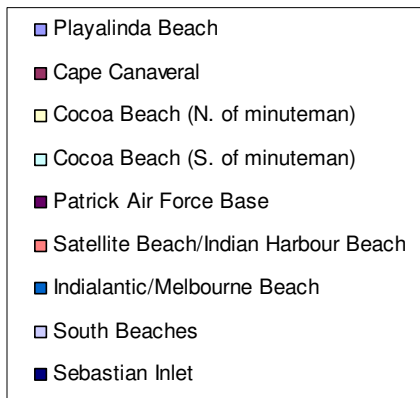
Source: PRÆCIPPIO EFS; data Kelly



Figure 3 highlights the areas considered to be the best surf spots for all surfers utilizing Brevard County. The joint area of Satellite Beach and Patrick Air Force comprises almost 40 percent of the distribution, similar to the distribution based on usage. Note that while Sebastian Inlet comprised 12 percent of usage (see Figure 2), it is considered the best spot by 32 percent of surfers.

Figure 3: Best Surf Spots in Brevard County

**Areas Considered the Best Surf Spots
By ALL Surfers**



Source: PRÆCIPPIO EFS; data Kelly

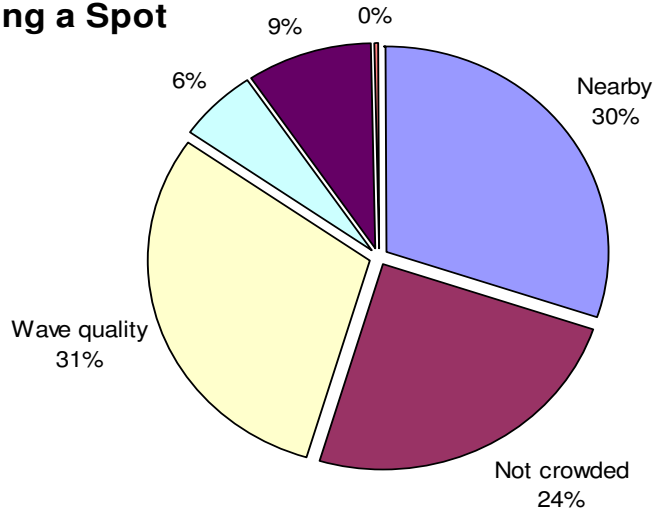
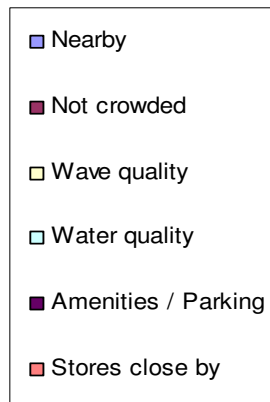
Figures 4a and 4b highlight the motivations of surfers in their choice of surf spot. Similar results are found with respect to surfer motivation: in short, about a third of respondents indicated that wave quality was their primary motivation, with the absence crowding the driving force for a quarter of respondents. Another prime motivator centered on the nearness of the break, with the emphasis on proximity stronger for locals.

Finally, it is informative to note the origins of the Brevard County surf market. Figures 5-7 provide snapshots of Brevard’s regional and national drawing power, and predictably depict visitation pattern intensity along the I-95 north-south interstate and the I-4 central Florida I-4 east-west corridor. Nationally, Brevard surfing exhibits scattered pull across the lower 48 states, with greater pull east of the Mississippi River.

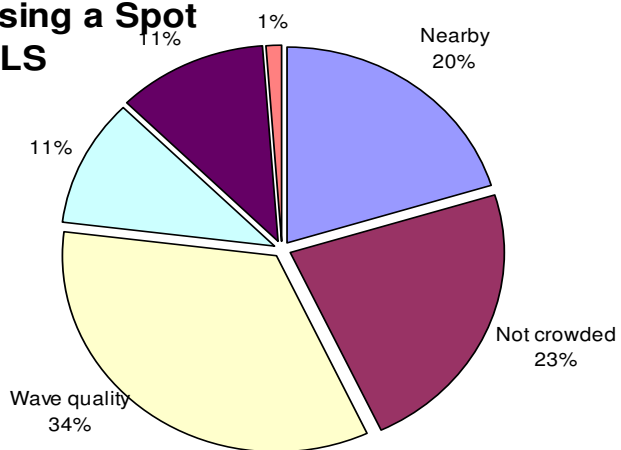
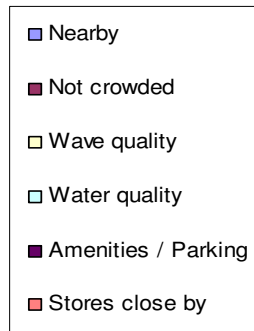


Figure 4a,b: Motivation for Choosing Surf Spots, Locals & Non-Locals

**Motivation for choosing a Spot
LOCALS**

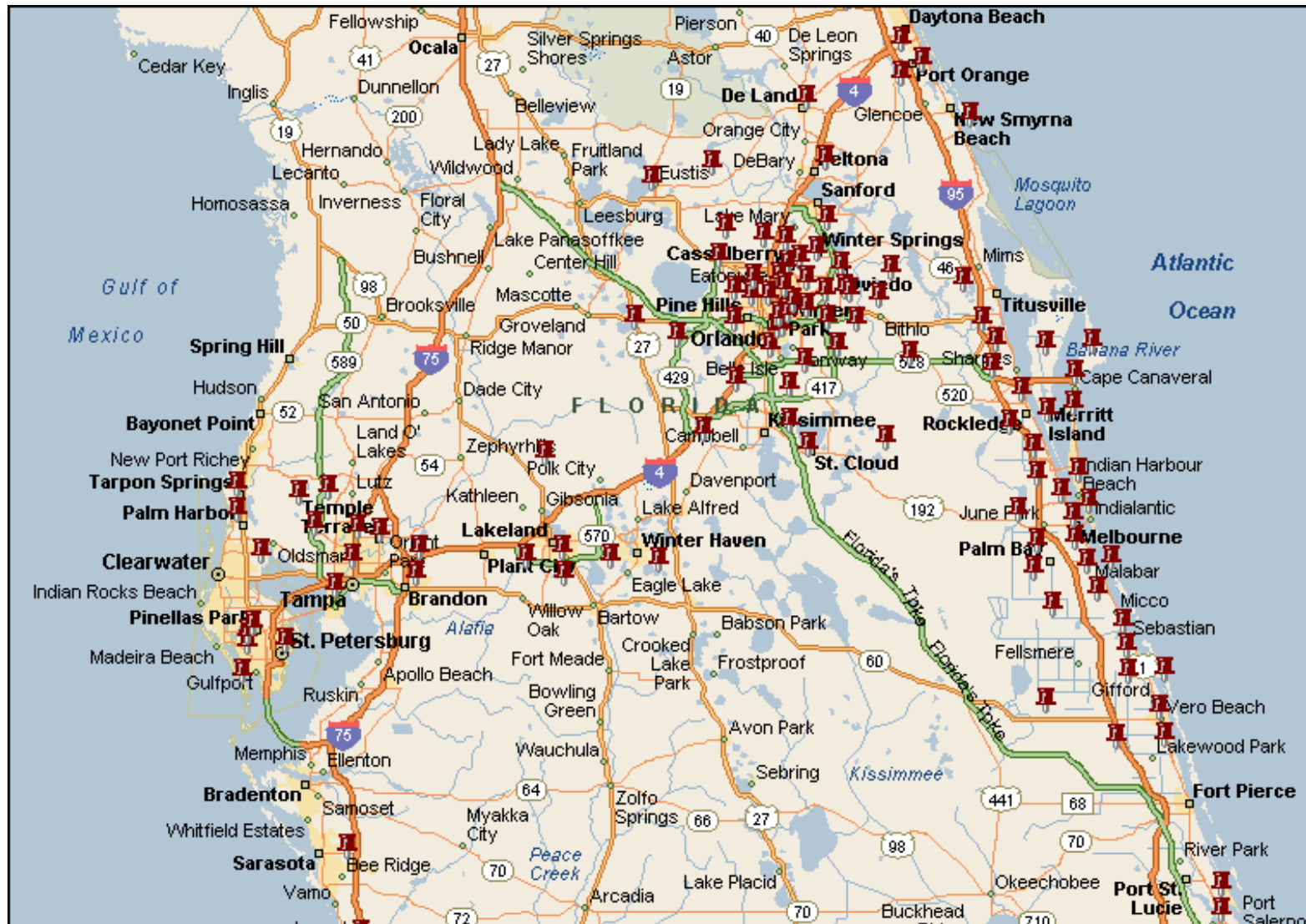


**Motivation for choosing a Spot
NON-LOCALS**



Source: PRÆCIPPIO EFS; data Kelly

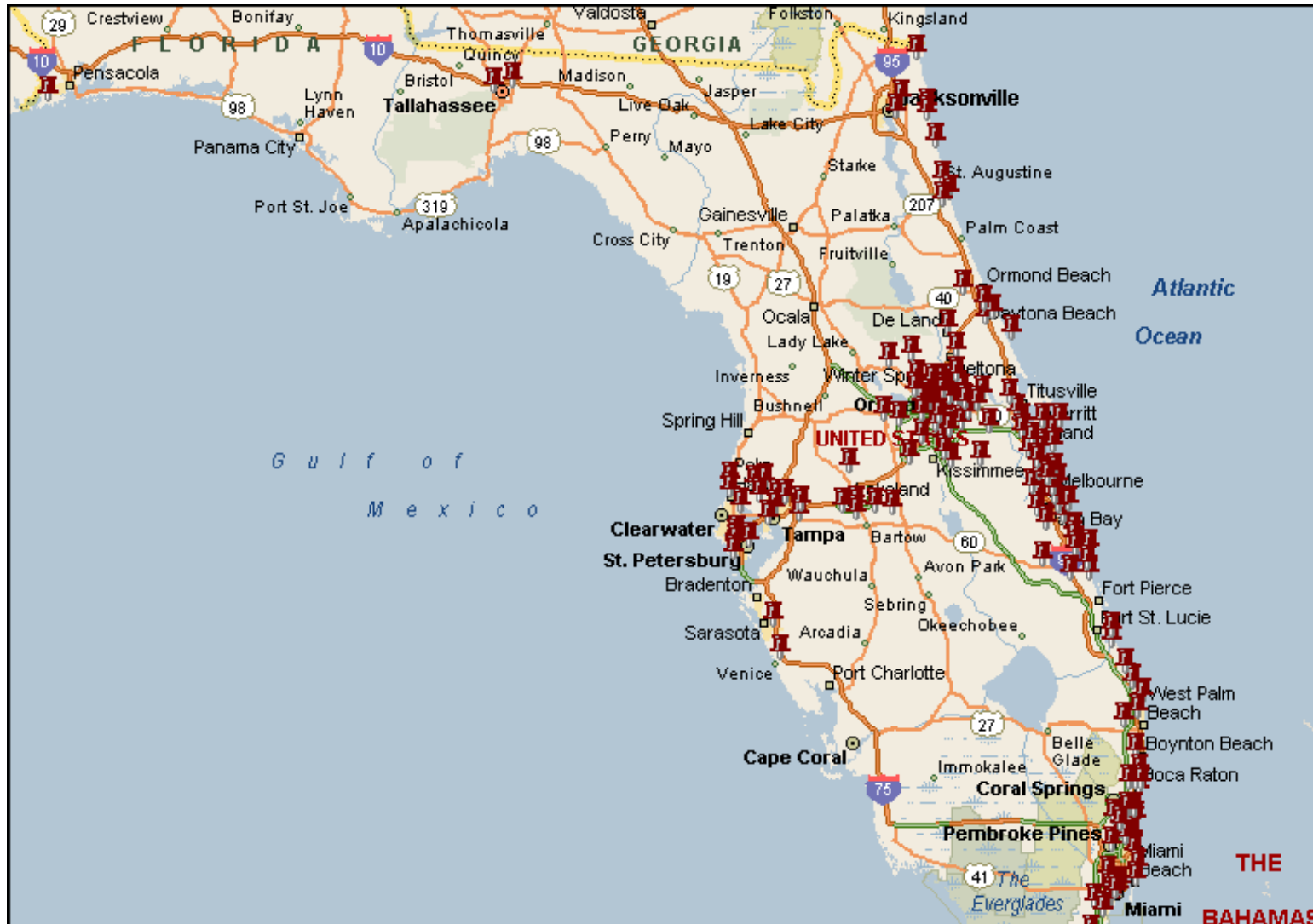
Figure 5: Origins of Surfers Using Brevard Breaks – Central Florida Focus



Source: PRÆCIPPIO EFS; data Kelly; Microsoft MapPoint 2009



Figure 6: Origins of Surfers Using Brevard Breaks – State of Florida Focus



Source: PRÆCIPPIO EFS; data Kelly; Microsoft MapPoint 2009



Figure 7: Origins of Surfers Using Brevard Breaks – United States Focus



Source: PRÆCIPPIO EFS; data Kelly; Microsoft MapPoint 2009



3.2 ARTIFICIAL SURFING REEF RECREATIONAL BENEFITS

3.21 *The Line-up & Shifts*

In section 4.5 of the main report, the expectation is expressed that surfers will congregate at the take-off point as is observed at Sebastian Inlet's "First Peak." The opinion of ASR America is that each arm of the reef can support about 15 surfers, defining a capacity of 50 surfers per shift. Interviews with surfers confirmed that this was a reasonable assumption.

Previous survey based reports, feasibility studies, and interviews with local surveys suggest a surf shift or session typically averages between 1.5-2.5 hours. For this analysis it is assumed that a rotation of 5 surf shifts/sessions occur per day.

3.22 *Yearly Improved Capacity*

Surfbreak Engineering Services has estimated that the proposed ASR will improve surfing conditions approximately 33.74 days per year. This result is accepted as a direct report. The yearly improved surf capacity increase is consequently the product of 33.74 improved surfing days per year multiplied by 50 surfers per shift multiplied by 5 shifts per day. This amounts to an increase in yearly improved capacity of 8,435 surf visit sessions. In Table 1 on **p.30**, this number is reported in column 2.

3.23 *Non-Local Share*

As discussed earlier in section 2 of this appended report, establishing a non-local share of visitation is imperative due to the ASR's open-access provision. Recent surveying of Brevard County surfers conducted by Florida Tech DMES master's student Brian Kelly revealed a local versus non-local distribution of 62% locals and 38% non-locals. Additionally, locals surf about 11 days per month while non-locals surf about 3 days per month. When the local vs. non-local share ratio is weighted by surfing intensity per month it yields a non-local surfing share of 16.6%. Or in other words, on any given day about one-sixth of the surfers at Brevard County breaks are non-local.

This ratio was corroborated with evidence from Trestles, California obtained from Chad Nelsen. At the county level Nelsen reckons that 80% of the surveyed surfers at Trestles were from either Orange or San Diego Counties, the host counties of Trestles. With greater surf intensity afforded to locals, the non-local surf ratio at Trestles also likely approximates one-sixth of total surfing activity.



TABLE 1: ESTIMATED ARTIFICIAL SURFING REEF RECREATIONAL BENEFITS

(1) Project Year	(2) Yearly Capacity Increase	(3) Non-Locals (NLs) share = 0.25	(4) Daily Tourist Sales 3.5% growth/yr	(5) Aggregated Direct Sales Daily Tourist Sales x NLs x Capture Rate = 90%	(6) Total Sales SAM Multiplier = 1.5	(7) REC BENS (DR = 0) Value-Added = 60% of Total Sales	(8) REC BENS (DR = 0) Tourist Sales Daily Tourist Sales x NLs	(9) REC BENS Value-Added DR = 16%	(10) REC BENS Tourist Sales DR = 16%
1	8,435	2,109	\$57.80	\$109,697	\$164,546	\$98,727	\$121,886	\$85,110	\$105,074
2	8,435	2,109	\$59.82	\$113,537	\$170,305	\$102,183	\$126,152	\$75,939	\$93,751
3	8,435	2,109	\$61.92	\$117,510	\$176,266	\$105,759	\$130,567	\$67,756	\$83,649
4	8,435	2,109	\$64.08	\$121,623	\$182,435	\$109,461	\$135,137	\$60,454	\$74,635
5	8,435	2,109	\$66.33	\$125,880	\$188,820	\$113,292	\$139,867	\$53,940	\$66,592
6	8,435	2,109	\$68.65	\$130,286	\$195,429	\$117,257	\$144,762	\$48,127	\$59,416
7	8,435	2,109	\$71.05	\$134,846	\$202,269	\$121,361	\$149,829	\$42,941	\$53,014
8	8,435	2,109	\$73.54	\$139,565	\$209,348	\$125,609	\$155,073	\$38,314	\$47,301
9	8,435	2,109	\$76.11	\$144,450	\$216,675	\$130,005	\$160,500	\$34,185	\$42,204
10	8,435	2,109	\$78.78	\$149,506	\$224,259	\$134,555	\$166,118	\$30,502	\$37,656
11	8,435	2,109	\$81.53	\$154,739	\$232,108	\$139,265	\$171,932	\$27,215	\$33,598
12	8,435	2,109	\$84.39	\$160,155	\$240,232	\$144,139	\$177,950	\$24,282	\$29,978
13	8,435	2,109	\$87.34	\$165,760	\$248,640	\$149,184	\$184,178	\$21,665	\$26,748
14	8,435	2,109	\$90.40	\$171,562	\$257,342	\$154,405	\$190,624	\$19,331	\$23,865
15	8,435	2,109	\$93.56	\$177,566	\$266,349	\$159,810	\$197,296	\$17,248	\$21,294
16	8,435	2,109	\$96.84	\$183,781	\$275,672	\$165,403	\$204,201	\$15,389	\$18,999
17	8,435	2,109	\$100.22	\$190,213	\$285,320	\$171,192	\$211,348	\$13,731	\$16,952
18	8,435	2,109	\$103.73	\$196,871	\$295,306	\$177,184	\$218,745	\$12,251	\$15,125
19	8,435	2,109	\$107.36	\$203,761	\$305,642	\$183,385	\$226,401	\$10,931	\$13,495
20	8,435	2,109	\$111.12	\$210,893	\$316,339	\$189,804	\$234,326	\$9,753	\$12,041
21	8,435	2,109	\$115.01	\$218,274	\$327,411	\$196,447	\$242,527	\$8,702	\$10,743
22	8,435	2,109	\$119.04	\$225,914	\$338,871	\$203,322	\$251,015	\$7,764	\$9,586
23	8,435	2,109	\$123.20	\$233,821	\$350,731	\$210,439	\$259,801	\$6,928	\$8,553
24	8,435	2,109	\$127.51	\$242,005	\$363,007	\$217,804	\$268,894	\$6,181	\$7,631
25	8,435	2,109	\$131.98	\$250,475	\$375,712	\$225,427	\$278,305	\$5,515	\$6,809

Source: PRÆCIPPIO EFS

\$744,154 \$918,709

Key parameter values: (i) 33.74 improved surfing days as estimated by SES; (ii) 25 surfers per line-up; (iii) dual line-ups (RHS & LHS point breaks); (iv) 5 shifts per improved surfing day; (v) non-local surfers as a percent of surfers on the ASR equals 25%; (vi) daily tourist sales (\$57.80) are deconstructed from PMG study; (vii) capture rate (90%), SAM multiplier (1.5), and value-added share of total sales (60%) are simulated from an IMPLAN run utilizing PMG sales by category; and, (viii) discount rate of 16% reflecting risk-free return and risk premium.



Model Assumptions

1. Yearly capacity increase (column 2) is the product of 33.74 improved surfing days (as determined by Surfbreak Engineering Services) multiplied by 250 surfers per day on the ASR (i.e., 25 per line-up x dual line-ups x 5 shifts per day where a shift is assumed to last for 1.5-2.0 hours).
2. Non-Local share of visitation (column 3) is imperative due to the ASR's open-access provision. Recent surveying of Brevard County surfers conducted by Florida Tech master's student Brian Kelly revealed respondents which were comprised of 62% locals and 38% non-locals, with locals surfing about 11 days per month and non-locals surfing about 3 days per month – this suggests a non-local surfing share of 16.6%. This ratio was corroborated with evidence from Trestles, CA obtained from Chad Nelsen. At the county level Nelsen reckons that 80% of the surveyed surfers were from either Orange or San Diego Counties, the host counties of Trestles. With greater surf intensity afforded to locals, the non-local surf ratio at Trestles also likely approximates one-sixth of total surfing activity. The non-local share ratio has been increased to 25% to account for the fact that for every surf party there are likely non-surfers that accompany participating surfers. The overage afforded here allows for 1 non-participant for every 2 participants.
3. Daily tourist sales (column 4) is deconstructed from the PMG study (and corroborated with literature citations). A 3.5% yearly growth rate is posited which accounts for inflation (2.5%) and a modest real increase (1%) in daily purchases.
4. The capture rate of 90% is simulated from an actual IMPLAN run with the PMG deconstructed sales figures by category. Sales “captured” account for the margining of retail purchases and constitute the aggregated direct sales effect associated with ASR induced tourism. Column 5 is the product of columns 3 and 4 multiplied by a factor of 0.9.
5. A multiplier of 1.5 reflects the multiplier obtained from an actual IMPLAN run with the PMG deconstructed sales figures by category. The Total Sales Effect (column 6) is simply column 5 multiplied by 1.5 and includes the direct, indirect, and induced effects of tourist purchases.
6. Recreational Benefits (column 7: value-added, discount rate = 0) are defined as the value-added accruing to Brevard County as a result of tourist purchases inclusive of multiplier effects; value-added refers to the income payments made by industry in wages, interest, profits, and indirect payments, and is a regional corollary to gross domestic product figures reported in business and economic reports. Value-added recreational benefits are obtained by multiplying column 6 by 0.6 – the value-added ratio of 60% of the total sales effect is arrived at from an actual IMPLAN run with the PMG deconstructed sales figures by category.
7. Recreational Benefits (column 8: tourist sales, discount rate = 0) are defined as daily tourist sales (column 4) multiplied by the number of additional tourists induced into the area due to the ASR (column 3). Column 8 is sometimes reported when assessing economic benefits, and would be an alternative to column 7. No multiplier effects are included here due to the assumption of full-employment.
8. Recreational Benefits must be appropriately discounted to convert benefits accruing over a 25-year time period into a present value utilized in cost-benefit analysis. Discount rates reflect the risk level of the use of funds, not their source. The economic benefits derived from an ASR are uncertain and thus a risk-adjusted discount rate of 16% is utilized. This discount rate reflects both a risk-free return (4%) and a risk premium (12%) commensurate with historic average returns yielded by small company stocks (see Ibbotson) – that is, investors would require a return of 16% to induce them to invest in the ASR project, an investment at least as risky as the risk associated with an aggregate average of small company stocks. Recreational benefit risks associated with this project, which provide for uncertainty surrounding yearly net cash flows, include the following: (i) new technology performance, (ii) open-access issues, (iii) economic downturn, (iv) construction, (v) weather, and (vi) funding – the latter three risks impacting recreational benefits in possibly delaying the time period in which benefits actualize.

Results

The Present Value of expected recreational benefits aggregated over a 25-year time period is about \$745,000 under the value-added approach (column 9) and \$920,000 under the tourist sales approach (column 10). Columns 9 and 10 constitute alternative measures of benefits and are not meant to be added.



The non-local share ratio has been increased to 25% to account for the fact that for every surf party there are likely non-surfers that accompany participating surfers. The overage afforded in this analysis allows for 1 non-participant visitor for every 2 participating surfers. Multiplying column 2 by 25% yields to 2,109 yearly tourist surf sessions which is reported in column 3 of Table 1.

3.24 *Daily Tourist Sales*

Daily tourist sales are deconstructed from the PMG tourism study of Brevard County. The analysis is presented in Appendix B of this report. Table B6 from the appendix, estimated daily expenditure per surf tourist, is also copied here for convenience. The figure of \$57.80 is entirely in line with studies cited in both Lazarow et al. (2007) and Nelson et al. (2007). A 3.5% yearly growth rate in daily expenditure is posited which accounts for the long-term inflation rate (2.5%) and a modest real increase (1%) in daily purchases. These numbers are reported in column 4 of Table 1.

Table B6: Estimated Daily Expenditures by Surf Tourists, 2008 (2008 dollars)

Surf Tourism Expenditures	Spending per Tourist (456,499 Surf Tourists)	Spending/Day '02 (2002 dollars)	Spending/Day '08 (2008 dollars)
Lodging	\$21.13	\$14.68	\$19.08
Food/Drink	\$29.05	\$20.17	\$26.22
Clothing	\$8.93	\$6.20	\$8.06
Beach Items	\$2.57	\$1.78	\$2.32
Other Retail	\$2.34	\$1.63	\$2.12
	\$64.02	\$44.46	\$57.80

Source: PRÆCIPPIO EFS; data PMG Associates

3.25 *The Direct Effect*

The capture rate of 90% is simulated from an actual IMPLAN run using the PMG deconstructed sales figures by category. Sales “captured” account for the margining of retail purchases; that is, it ascertains the portion of total surf spending that accrues to local production. This accrued portion constitutes the aggregated direct sales effect associated with ASR tourism. This is reported in column 5 of Table 1, and is the product of column 3 multiplied by column 4 multiplied by a factor of 0.9.



3.26 Secondary Effects: Indirect & Induced Effect and the Multiplier

A SAM Multiplier of 1.5 reflects the multiplier obtained from an actual IMPLAN run with the PMG deconstructed sales figures by category. The Total Sales Effect (column 6 of Table 1) is simply column 5 multiplied by 1.5 and aggregates the direct, indirect, and induced effects of tourist purchases.

3.27 Estimated Value-Added Accruing to Brevard County, Undiscounted

Value-added refers to the income payments made by industry in wages, interest, profits, and indirect payments, and is a regional corollary to gross domestic product figures reported in business and economic reports. Value-added recreational benefits are essentially the net income accruing to the Brevard Community via ASR tourism. It is obtained by multiplying column 6 of Table 1 by 0.6, where the value-added ratio of 60% of the total sales effect is arrived at from an actual IMPLAN run with the PMG deconstructed sales figures by category. These numbers are reported in column 7 of Table 1, and are undiscounted. To convert benefits accrued in future years to a present value an appropriate discount rate must be utilized. In sum, Recreational Benefits (column 7: value-added, discount rate = 0) are defined as the value-added accruing to Brevard County as a result of tourist purchases inclusive of multiplier effects.

3.28 Estimated Tourist Sales Accruing to Brevard County, Undiscounted

An alternative definition for Recreational Benefits is simply defined as daily tourist sales (column 4) multiplied by the number of additional surf tourist visit days induced by the ASR (column 3). Column 8 of Table 1 (tourist sales, discount rate = 0) is oftentimes reported when assessing economic benefits, and due to its familiarity is Coastal Tech's preferred measure for inclusion in the broader study to which this report is appended. No multiplier effects are included here due to the assumption of full-employment.

3.29 Risk-Adjusted Recreational Benefits, Present Value

Recreational Benefits must be discounted to convert benefits accruing over a 25-year time period into a present value utilized in cost-benefit analysis. Discount rates reflect the use of funds, not their source. As documented in the reconnaissance review, the economic benefits derived from an ASR are uncertain, and thus, a risk-adjusted discount rate of 16% is utilized. This discount rate reflects both a risk-free return (4%) and a risk premium (12%) commensurate with historic average returns yielded by small company stocks (see Ibbotson) – that is, investors would require a return of 16% to induce them to invest in the ASR project, an investment at least as risky as the risk associated with an aggregate average of small company stocks. Recreational benefit risks associated



with this project, which provide for uncertainty surrounding yearly net cash flows, include the following: (i) new technology performance, (ii) open-access issues, (iii) economic downturn, (iv) construction, (v) weather, and (vi) funding – the latter three risks impacting recreational benefits in possibly delaying the time period in which benefits (economic returns) actualize.

The Present Value of expected recreational benefits aggregated over a 25-year time period is about **\$745,000** under the value-added approach (column 9 of Table 1) and **\$920,000** under the tourist sales approach (column 10 of Table 1). Columns 9 and 10 constitute alternative measures of benefits and *are not meant to be added*.

3.3 ARTIFICIAL SURFING REEF SPECIAL EVENT BENEFITS

3.31 Overview

The reconnaissance review detailed the notion of the ASR X-Factor, a major ASP sanctioned surf competition with the drawing power to generate an economic impact in the millions. There are a few basic pros and cons surrounding the applicability of this concept and they are briefly touched upon prior to an estimation of expected benefits.

On the positive side, Brevard County already hosts a 5-star rated event, the O’Neill Sebastian Inlet Pro, the only star-rated event on the eastern seaboard of the United States (see Charts 1A and 1b). The festival promoter of the O’Neill Sebastian Inlet Pro, Mitch Varnes, was consulted several times during the course of this study and was an invaluable resource. Provided the ASR performs to specification (i.e., “the best break in the area”), Varnes expressed an interest in promoting an event based at the ASR, and his experience and command of the institutional detail needed to bring such a project to fruition is certainly a key entry on the positive side of the X-Factor ledger.

Another positive is the confluence of several factors providing an optimal window of opportunity. The Sebastian Inlet competition is held in January, and two major surf (though non-rated) events occur in Cocoa Beach: the Easter Surf Festival and the Labor Day weekend National Kidney Foundation Festival, respectively. During the months of peak tropical weather activity, i.e., September & October, swell is usually greatest and the local event calendar is open. A target of Columbus Day weekend would not conflict with any existing event and would occur during a period where weather conditions would be optimal. Chart 2, provided by Surfbreak Engineering Services, provides an historical distribution of swell wave occurrences and is supportive of this position.



Chart 1A: ASP World Qualifying Series Events, 2008

Rating	Date	Site	Event	Prize (\$K)
5 Star	Jan 4-11	Sebastian Inlet, Florida-USA	O'Neill Sebastian Inlet Pro (pres. by Ron Jon)	110
3 Star	Jan 27-Feb 6	Banzai Pipeline, Oahu-Hawaii	Monster Energy Pro (pres. by Billabong)	50
5 Star Prime	Feb 12-17	Ferrando de Noronha-BRZ	Hang Loose Pro	110
4 Star	Mar 11-16	Soldiers Beach, NSW-AUZ	Arrive Alive Central Coast Pro	80
1 Star	Mar 20-22	Tapia-Spain	Goanna Pro	10
2 Star	Mar 26-30	Huntington Bch, California-USA	Var's Pier Classic (pres. by Jack's Surfboards)	25
4 Star	Mar 31-Apr 6	Merewether, Newcastle, NSW-AUZ	Mark Richards Pro	80
6 Star PRIME	Apr 6th(trials) 7-13	Margaret River-West AUZ	Drug Aware Pro Margaret River (pres. by O'Neill AUZ)	135
6 Star PRIME	Apr 13th(trials) 14-20	New Pier (mobile), Durban-RSA	Quiksilver Pro Durban (pres. by Virgin Mobile & Resolution)	135
4 Star	Apr 15-20	La Sauzade, Breignolles-France	Vendee Surf Pro	80
6 Star PRIME	Apr 23-30	Thurso-Scotland	O'Neill Highland Open by Swatch	135
4 Star	Apr 29-May 3	Lowers Trestles, Calif-USA	6.0 Lower's Pro	80
1 Star	May 10-11	Oceanside Harbour, Calif-USA	Koastalkaos.com Pro	10
1 Star	May 15-18	North Beach, Durban-RSA	Lizzard Nandos Surf Pro (pres. by Weekend Witness)	10
1 Star	May 13-18	Sandy Beach, Oahu-Hawaii	Macy's E'Series	10
6 Star PRIME	Jun 8th(trials) 9-15	Pasta Point-Maldives	Maldives presents SriLankan Airlines Pro	135
5 Star	Jun 17-22	Praia do Forte, Bahia-BRZ	Billabong ECO Surf Festival	110
5 Star	Jun 24-29	Guaruja, Sao Paulo-BRZ	Local Motion Guaruja Surf Pro	110
6 Star	Jun 30-July 6	Durban-RSA	The Mr Price Pro	135
1 Star	July 10-13	Cordoama-Portugal	Super Bock Pro	10
1 Star	July 8-16	Ala Moana Bowls, Oahu-Hawaii	Macy's E'Series	10
6 Star	July 18-20(trials) 21-27	Huntington Bch, California-USA	Honda Men's US Open (pres. by O'Neill)	135
6 Star	July 29-Aug 3	Akabane Beach, Tahara-Japan	Yumeya Billabong Pro Tahara	135
5 Star	Aug 5-10	Fistral Beach, Newquay-England	Rip Curl Board Masters	110

Source: ASP

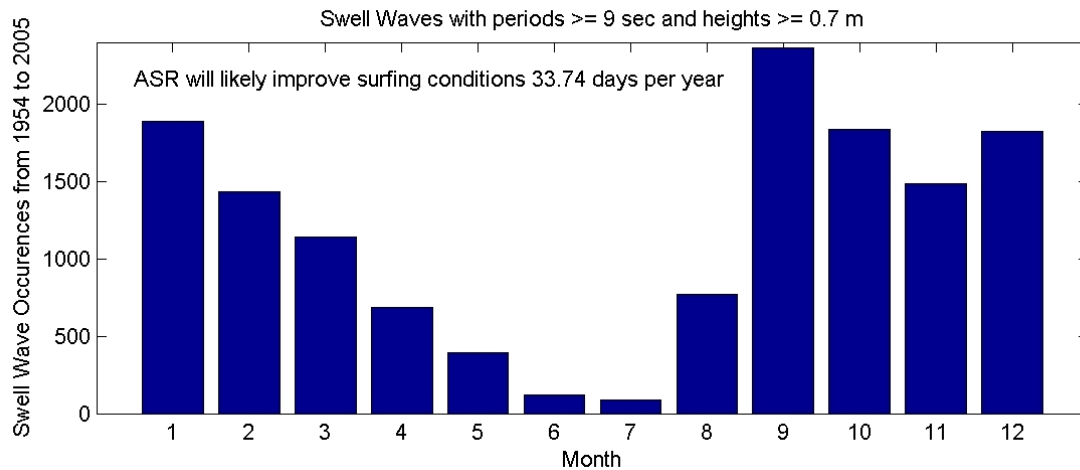

Chart 1B: ASP World Qualifying Series Events, 2008

Rating	Date	Site	Event	Prize (\$K)
6 Star	Aug 12-17	Grand Plage, Lacanau, Gironde-France	Sooruz Lacanau Pro	\$135,000
6 Star PRIME	Aug 18-24	Hossegor/Seignosse, Landes-France	Rip Curl Pro	\$135,000
6 Star	Aug 26-31	Ericeira-Portugal	Buondi Billaborg Pro	\$135,000
2 Star	Sep 2-7	Fukushima-Japan	Murasaki Pro Kitaizumi	\$25,000
5 Star	Sep 2-7	Pantin-Spain	Movistar Pantin Classic	\$110,000
3 Star	Sep 3-7	Praia da Saudade, Sao Francisco do Sul, SC-Brazil	Gatorade Surf Classic	\$50,000
2 Star	Sep 3-6	Ponto, Calif-USA	Van's El Ponto Loco (pres by Sun Diego)	\$25,000
1 Star	Sep 11-14	Geraldton-West Australia	Sunshine Surfmasters	\$10,000
5 Star	Sep 9-14	Zarauz-Basque Country	Rip Curl Pro Zarautz	\$110,000
2 Star	Sep 16-21	56th St Newport, California-USA	Oakley NB Pro	\$25,000
2 Star(tent)	Oct 9-12	Ogurahama Hyuga-shi, Miyazaki-Japan	Hyuga Pro	\$25,000
4 Star	Oct 6-12	Confita, Gran Canaria-Canaries	La Caja de Canarias-Ocean & Earth Pro	\$80,000
6 Star	Oct 6-12	Rio de Janeiro-Brazil	Rio de Janeiro International	\$135,000
2 Star	Oct 11-12	San Miguel-Mexico	Squabo Mexican Surf Fiesta	\$25,000
6 Star PRIME	Oct 14-19	S. Juan, Lanzarote-Canaries	La Santa Surf Pro	\$135,000
6 Star	Oct 14-19	Itajaí, Santa Catarina-Brazil	Maresia Surf International	\$135,000
4 Star	Oct 21-26	Santa Cruz, California-USA	O'Neil Coldwater Classic	\$80,000
6 Star	Oct 21-26	Ubatuba, Sao Paulo-Brazil	Orbongo Pro Surfing	\$135,000
6 Star	Oct 21-26	Carcavelos, Lisbon-Portugal	Estoril Coast Pro	\$135,000
4 Star	Oct 26-Nov 10	Sunset Bch, Oahu-Hawaii	Xcel Pro	\$80,000
3 Star	Nov 12-16	Puerto Escondido-Mexico	PXM International Van's Pro	\$50,000
6 Star PRIME	Nov 12-23	Alii Beach, Haleiwa, Oahu-Hawaii	Reef Hawaiian Pro	\$135,000
6 Star PRIME	Nov 24-Dec 6	Sunset Bch, Oahu-Hawaii	O'Neil World Cup	\$135,000

Source: ASP



Chart 2: Swell Waves With Periods \geq 9 sec and heights \geq 0.7 m



Source: Surfbreak Engineering Services

Meg Bernardo, Executive Manager of ASP North America, was contacted by PRÆCIPPIO EFS to ascertain what criteria in addition to sanctioning fees are required by ASP to promote a World Qualifying Series (star-rated) event. A main point emphasized by Bernardo was that ASP North America highly discourages overlap in North American events, and thus requires that new entrants to the market respect the schedules of incumbents. Using ASP North America’s 2008 schedule as a benchmark, time gaps exist from Sep 22–Oct 2 & Oct 6–20, ideal windows from the perspective of swell occurrence and openings in Brevard’s event calendar.

Finally, local stakeholders such as hoteliers, tourism officials, and surf industry participants are definitively interested in the project. Cocoa Beach hoteliers carry significant marketing dollars, and advertising budgets should be able to accommodate an additional event. The area is also a cultural icon in the surfing industry, and the legacy of surfers who originated in the area is immense.

On the negative side of the ledger, several factors merit consideration. Brevard County already hosts a 5-star rated competition. Is it likely, given that no other site on the eastern seaboard hosts a single event, that Brevard would be able to promote and support a second? Financial support necessary to promote an event is significant. Varnes, for example, reckons that funding of \$450,000-500,000 would be necessary for promotion. Given that some of the same surf stakeholders are already being solicited, at what point are traditional funding bases tapped out?



Another detrimental factor is associated with the swell wave occurrence chart. While the best window of opportunity for a surf competition occurs in the September – October time frame, the number of days when the ASR would likely improve surfing conditions is still not that large, about 10 days or 1 in 6 during the optimal calendar. Surf events usually allow multi-day windows to ensure sufficient time to complete the competitive brackets, a process which takes several days. The likelihood that a majority of the improved surfing days would necessarily occur in the event’s schedule window is problematic.

Distance to the shoreline is also a major drawback. The ASR and its take-off zone would be several hundred yards from the shore. The viability of spectatorship at this distance is somewhat compromised. Accommodation for judging would also have to be considered. While there are surfing competitions that occur miles from the shoreline, these events run off an economic model based on web streaming and the associated advertising dollars. Unlike Opunake, Cocoa Beach does not constitute a natural amphitheatre, so the question remains: Will visitors attend an event where the action occurs almost three football fields away?

3.32 Special Event Benefits – The Starting Point

In Table 2 on **p. 44** - Column 4, row 3, i.e., \$2,750,000, provides the starting point for this analysis. Mitch Varnes, the festival promoter of the O’Neill Sebastian Inlet 5-star ASP event, revealed that his festival generated an economic impact (sales) of about \$2,625,000, utilizing commonly accepted tourism benchmarks employed by the Space Coast Office of Tourism as well as other TDCs. While no formal analysis was employed, Varnes’ number and insights on surfing festivals are afforded special privilege - as stated earlier, his event is currently the only ASP star-level sanctioned event on the eastern seaboard of the United States. The figure of \$2,625,000 is adjusted upwards to \$2,750,000 to reflect a future period starting point.

Column 4 lists total sales impact figures inclusive of multiplier effects. To ascertain tourist sales as well as the direct sales capture after margining, the same assumptions concerning the size of the multiplier (i.e., 1.5), capture rate (i.e., 90%), and yearly growth rate (i.e., 3.5%) are employed as were utilized during the ASR recreational benefit analysis. In Table 2 - Columns 2 and 3 are arrived at by working backwards from the initial total sales impact figure of \$2,750,000. The multiplier of 1.5 reflects the multiplier obtained from an actual IMPLAN run with the PMG deconstructed sales figures by category. Dividing column 4 by 1.5 yields column 3. The capture rate of 90% is simulated from an actual IMPLAN run with the PMG deconstructed sales figures by category. Sales “captured” account for the margining of retail purchases and constitute the direct sales effect associated with ASR prompted tourism. Column 3 divided by 0.9 yields column 2, the tourist sales derived from the O’Neill Sebastian Inlet Surf Festival, which are posited to grow by 3.5% per year.



TABLE 2: ESTIMATED ARTIFICIAL SURFING REEF SPECIAL EVENT BENEFITS

(1) Project Year	(2) SURF FESTIVAL (ASP 5-Star) TOURIST SALES 3.5% growth/yr	(3) SURF FESTIVAL (ASP 5-Star) DIRECT SALES CAPTURE = 90%	(4) SURF FESTIVAL (ASP 5-Star) TOTAL SALES MULTIPLIER = 1.5	(5) SURF FESTIVAL (ASP 5-Star) VALUE-ADDED = 60% TOTAL SALES	(6) SURF FESTIVAL FUNDING COST LOCAL SHARE = 33% 3.5% growth/yr	(7) EVENT BENS VALUE-ADDED DR = 16% CERTAINTY	(8) CONDITIONAL PROBABILITY FESTIVAL SUCCESS	(9) MULTIPLICATIVE PROBABILITY FESTIVAL SUCCESS	(10) EVENT BENS VALUE-ADDED DR = 16% UNCERTAINTY	(11) EVENT BENS TOURIST SALES DR = 16% UNCERTAINTY
1	\$0	\$0	\$0	\$0	\$0	\$0	0.0%	0.0%	\$0	\$0
2	\$0	\$0	\$0	\$0	\$0	\$0	0.0%	0.0%	\$0	\$0
3	\$2,037,037	\$1,833,333	\$2,750,000	\$1,650,000	\$150,000	\$960,986	33.3%	33.3%	\$320,009	\$402,579
4	\$2,108,333	\$1,897,500	\$2,846,250	\$1,707,750	\$155,250	\$857,432	66.6%	22.2%	\$190,160	\$239,225
5	\$2,182,125	\$1,963,912	\$2,945,869	\$1,767,521	\$160,684	\$765,036	80.0%	17.7%	\$135,735	\$170,757
6	\$2,258,499	\$2,032,649	\$3,048,974	\$1,829,384	\$166,308	\$682,597	90.0%	16.0%	\$108,997	\$137,121
7	\$2,337,547	\$2,103,792	\$3,155,688	\$1,893,413	\$172,128	\$609,041	95.0%	15.2%	\$92,389	\$116,228
8	\$2,419,361	\$2,177,425	\$3,266,137	\$1,959,682	\$178,153	\$543,412	95.0%	14.4%	\$78,312	\$98,518
9	\$2,504,039	\$2,253,635	\$3,380,452	\$2,028,271	\$184,388	\$484,855	95.0%	13.7%	\$66,379	\$83,507
10	\$2,591,680	\$2,332,512	\$3,498,768	\$2,099,261	\$190,842	\$432,607	95.0%	13.0%	\$56,265	\$70,783
11	\$2,682,389	\$2,414,150	\$3,621,225	\$2,172,735	\$197,521	\$385,990	95.0%	12.4%	\$47,692	\$59,998
12	\$2,776,272	\$2,498,645	\$3,747,968	\$2,248,781	\$204,435	\$344,396	95.0%	11.7%	\$40,425	\$50,856
13	\$2,873,442	\$2,586,098	\$3,879,147	\$2,327,488	\$211,590	\$307,285	95.0%	11.2%	\$34,266	\$43,107
14	\$2,974,012	\$2,676,611	\$4,014,917	\$2,408,950	\$218,995	\$274,172	95.0%	10.6%	\$29,044	\$36,539
15	\$3,078,103	\$2,770,292	\$4,155,439	\$2,493,263	\$226,660	\$244,628	95.0%	10.1%	\$24,619	\$30,971
16	\$3,185,836	\$2,867,253	\$4,300,879	\$2,580,527	\$234,593	\$218,267	95.0%	9.6%	\$20,868	\$26,252
17	\$3,297,341	\$2,967,607	\$4,451,410	\$2,670,846	\$242,804	\$194,747	95.0%	9.1%	\$17,688	\$22,252
18	\$3,412,748	\$3,071,473	\$4,607,209	\$2,764,326	\$251,302	\$173,761	95.0%	8.6%	\$14,993	\$18,861
19	\$3,532,194	\$3,178,974	\$4,768,462	\$2,861,077	\$260,098	\$155,037	95.0%	8.2%	\$12,708	\$15,988
20	\$3,655,821	\$3,290,238	\$4,935,358	\$2,961,215	\$269,201	\$138,330	95.0%	7.8%	\$10,772	\$13,552
21	\$3,783,774	\$3,405,397	\$5,108,095	\$3,064,857	\$278,623	\$123,424	95.0%	7.4%	\$9,131	\$11,487
22	\$3,916,206	\$3,524,586	\$5,286,879	\$3,172,127	\$288,375	\$110,124	95.0%	7.0%	\$7,739	\$9,736
23	\$4,053,274	\$3,647,946	\$5,471,919	\$3,283,152	\$298,468	\$98,257	95.0%	6.7%	\$6,560	\$8,253
24	\$4,195,138	\$3,775,624	\$5,663,436	\$3,398,062	\$308,915	\$87,669	95.0%	6.3%	\$5,561	\$6,995
25	\$4,341,968	\$3,907,771	\$5,861,657	\$3,516,994	\$319,727	\$78,222	95.0%	6.0%	\$4,713	\$5,929

Source: PRÆCIPPIO EFS

\$1,335,025 \$1,679,494

Key parameter values: (i) Surf festival tourist sales and total sales effect are established by the O'Neill Sebastian Inlet ASP 5-star event held in January – Festival promoter Mitch Varnes, in conjunction with the Space Coast Office of Tourism, report an economic sales impact of \$2.65 million...this number is adjusted upwards to reflect a future start date (i.e., column 4, row 3, \$2.75 million); (ii) The capture rate (90%), SAM multiplier (1.5), and value-added share of total sales (60%) are simulated from an IMPLAN run utilizing PMG sales by category; (iii) Varnes offers a conditional probability of 25% to 50% on whether a 5-star ASR Surf Event would ever materialize due to funding costs of approximately \$450-500k; consequently, for this and other reasons the likelihood of a festival actualizing within three years of reef construction is assessed at 33.3%. Conditional on the inaugural festival transpiring, the likelihood of a second festival increases to 66.6%, a third festival at 80%, a fourth festival at 90%, and a fifth festival at 95%...the remaining festivals would then have 95% probability of occurring; (iv) The multiplicative probability of the first festival occurring is 33.3%, the second is 22.2% (i.e., 33.3% x 66.6%), the third is 17.2% (i.e., 22.2% x 80%), and so on; and, (v) The discount rate of 16% reflects a risk-free return and risk premium.



Model Assumptions

1. Column 4, row 3, i.e., \$2,750,000, provides the starting point for this analysis. Mitch Varnes, the festival promoter of the O'Neill Sebastian Inlet 5-star ASP event, revealed that his festival generated an economic impact (sales) of about \$2,625,000, utilizing commonly accepted tourism benchmarks employed by the Space Coast Office of Tourism as well as other TDCs. While no formal analysis was employed, Varnes' number and insights on surfing festivals are afforded special privilege as his event is currently the only ASP star-level sanctioned event on the eastern seaboard of the United States. The figure of \$2,625,000 is adjusted upwards to \$2,750,000 to reflect a future period starting point.

2. Columns 2 and 3 are arrived at by working backwards from Varnes' adjusted sales impact figure of \$2,750,000. The multiplier of 1.5 reflects the multiplier obtained from an actual IMPLAN run with the PMG deconstructed sales figures by category. Dividing column 4 by 1.5 yields column 3. The capture rate of 90% is simulated from an actual IMPLAN run with the PMG deconstructed sales figures by category. Sales "captured" account for the margining of retail purchases and constitute the direct sales effect associated with ASR prompted tourism. Column 3 divided by 0.9 yields column 2, the tourist sales derived from the O'Neill Sebastian Inlet Surf Festival, which are posited to grow by 3.5% per year.

3. Surf Festival value-added are defined as the value-added accruing to Brevard County as a result of tourist purchases inclusive of multiplier effects; value-added refers to the income payments made by industry in wages, interest, profits, and indirect payments, and is a regional corollary to gross domestic product figures reported in business and economic reports. Value-added recreational benefits are obtained by multiplying column 4 by 0.6 – the value-added ratio of 60% of the total sales effect is arrived at from an actual IMPLAN run with the PMG deconstructed sales figures by category. Surf Festival funding costs are not inconsequential and can be a significant inhibitor of entry into this market as well as a cause of exit. According to Varnes a 5-star event would require \$450-500k (adjusted upwards to the later start date). The O'Neill Sebastian Inlet Surf Festival derives a third of its funding from local sources; thus, in establishing SURF EVENT BENEFITS these costs must be subtracted from value-added. The Sebastian Inlet event is used as a proxy where approximately \$150,000 of funding is derived from local sources (column 6). Local funding is assumed to grow at 3.5% per year.

4. EVENT BENEFITS based on net value-added (column 7) are arrived at by subtracting column 6 from column 5 and then discounting. EVENT BENEFITS must be appropriately discounted to convert benefits accruing over a 25-year time period into a present value utilized in cost-benefit analysis. Discount rates reflect the risk level of the use of funds, not their source. The economic benefits derived from an ASR are uncertain and thus a risk-adjusted discount rate of 16% is utilized. This discount rate reflects both a risk-free return (4%) and a risk premium (12%) commensurate with historic average returns yielded by small company stocks (see Ibbotson) – that is, investors would require a return of 16% to induce them to invest in the ASR project, an investment at least as risky as the risk associated with an aggregate average of small company stocks. Since the new festival is posited to start in year 3 (allowing for one year of monitoring and 18-24 months in planning and fundraising the event), the first undiscounted net value-added is divided by $(1 + r)^3$, i.e., $\$960,986 = [\$1,650,000 - \$150,000] / (1.16)^3$.

5. Column 7 reveals EVENT BENEFITS under the condition of certainty, or in other words, expected income generated for Brevard *IF* the festival occurs. According to Varnes, the funding hurdle of raising \$450-500k, as well as ancillary concerns such as the surf break lying several hundred yards off the shoreline (and the festival attendees), make the probability of success substantially less than unity (100%). Varnes reckoned that a new ASR associated ASP sanctioned event would have a 25% to 50% chance of materializing. Another concern raised by PRÆCIPPIO EFS includes the relatively sparse number of improved surfing days (about 1 in 6) in a potential festival's optimal window of opportunity, the months of September and October. And of course, this excludes the previously cited risks associated with the ASR's net cash flows, which are factored into the discount rate (see #6 above). Accordingly, the midpoint of Varnes' range is taken as a starting point and adjusted downward slightly for the additional sources of potential festival failure. The result: column 8 begins with a conditional probability of Festival success of 33.3%, i.e., there's a 33.3% chance that a festival would materialize in year 3. If the festival does materialize, the conditional probability rises in year 4 to 66.6%, in essence, doubling. This means that if a festival does occur in year 3, there's a 66.6 chance that it will reoccur in year 4. The conditional probability is posited to escalate to 80% in year 5, 90% in year 6, and 95% in year 7 and thereafter.

6. Column 9 details the multiplicative probability of success in any year. For example, if the probability of success in year 3 is 33.3%, and the conditional probability of success in year 4 is 66%, then the multiplicative probability of success in year 4 is $33.3\% \times 66.6\% = 22.2\%$. For year 5, the multiplicative probability of success in year 4 (i.e., 22.2%) would be multiplied by the conditional probability of success in year 5 (i.e., 80%), yielding 17.7. Column 9 multiplied by column 7 yields discounted EVENT BENEFITS, based on value-added, under conditions of uncertainty (column 10). Column 11, based on tourist sales, highlights discounted EVENT BENEFITS under conditions of uncertainty. Column 11 = [(column 2 – column 6) x column 9] / $(1.16)^t$.

Results

The Present Value of expected event benefits aggregated over a 25-year time period is about \$1.335 million under the value-added approach (column 10) and \$1.68 million under the tourist sales approach (column 11). Columns 9 and 10 constitute alternative measures of benefits and are not meant to be added.



3.33 Special Event Benefits – Net Value-Added

Surf Festival value-added is defined as the value-added accruing to Brevard County as a result of tourist purchases inclusive of multiplier effects; value-added refers to the income payments made by industry in wages, interest, profits, and indirect payments, and is a regional corollary to gross domestic product figures reported in business and economic reports. Value-added special event benefits are obtained by multiplying column 4 by 0.6 – the value-added ratio of 60% of the total sales effect is arrived at from an actual IMPLAN run with the PMG deconstructed sales figures by category. Surf Festival funding costs are not inconsequential and can be a significant inhibitor of entry into this market as well as a cause of exit. According to Varnes, a 5-star event would require \$450-500k. The O’Neill Sebastian Inlet Surf Festival derives a third of its funding from local sources; thus, in establishing SURF EVENT BENEFITS, these costs must be subtracted from value-added. The Sebastian Inlet event is used as a proxy where approximately \$150,000 of funding is derived from local sources (column 6). Local funding is assumed to grow at 3.5% per year.

EVENT BENEFITS based on net value-added (Table 2 - column 7) are arrived at by subtracting column 6 from column 5 and then discounting. EVENT BENEFITS must be discounted to convert benefits accruing over a 25-year time period into a present value utilized in cost-benefit analysis. Discount rates reflect the risk level of the use of funds, not their source. The economic benefits derived from an ASR are uncertain and thus a risk-adjusted discount rate of 16% is utilized. This discount rate reflects both a risk-free return (4%) and a risk premium (12%) commensurate with historic average returns yielded by small company stocks (see Ibbotson) – that is, investors would require a return of 16% to induce them to invest in the ASR project, an investment at least as risky as the risk associated with an aggregate average of small company stocks. Since the new festival is posited to start in year 3 (allowing for one year of monitoring and 18-24 months in planning and fundraising the event), the first undiscounted net value-added is divided by $(1 + r)^3$, i.e., $\$960,986 = [\$1,650,000 - \$150,000] / (1.16)^3$.

3.34 Special Event Benefits – Conditional Probability

In Table 2 - Column 7 reveals EVENT BENEFITS under the condition of certainty, or in other words, expected income generated for Brevard *IF* the festival occurs.¹⁶ According to Varnes, the funding hurdle of raising \$450-500k, as well as ancillary concerns such as the surf break lying several hundred yards off the shoreline (and the festival attendees), make the probability of success substantially less than unity (100%). Varnes reckoned that a new ASP sanctioned event at the proposed ASR would have a 25% to 50% chance of materializing. Another concern raised by PRÆCIPPIO EFS includes the relatively sparse number of improved surfing days (about 1 in 6) in a potential festival’s optimal window of

¹⁶ Hellman (2001) provides a discussion on the incorporation of conditional probability into the setting of discount rates by venture capitalists.



opportunity, the months of September and October. And of course, this excludes the previously cited risks associated with the ASR's net cash flows, which are factored into the discount rate. Accordingly, the midpoint of Varnes' range is taken as a starting point and adjusted downward slightly for the additional sources of potential festival failure. The result: Table 2 - column 8 begins with a conditional probability of Festival success of 33.3%, i.e., there's a 33.3% chance that a festival would materialize in year 3. If the festival does materialize, the conditional probability rises in year 4 to 66.6%, in essence, doubling. This means that if a festival does occur in year 3, there is a 66.6% chance that it will reoccur in year 4. The conditional probability is posited to escalate to 80% in year 5, 90% in year 6, and 95% in year 7 and thereafter.

3.35 *Special Event Benefits – Multiplicative Probability*

Table 2 - Column 9 details the multiplicative probability of success in any year. For example, if the probability of success in year 3 is 33.3%, and the conditional probability of success in year 4 is 66.6%, then the multiplicative probability of success in year 4 is $33.3\% \times 66.6\% = 22.2\%$. For year 5, the multiplicative probability of success in year 4 (i.e., 22.2%) would be multiplied by the conditional probability of success in year 5 (i.e., 80%), yielding 17.7.

3.36 *Special Event Benefits Under Conditions of Uncertainty*

Column 9 multiplied by column 7 yields discounted EVENT BENEFITS, based on value-added, under conditions of uncertainty (Table 2 - column 10).

Like the earlier analysis, a simplified version of economic benefits is offered based on tourist sales. Column 11 highlights discounted EVENT BENEFITS under conditions of uncertainty via the tourist sales approach, i.e., Column 11 = $[(\text{column 2} - \text{column 6}) \times \text{column 9}] / (1.16)^t$.

The Present Value of expected event benefits aggregated over a 25-year time period is about **\$1.335 million** under the value-added approach (column 10 of Table 2) and **\$1.68 million** under the tourist sales approach (column 11 of Table 2). Columns 9 and 10 constitute alternative measures of benefits and *are not meant to be added*.



3.4 OTHER BENEFITS AND COSTS

3.41 *Benefits*

Besides tourism expenditures, or the community income derived from it, there are other potential benefits which either fall outside the scope of this study or were deemed insignificant. It has been speculated that the proposed ASR would enhance property values in the immediate vicinity of the reef, providing residential benefits in the form of property valuation. While this lies outside the parameters of this analysis, PRÆCIPPIO is of the opinion that those initial speculations are probably biased due to the exploding property markets of the first half of this decade. Real estate markets are now declining throughout the United States as well as globally, and it is unlikely that the proposed ASR would significantly impact property appraisal in Brevard County. According to estimates by the lead author of this study, Brevard likely has between 10,000-12,000 more residential units than can be supported by population fundamentals. In addition, future retirees who may be contemplating relocating to the area may actually frown upon the idea of an ASR. While overall community support is expected, it certainly will not be universal, and this must be factored into a comprehensive analysis, a task not feasible here.

It has also been suggested that the proposed ASR contributes benefits in the form of unpaid advertising; in essence, the value provided from free media exposure. While this point lies outside the scope of the analysis here, it also should be treated critically because the exposure in question can be negative. For example, “Cash-Strapped Opunake Surf Reef will be Completed, says Trust,” (Stuff.co.nz) or “Artificial Reef Fails To Win Surfers’ Approval” (Bay of Plenty Times) would certainly represent the sort of advertising which would not signify an enhanced value. In short, this avenue is problematic, and as stated before, not tasked in this study.

Other potential recreation users include surf schools, divers, and fishers. Craig Carroll of Ron Jon’s Surf School was interviewed as part of this project and he expressed the notion that more consistency and reliability with respect to surfable days could facilitate an expansive schedule of beginning and intermediate lessons. While this may be true, there are several factors which most likely negate this effect.

First, on the days the ASR improves surfing conditions it is unlikely, in the absence of regulation on the water, that the line-up will defer to surf school lessons. Second, capacity being what it is, even if the surf school gains access it simply supplants one set of expenditures for another. Third, the break is located several hundred yards from the shoreline, and is most likely inappropriate for surfers at the lessons stage. Indeed, there may even be liability issues to consider. Finally, as for surf camps, the same factors would apply in addition to the fact that as Chart 2 shows, during the summer months the availability of improved surfable days would be marginal at best (maybe 3-4 days). There simply is no way to reliably schedule based upon expected ASR performance.



Diving and fishing are two alternative forms of recreation that do not necessarily compete on the basis of surfable days. Diving was quickly excluded due to the lack of visibility in the water. While the ASR will promote marine colonization, it is unlikely to become a significant tourist draw due to the murkiness of the water. In short, while some diving would occur at the reef, and while some tourists may dive at the reef, the relative quality of the diving makes it likely that the diving will not be the primary driver bringing tourists into the area. Or in other words, tourists who express a primary desire for diving will most likely choose other venues to visit.

Fishing provided a bit more difficult issue to assess. Nearshore fishing charters would probably utilize the ASR during specific seasons, which may not necessarily overlap during periods of improved surfing. Nearshore fishing charters would normally draw a significant percentage of tourists, who would infuse new dollars into the area. One of the drawbacks of fishing activity centers on the maintenance of the ASR. The geotextile sandbags comprising the reef are not invulnerable and would be susceptible to puncture by anchors and hooks. As a consequence, the greater the volume of fishing activity, the greater the probability of damage to the ASR. Also, on the days of improved surfing, and in the absence of regulation, there could be congestion effects associated with surfers and fishers congregating simultaneously.

An additional concern revolves around possible exclusionary effects. To explain, if it transpires that the ASR becomes a prime fishing draw, then it is unlikely to also become the best surf spot in the area, and if that is the case, a 5-star surf festival will not actualize. Given this study's estimate that the benefits from a 5-star surf competition constitute 65% of the overall benefits from surf amenity, this would substantially lower the overall result. Since the benefits from seasonal nearshore charters are unlikely to supersede the benefits from surfing or surf competitions, the analysis here remains focused on surf amenity.¹⁷

Finally, there are surf amenity values that are not captured by the market. The use value that surfers appropriate beyond what they pay for trip incidentals are economic benefits, albeit not reflected in market expenditures. In his surveying of the Brevard County surf market Kelly asked two questions that were pertinent with respect to this issue: 1. "Suppose one way to improve the surfing conditions at a specific site in Brevard County was with an artificial reef. The artificial reef would increase the number of surfable days at this site. Of the options listed below, what is the MINIMUM number of additional days that you would deem to be a significant INCREASE from existing surfing conditions at this site?; and 2. For your answer to the question immediately above this one, what dollar amount would you be willing to pay, beyond your typical annual surfing related expenses, as a ONE-TIME payment each year to support the additional number of surfable days chosen above?"

The median value for the minimum additional days that was deemed significant was 30 (sample size = 447). Based on what respondents stated they would be willing to pay for the additional days specified, it averaged to about \$2 per surf

¹⁷ And if the fishing benefit were greater, why spend \$6 million for a modeled surf reef? Other structures would suffice, at much lower cost.



day visit. No significant differences were observed between locals and non-locals. Due to the fact that: a) this *uncaptured* value represents income generation *potential*, not income generation and b) that its present value is less than 4 percent of the total economic benefits reported here, it does not impact the analysis and has been omitted.

3.42 Costs

Several costs have been excluded from the analysis. For example, with most new projects it is likely that marketing dollars would be devoted, at least early in its life-cycle. After consultation with TDC Executive Director Rob Varley, it is assumed that any marketing would be accomplished from existing budgets, and would not entail a sacrifice in terms of lost advertising for other purposes.

New tourists typically entail county expenditures on basic service, public safety, water & sewerage, etc. Since the number of surf visit tourist days is minor with respect to tourism overall, it is assumed that county-level incremental costs are negligible. Moreover, county-level costs associated with the special events are assumed to be paid from special budgets. Thus, they are already debited in the results provided.

Displacement costs have also been ignored. The proposed surf festival would obviously detract improved surfable day capacity from the recreational tourism benefits ledger, but since the number of days involved is relatively small, it has been ignored.



4.0 CONCLUSIONS AND OBSERVATIONS

With respect to the recreational benefits associated with the proposed ASR, results from this analysis support the following:

- **Exclusive of special event benefits, the ASR is expected to induce an additional 2,109 surf visit days per year**
- **Tourist expenditure per surf visit day amounts to \$57.80, of which about \$19 is spent on lodging**
- **Using an average daily room rate of \$95 per night, this constitutes a lodging impact of 422 room nights per year**
- **Exclusive of special event benefits, the present value of ASR recreational benefits over a 25-year period is about \$920,000**
- **These economic benefits would support, on a yearly basis, about 3 jobs and \$18,000 in tax revenue – the revenue split would be \$7,000 Federal and \$11,000 State & Local**
- **With respect to special event benefits, the present value of an ASR 5-star surf competition, over a 25-year period, is \$1.68 million**
- **Collectively, the recreational and special event benefits associated with surf amenity amounts to about \$2.6 million**
- **Given an expected project cost, in present value terms, of about \$6 million, recreational benefits in and of itself are unlikely to justify costs**
- **The so-called X-Factor, economic benefits associated with a surf competition, are the dominant benefit stream but carry significant uncertainty**

With respect to the reconnaissance review conducted for this report, the following observations can be forwarded:

- **The surf market is a burgeoning industry**
- **ASRs are a new and innovative technology and product**



- **Due to the lack of any formal retrospective evaluation on the benefits derived from ASRs, very little is known about their commercial performance; consequently, expected economic values to be derived from ASRs carry significant uncertainty**
- **The market has responded to this uncertainty by requiring independent third party monitoring to ensure an improvement in surfing conditions (see Bournemouth Borough Council Minutes) – the retention of final construction payment serves as guarantor**
- **The management of expectations is crucial for a community building an ASR – it requires a balancing act between building support for an ASR but avoiding unrealistically high expectations on eventual performance**

Finally, the ASR market moves at a measured pace; in ten years time, four ASRs (five if you count Bargara) have been completed (Narrowneck, Cables, Pratte's, Mount Maunganui), one is almost complete (Opunake), and the latest entry, Bournemouth-Boscombe, has recently broken water. Metaphorically speaking, the center of the ASR universe has shifted from New Zealand to southern England. Whether or not the difficulties experienced in New Zealand represent temporary setbacks that occur as new technology moves along a learning curve, or hurdles of a more lasting nature, will be revisited. Future readers of this report should take that under consideration.*

* The preceding analysis represents the professional opinion of PRÆCIPPIO EFS. A dissenting opinion has been written by ASR America and can be found at the following website: www.spacecoastreef.com.

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APPENDIX A: OPUNAKE BENEFIT ESTIMATION, TRC

OPUNAKE Regional Analysis

- The reef is estimated to attract 300 visitors in year 1, increasing to 800 visitors in year 5. Using an average length of stay of 2.68 days and an average daily spend of \$60 (both derived from domestic travel surveys), in year 1 reef direct tourism expenditures total \$48,240 (i.e., 300 visitors x 2.68 days/visitor x \$60 per day per visitor) and by year 5 reef direct tourism expenditures total \$128,640 (i.e., 800 visitors x 2.68 days/visitor x \$60 per day per visitor). Including the relevant indirect and induced effects as reflected by the multiplier of 1.75 yields total effects in years 1 and 5 of **\$84,420** and **\$225,120** (TRC, p.30)
- The reef is also estimated to facilitate the retention of Taranaki resident who would otherwise have embarked on travel outside the region for surf-related purposes. These expenditures, referred to in the input-output literature as “deflected purchases,” are a valid direct benefit of the proposed reef. In year 1, some 260 Taranaki residents are assumed to have been retained, increasing to 360 Taranakians in year 5. Using an average length of stay outside the region of 2.0 days and an average daily spend of \$50 (both derived from surf surveys), in year 1 reef direct deflected tourism expenditures total \$26,000 (i.e., 260 retained visitors x 2.0 days/visitor x \$50 per day per visitor) and by year 5 direct deflected tourism expenditures total \$36,000 (i.e., 360 retained visitors x 2.0 days/visitor x \$50 per day per visitor). Including the relevant indirect and induced effects as reflected by the multiplier of 1.75 yields retained total effects in years 1 and 5 of **\$45,500** and **\$63,000** (TRC, p.30)
- The reef is thus estimated to provide an additional **\$129,920** (i.e., \$84,420 + \$45,500) in year 1 and **\$288,120** (i.e., \$225,120 + \$63,000) in year 5

SOUTH TARANAKI District Analysis –

- Noting that the district is a municipality within the overall region, the DISTRICT will benefit from a portion of the regional expenditure generated by the reef, factored in the following manner: 20% of the regional visitors choose to stay within the DISTRICT, and of the 80% of regional visitors who stay outside the DISTRICT, on average they will devote 1 of their 2.68 visit days to the DISTRICT and spend about \$25 of their \$60 of daily expenditure. This implies a factor weight of 32.44% [i.e., $0.2 + 0.8 \times (1 \text{ day}/2.68 \text{ days}) \times (\$25/\$60)$], rounded to 32% (TRC, p.31)
- At the DISTRICT level regional reef visitation is thus estimated to provide an additional \$41,574.40 (i.e., $0.32 \times \$129,920$), rounded to **\$41,570** in year 1 and \$92,198.40 (i.e., $0.32 \times \$288,120$), rounded to **\$92,200** in year 5 (TRC, p.31)
- At the DISTRICT level the reef was estimated to attract 3,400 visitors in year 1 and 5,600 in year 5; additionally, 70% of the visitors are assumed to have originated from outside the district. Assuming average stays of 1.5 days in the DISTRICT and an average daily spend of \$25, this yields year 1 reef direct tourism expenditures totaling **\$89,250** (i.e., 2,380 visitors x 1.5 days/visitor x \$25 per day per visitor) and year 5 reef direct tourism expenditures totaling **\$147,000** (i.e., 3,920 visitors x 1.5 days/visitor x \$25 per day per visitor). Including the relevant indirect and induced effects as reflected by the multiplier of 1.75 yields total effects in years 1 and 5 of \$156,187.50 (rounded to **\$156,190**) and **\$257,250** (TRC, p.31)
- Thus, at the DISTRICT level the reef is estimated to provide an additional **\$197,760** (i.e., \$41,570 + \$156,190) in year 1 and **\$349,450** (i.e., \$92,200 + \$257,250) in year 5



APPENDIX B: RECONNAISSANCE SURVEY OF THE PMGA TOURISM STUDY (2002)

Surveys were conducted in Cocoa Beach at various high-volume locations as well as hotel/motel properties

Surveys were conducted on 12 dates throughout the year

A General Tourist Survey was used to estimate general characteristics of the tourist population

Primary Tourist Locations Surveyed: City Pier, City Park, Ron Jon's store, parking garage near Ron Jon and the Cocoa Beach Surf Company

The following classification system was employed:

Permanent Residents	Tourists (overnights)	Seasonal Visitors	Day Visitors		
			Other Brevard	Other Florida	Other U.S.

With the following definitions:

Tourists - persons staying for one to 29 nights in hotel/motels, rented condominiums, time share units, or visiting friends or family in their residence

Seasonal Visitors - visitors staying greater than 30 but less than 180 days; seasonal visitors were surveyed through telephone numbers from real estate agents who specialize in seasonal leases

A Hotel/Motel Survey was administered to visitors at local hotel/motel properties in Cocoa Beach

This survey included many of the General Tourist Survey questions as well as questions regarding party size, the number of rooms procured, and length of stay

An assumption employed in the study was that hotel/motel and time share tourists are homogenous

Occupancy rates at Cocoa Beach facilities were established by using secondary data from the Space Coast Office of Tourism (SCOT)

According to SCOT, 5,733 hotel/motel rooms and 391 time shares totaling 6,124 rooms and 2,235,260 yearly room nights were occupied at a rate of 65%; thus, **1,452,919** room nights were booked

The following estimates were derived from the hotel/motel survey:

- (1) the average party size was 3.19 persons,
- (2) the average length of stay was 3.3 days; and,
- (3) the average number of rooms per party was 1.35

If, on average, each party books 1.35 rooms and stays 3.3 days, then each party books **4.455** room nights (i.e., 1.35 x 3.3)

The number of parties then equals the number of booked room nights divided by the average number of room nights booked per party; thus number of parties equals 1,452,919 divided by 4.455 or **326,132** yearly tourist parties



Since each party is comprised of 3.19 people, the number of tourists who stayed in hotel/motels or time shares equals **326,132 x 3.19** or **1,040,361**

1,085 people completed the General Tourist Survey, with the following demographic breakdown:

- (1) 307 were from Brevard County;
- (2) 460 were day trip visitors; and,
- (3) **318** were overnight tourists

Of the **318** overnight visitors:

- (a) 75.4% stayed in hotel/motels;
- (b) 7.3% stayed in time shares;
- (c) 11.5% stayed with friends/relatives; and,
- (d) 5.8% rented a house or condo

By assumption, categories (a) and (b) were considered to be homogenous; thus, just under five-sixths of the surveyed overnight visitors (some 82.7%) were hotel/motel or time share guests

Dividing the percent of overnight visitors staying with friends/relatives (11.5%) by 82.7% yields a convenient benchmarking ratio of about 14%; thus, the number of tourist parties staying with friends/relatives was established as being 14% of the estimated tourist parties booking rooms in hotel/motel/time shares; multiplying 0.14 by **326,132** hotel/motel/time share tourist parties yields **45,658** friends/relative tourist parties

Survey results revealed the number of tourists per friend/relatives party at 2.74; thus, multiplying **45,658** friends/relatives tourist parties by 2.74 tourists per party yielded **125,103** tourists staying with friends/relatives

Turning to the house/condo segment, dividing the percent of overnight visitors renting a house/condo (5.8%) by 82.7% yields a convenient benchmarking ratio of about 7%; thus, the number of tourist parties renting a house/condo was established as being 7% of the estimated tourist parties booking rooms in hotel/motel/time shares; multiplying 0.07 by **326,132** hotel/motel/time share tourist parties yields **22,829** house/condo tourist parties

Survey results revealed the number of tourists per house/condo party at 3.42; thus, multiplying **22,829** house/condo tourist parties by 3.42 tourists per party yielded **78,075** tourists staying in houses/condos

In total, **1,243,539** overnight tourists of all segments [i.e., **1,040,361 (hotel/motel) + 125,103 (friends/family) + 78,075 (house/condo)**] were estimated to have visited Cocoa Beach during the yearly study

The hotel/motel survey revealed that 3.8% of hotel/motel tourists expressed a surfing purpose for their trip; multiplying **1,040,361** hotel/motel tourists by 0.038 yields 39,534 tourists and 12,393 tourist parties (i.e., divide 39,534 tourists by 3.19 tourists per party) drawn to Cocoa Beach for surfing



Utilizing the estimated average spending per hotel/motel tourist party as a benchmark for the average spending per hotel/motel surf tourist party yields the following:

Table B1: Expenditures by Surf Parties Staying at Hotel/Motels, 2002

Hotel/Motel Surf Tourists Expenditure Category	Daily Spending per Party	Total Spending per Party (x 3.3 days)	Total Expenditures for Surf Parties (x 12,393 parties)
Lodging	\$173.60*	\$572.80	\$7,098,710
Food/Drink	\$108.51	\$358.08	\$4,437,685
Clothing	\$35.91	\$118.50	\$1,468,571
Beach Items	\$9.98	\$32.93	\$408,101
Other Retail	\$10.40	\$34.32	\$425,328

*average daily rate of \$75.78 plus other revenue rate of \$52.81 x 1.35 rooms/party
 Source: PRÆCIPPIO EFS; data PMG Associates

The General Tourist Survey revealed that overall, surfing accounts for about 5.95% of overnight tourist parties which amounts to 23,480 parties; this figure is arrived at by multiplying the number of overnight tourist parties (i.e., 394,619 = **326,132** + **45,658** + **22,829**) by 0.0595

As has already been determined, 12,303 parties are attributable to hotel/motel tourists; thus, 11,177 (i.e., 23,480 – 12,303) parties remain to be distributed to the house/condo rentals or family/friend overnight visitation segments

With no other intelligible principle, a conservative approach is employed and the remainder is split 85 - 15% with the larger segment accruing to friends/families; this accords with the Kelly study (DMES, 2008) which revealed about the same number of overnight surf tourists staying with friends/families as stayed in hotel/motels

Accordingly, surfing accounts for 9,500 tourist parties (i.e., 11,177 x 0.85) staying with friends & families, which when multiplied by 2.74 people per party yields a total of 26,030 surf tourists staying with friends/relatives; these 26,030 tourists constitute about 20.8% of the overall staying with friends/family tourist category

Table B2: Expenditures by Surf Parties Staying w/ Friends/Families, 2002

Friends Surf Tourists Expenditure Category	Daily Spending per Party	Total Spending per Party (x 3.86 days)	Total Expenditures for Surf Parties (x 9,500 parties)
Lodging	\$0.00	\$0.00	\$0
Food/Drink	\$41.45	\$160.00	\$1,425,000
Clothing	\$22.11	\$85.34	\$810,730
Beach Items	\$8.95	\$34.55	\$328,225
Other Retail	\$5.26	\$20.30	\$192,850

Source: PRÆCIPPIO EFS; data PMG Associates



Overnight surf tourists staying in house/condo rentals amounts to 1,677 tourist parties (i.e., 11,177 x 0.15), which when multiplied by 3.42 people per party totals to 5,735 surf tourists; these 5,735 tourists constitute about 7.5% of the house/condo rentals category

Table B3: Expenditures by Surf Parties Renting Houses/Condos, 2002

Rentals Surf Tourists Expenditure Category	Daily Spending per Party	Total Spending per Party (x 7.27 days)	Total Expenditures for Surf Parties (x 1,677 parties)
Lodging	\$209.08	\$1,520.00	\$2,549,040
Food/Drink	\$69.47	\$505.05	\$846,969
Clothing	\$27.27	\$198.25	\$332,465
Beach Items	\$5.11	\$37.15	\$62,301
Other Retail	\$5.00	\$36.35	\$60,959

Source: PRÆCIPPIO EFS; data PMG Associates

The final component of tourist visitation includes day-trippers from outside of Brevard County

In light of the surf-related purpose of this study we assume that Florida resident/Day trippers constitute the broader set from which surf day-trippers hail; this set comprises a similar number of tourist parties as overnight guests (i.e., 400,000)

Multiplied by 3.21 people per day-trip party yields 1,284,000 "day-trippers"

About 30% of day-trippers and parties are surf motivated (i.e., 385,200 day-trippers and 120,000 parties)

Table B4: Expenditures by Surf "Day-Trippers, 2002

Surf Day-trippers Expenditure Category	Daily Spending per Party	Total Spending per Party (x 1.00 days)	Total Expenditures for Surf Parties (x 120,000 parties)
Lodging	\$0.00	\$0.00	\$0
Food/Drink	\$54.61	\$54.61	\$6,553,200
Clothing	\$12.19	\$12.19	\$1,462,800
Beach Items	\$3.12	\$3.12	\$374,400
Other Retail	\$3.24	\$3.24	\$388,800

Source: PRÆCIPPIO EFS; data PMG Associates

In summary, deconstructing the PMG Associates study yielded the following metrics:

- (1) 39,534 tourists and 12,303 tourist parties associated with surf-related hotel/motel stays;
- (2) 26,030 tourists and 9,500 tourist parties associated with surf-related friends/family stays;
- (3) 5,735 tourists and 1,677 tourist parties associated with surf-related house/condo rentals;
- (4) 385,200 tourists and 120,000 tourist parties associated with surf-related day-trip visits;
- (5) **Totals = 456,499 tourists and 143,480 parties**



Table B5: Estimated Total Expenditures by Surf Tourists, 2002 (2002 dollars)

Surf Tourism Expenditures	Spending by Category	Spending per Party (143,480 parties)	Spending per Tourist (456,499 Surf Tourists)
Lodging	\$9,647,750	\$67.24	\$21.13
Food/Drink	\$13,262,854	\$92.44	\$29.05
Clothing	\$4,074,566	\$28.40	\$8.93
Beach Items	\$1,173,027	\$8.18	\$2.57
Other Retail	\$1,067,937	\$7.44	\$2.34
	\$29,226,134	\$203.70	\$64.02

Source: PRÆCIPPIO EFS; data PMG Associates

To arrive at a spending figure per surf visit day, an average number of days visited must be established for surf tourists:

385,200 surf day-trip tourists visit (1.0 days) = 385,200 surf days

39,534 surf hotel/motel tourists visit (3.3 days) = 130,462 surf days

26,030 surf friends/family tourists visit (3.86 days) = 100,476 surf days

5,735 surf house/condo tourists visit (7.27 days) = 41,693 surf days

Total surf days visited = 657,831

Days/ surf tourist = 657,831 surf days /456,499 surf tourists = 1.44

Spending per surf day = \$64.02 expenditure per surf tourist divided by 1.44 surf days per tourist =

\$44.46 per surf visit day in 2002 (2002 dollars)

Projecting to 2008 figures is accomplished by multiplying \$44.46 by **1.3** = \$57.80 per surf visit day in 2008 (2008 dollars) – this increase captures inflation and a yearly 1% real increase in daily expenditures

Table B6: Estimated Daily Expenditures by Surf Tourists, 2008 (2008 dollars)

Surf Tourism Expenditures	Spending per Tourist (456,499 Surf Tourists)	Spending/Day '02 (2002 dollars)	Spending/Day '08 (2008 dollars)
Lodging	\$21.13	\$14.68	\$19.08
Food/Drink	\$29.05	\$20.17	\$26.22
Clothing	\$8.93	\$6.20	\$8.06
Beach Items	\$2.57	\$1.78	\$2.32
Other Retail	\$2.34	\$1.63	\$2.12
	\$64.02	\$44.46	\$57.80

Source: PRÆCIPPIO EFS; data PMG Associates



APPENDIX C: GLOSSARY OF TERMS

Capture Rate	The portion of total surf spending that accrues to local production (i.e., the direct effect)
Direct Effects	The set of expenditures applied to the predictive model for impact analysis (i.e., the first round of spending)
Final Demands	Consist of purchases of goods and services for final consumption as opposed to an intermediate purchase where the good will be further remanufactured
Forward Linkage	Links between an industry producing a good or service and the consumers of the good or service
Indirect Business Taxes	Sales, excise taxes, custom duties, fees collected by businesses
Indirect Effects	The changes in sales, income or employment within the region in backward-linked industries supplying goods and services
Induced Effects	The increase in sales within a region from household spending of the income earned via direct and indirect effects
Input–Output (I-O) Model	Models the flows or interactions between industrial sectors within a county or region
Leakages	Dollars lost from the local economy in the form of state & federal tax payments, savings, profits earned by non-residents, and payments for goods/services imported from outside of the study region
Margins	Represent the difference between producer and purchaser prices
Producer Prices	Prices of the goods at the site of production for commodity industries. For the margin industries, it is the value added (or the margin) to the value of goods purchased for resale.
Purchaser Prices	Prices paid by the end user of the good or service at a retail store.
Total Effects	The sum of direct, indirect and induced effects.
Type SAM Multipliers	The total production requirements of all industries within a given region to meet the industry and institutions demands, as specified by the user, triggered by \$1 of consumption of the goods/services produced by a specified industry. They include direct, indirect, and induced effects and account for commuting, tax, and saving behavior by households.
Value-Added	Payments made by industry to workers, interest, profits and indirect business taxes; equivalent to GDP



APPENDIX D: STAKEHOLDER INTERVIEWS

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FOCUS: NARROWNECK ASR

The Northern Gold Coast Beach Protection Strategy of which Narrowneck ASR comprised a part was developed and project managed by International Coast Management for the Gold Coast City Council

Selected Bibliography:

- Jackson, L.A.**, Corbett, B., McGrath, J., Tomlinson, R., Stuart, G. (2007). Narrowneck reef: Review of seven years of monitoring. *Shore & Beach* (75)4: 67-79.
- Smit, F., Mocke, G.P., **Jackson, L.A.** (2007). Design and construction methodology of a novel multi-function artificial reef for Dubai. *Proceedings of the International Conference Coastal Structures: Venice, Italy.*
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Angus Jackson's pre-survey comments:

- Narrowneck is a multi-functional artificial reef [MFAR rather than a more simple artificial surf reef = ASR] designed as an integral part of the Northern Gold Coast Beach Protection Strategy. Improving Surfing was a secondary objective: <http://coastalmanagement.com.au/projects/NGCBPS/>
- Surfing reefs are relatively easy and need not be expensive to construct given practical design and construction expertise. Costs have varied considerably – see 2007 paper [note the 2 in NZ are not finished and it looks unlikely that councils funding some of the costs will invest any more – they don't see positive cost/ benefit from additional monies.]
- It is easier to add surfing to a coastal protection reef than coastal protection to a surf reef. A surf reef does not automatically give coastal protection – it may damage the beach if too shallow or wrongly placed too close to beach [Mt. Manganui may fit into this category but small size limits adverse impacts??]

Angus Jackson's Q&A:

1. *Did the Narrowneck-ASR MFAR significantly improve surfing conditions?*

When swell and wind conditions are good – YES!!!! But then surf is good on other locations as well. See 2007 paper attached.



2. *Did the ~~ASR~~ MFAR attract more visitors and economic expenditures in the surrounding region?*

The NGCBP strategy did. The MFAR has contributed.

3. *Did the ~~ASR~~ MFAR benefit local erosion control efforts?*

YES!!!! Nourishment is interlinked but MFAR acts as a control structure that forms salient in fine weather and reduces extent of storm cut in storms.

4. *Is there any evidence of enhanced biological diversity around the ~~ASR~~ MFAR?*

YES!!! – see 2004 paper. We have used this data to eco-engineer the next generation of MFAR to obtain environmental objectives.

5. *Is there any evidence that the ~~ASR~~ MFAR is economically justified (i.e., a benefit-cost ratio greater than one)?*

As part of larger strategy, YES!!! On its own, for beach protection, fishing and diving, YES, but surfing alone, probably very marginal, particularly with the bad press from some “interested” commercial interests.

6. *Retrospectively, are there any apparent lessons or insights to be garnered from the Narrowneck ~~ASR~~ MFAR project that might drive more favorable benefit-cost ratios at prospective ASRs?*

A lot has been learned:

- Surf reefs [ASRs] are relatively easy to design and construct with appropriate design and construction expertise and REALISTIC EXPECTATIONS!
- They can be beneficial in correct location with good conditions if design and construction are appropriate.
- Don't get too paranoid about tolerances – need to be reasonable and tolerances are related to wave length.
- Surfing is a very diverse sport - the perfect wave and perfect reefs only exist in the sales brochures.
- Simple and cost effective is good - Bargara definitely has been highly beneficial!

There are a number of engineers who are involved in MFAR design and construction. You should also talk to:

- Dave Skelly in California who designed and constructed Pratte's reef project - a lot of was leaned there.
- Gary Mocke in Dubai – he has done some really innovative designs of the next generation of MFAR.

Email Exchange: March 2008



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FOCUS: NARROWNECK ASR

The Northern Gold Coast Beach Protection Strategy of which Narrowneck ASR comprised a part was developed for the Gold Coast City Council

Selected Bibliography:

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- Jackson, L.A., Reichelt, R.E., Restall, S., Corbett, B., Tomlinson, R., **McGrath, J.** (2004). Design and construction methodology of a novel multi-function artificial reef for Dubai. *Proceedings of the 29th International Conference on Coastal Engineering*: Lisbon, Portugal.

John McGrath's Q&A:

1. *Did the Narrowneck ASR significantly improve surfing conditions?*

There was some improvement but it didn't live up to expectations. The improvements were significant though from a technology point of view. But the improvements were well short of the expectation of our local surfing community.

2. *Did the ASR attract more visitors and economic expenditures in the surrounding region?*

The location was already a popular surfing spot. There has been additional surfers attracted including competitions, but these people have been disappointed. The reef has been more spectacular in attracting fishing and diving which hardly existed here before. The ASR is now a recognised fishing and diving location. The major objective of the reef was to stabilise sand nourishment on the beach. Our competing tourist regions have experienced erosion that has dented their income over recent years. Surfers Paradise has had high quality beaches. The reef and nourishment has contributed to this success. The economic study suggested that beach erosion at Surfers Paradise would mean people chose to take holidays elsewhere. The benefit-cost ratio calculated due to projected lost tourist nights was 70:1 for our A\$10M project. I'd say that the evidence has been that we have exceeded this benefit in terms of tourist growth in surfers.



3. *Did the ASR benefit local erosion control efforts?*

Beach nourishment has improved beach health. The reef's job is to stabilise this sand on the beach. The University of NSW ARGUS monitoring program is showing that the reef is doing its job well (www.unsw.edu.au/coastalimaging). Certainly our community is happy with the beach protection job the reef seems to be doing. The reality is that the beach nourishment probably has had the bigger effect during this first decade. The real test for the reef will be the longer term stability of the beach over the next few decades.

4. *Is there any evidence of enhanced biological diversity around the ASR?*

The ecological colonisation of our reef was amazing - both in biodiversity and speed. Really incredible diversity. The reef is in the surf zone, and has more species even than natural reefs nearby in deeper water.

5. *Is there any evidence that the ASR is economically justified (i.e., a benefit-cost ratio greater than one)?*

Yes - our community would collapse if we did not invest into the health of our coastline. Our community won't put up with rock or concrete fouling their enjoyment of the sandy beach or swimming surf zone.

6. *Retrospectively, are there any apparent lessons or insights to be garnered from the Narrowneck ASR project that might drive more favorable benefit-cost ratios at prospective ASRs?*

The size of our reef at Narrowneck was conservative. There were a lot of bags placed into the lower layers to ensure a bulky seafloor footprint. The next reef we designed for Palm Beach was a smaller volume of material placed more compact which we hoped would have a similar impact on our coast at less cost. This would improve the benefit-cost ratio. Also our benefit cost ratio was just calculated on the projected lost visitor nights. We did not include any benefit for recreation or local resident lifestyles, nor any allowance for habitat or geophysical contribution to value. The secondary economic impact of recreation and tourist accommodation spend was also not included. There is no doubt these benefits are real and a much higher benefit cost ratio could be justified if required.

Email Exchange: March 2008



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FOCUS: NARROWNECK ASR

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- Jackson, L.A., **Corbett, B.**, McGrath, J., Tomlinson, R., Stuart, G. (2007). Narrowneck reef: Review of seven years of monitoring. *Shore & Beach* (75)4: 67-79.
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Bobbie Corbett's Q&A:

1. *Did the Narrowneck ASR significantly improve surfing conditions?*

Yes - in a number of ways. The Reef is built offshore and breaking in that location obviously occurs more frequently than it did prior to construction - about 50% of the time. With the final design crest height of -1.5m LAT [low tide], breaking is initiated with wave heights of between 1-2m, depending on the tide. The type of break is often spilling in more typical conditions, although larger waves with longer periods produce very good plunging waves that attract experienced surfers. It tends to suit different types of craft depending on the weather. Unfortunately, the waves here are often bi-modal and are not always the long, clean swell produced in the numerical model design. We have tracked a surfer using a wrist-mounted GPS. Average ride lengths are 150-200m, but we recorded ride lengths up to 270m - from the reef all the way to the beach. This is achievable because the reef impacts on the adjacent bars, so that the reef break can merge with the bar break when conditions are favourable. Even when the reef itself is not breaking, the impact on the adjacent bars means that it typically breaks better shoreward of the reef than the adjacent breaks. The surf life savers typically put their flags leeward of the reef, indicating it is safer in this location. A number of surf competitions have been held there, but the roxy pro and the major comps are still held in their traditional locations - we have a number of world-class surfing spots on the Gold Coast [severe competition for the reef].

Local perception of the reef performance is mixed. Plenty think it is great, but others have been disappointed. Some of this is because locals are used to surfing beach breaks, so don't plan around tides and waves - which affects the performance of the reef substantially. Some is because the reef performs better in larger, cleaner swell and this is also the time when natural breaks are also performing well. Some is because the reef is 300m offshore and a bit of a swim - many swim out if they see someone out there catching waves, but don't bother until they have proof. A big part of the perception was also that the media coverage of the reef prior to



construction was too positive - suggesting it would be the perfect break all the time. While it is definitely improved, many surfers love it and there are crowds on the reef when the conditions are good, it does not always break let alone always break perfectly.

2. *Did the ASR attract more visitors and economic expenditures in the surrounding region?*

Spoke to Angus about this briefly and he confirmed that there has been no follow up study on the economics. I was not really involved in the preliminary economic study, so I cannot help here much, either. I do know that there were previous studies that indicated that not having a beach was damaging to the Gold Coast's economy. One TV commercial [with heaps of people] has been shot on Narrowneck reef - don't know how much it generated, though - in \$\$ or jobs. Angus mentioned that beachfront properties in this area are very valuable - one sold for \$13.5M recently and I doubt they would have got that without a beach. There would be some income to Council from rates increases. As the beach is stable with the reef, there would be no need for further beach protection works [and associated expense]. Some business operators [e.g. surfboard hire] operate at Narrowneck. Maybe other benefits, but it is very difficult to judge increases in visitors to the area and the actual \$\$ impact.

3. *Did the ASR benefit local erosion control efforts?*

Yes. Before construction, erosion would go back to the rock wall annually. Have not seen the rock wall since construction in 2000 / 2001. Obviously still get scarps during big events, but there is still an adequate beach. After the last big storm there was over 50m of beach. There is also a groyne effect given the shape of the reef [i.e. the erosion protection benefits extend south to help protect Surfers Paradise].

4. *Is there any evidence of enhanced biological diversity around the ASR?*

Yes. The extent of development was unexpected - the geotextile containers provided an ideal substrate and the bags would be covered with small algae within a week of placement. After 6 months, it would be entirely covered with a dense mat of 10cm long seagrasses. After that, development would vary depending on location and arrangement of the bags among other things. It is dominated by macro-algae [e.g. seagrasses], although there are a wide variety of species evident. Biologists believe that this is in part because of the age of the reef and that it will develop further over time. There are also plenty of fish and other marine life [turtles, wobbegong, stingray, lobster] - both pelagic [wander around] and demersal [make a home on the reef]. While it is often argued that reefs attract fish and therefore reduce the fish population, the marine biologists study found that the reef enhanced productivity and biodiversity at a local scale and contributed to overall regional productivity.

5. *Is there any evidence that the ASR is economically justified (i.e., a benefit-cost ratio greater than one)?*

Hopefully this is something John McGrath will be able to help you with. Besides what I have suggested above, I have not looked into this.

6. *Retrospectively, are there any apparent lessons or insights to be garnered from the Narrowneck ASR project that might drive more favorable benefit-cost ratios at prospective ASRs?*

Certainly we have learnt a great deal from Narrowneck. In terms of benefit/cost ... it is unwise to oversell the benefits in terms of surfing as surfers can have very high expectations. The results of numerical modeling are based on clean swell that tends to indicate that the reef will perform better than may be the case in reality. A multi-function structure generally has a greater chance of achieving a positive benefit/cost than a purely surfing reef.

Email Exchange: March 2008



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FOCUS: PRATTE’S REEF ASR

In conjunction with the Surfriider Foundation, Dr. Borrero conducted a monitoring program at Pratte’s Reef ASR and authored or co-authored the assessment studies which are listed in the bibliography. Dr. Borrero is also manager of Coastal Science Group, ASR Limited, Raglan, New Zealand.

Selected Bibliography:

- Borrero, J.C.**, Nelsen, C. (2003). Results of a comprehensive monitoring program at Pratte’s Reef. Proceedings of the 3rd International Surfing Reef Symposium: Raglan, New Zealand.
- Borrero, J.C.** (2003). Two years of Pratte’s Reef: Performance and considerations for future artificial reef endeavours in Santa Monica Bay. Proceedings of the 2nd Surfing Arts, Science and Issues Conference: Ventura, CA.

Jose Borrero’s Q&A:

1. *Did the Pratte’s Reef ASR significantly improve surfing conditions?*

NO. The design was doomed from the beginning. Pratte's was not designed properly if at all... There were a few days when the reef 'broke', but other sites were as good or better on those same wave conditions.

The 'designer' of Pratte's, Dave Skelly, did not do any numerical modeling, wave climate analysis or beach surveys at the site before designing Pratte's.

2. *Did the ASR attract more visitors and economic expenditures in the surrounding region?*

Very little if any, but that is just because the reef didn't work. Had a properly designed reef been built that worked, it would have been visited many more times. Also, that quantity would be very hard to measure for the Pratte's Reef site as it is a relatively isolated industrial area in the midst of a large urban environment. It would be hard to get any sort of statistically meaningful number from a 'surf reef' sized project given the economic scale of everything else in the area.

Again, it's a neutral effect, not a negative or a positive. Should not be listed as 'no effect', i.e., 'a reef was built in El Segundo and it had no net effect on the



economy' as that has a negative connotation. Should be more viewed as a non-event and not really considered a reef project since it had no hope of success from the beginning.

3. *Did the ASR benefit local erosion control efforts?*

It wasn't designed for that, the area was not an eroding site. It had no net impact on the shoreline one way or the other. Didn't benefit, but didn't harm either. Neutral.

4. *Is there any evidence of enhanced biological diversity around the ASR?*

Now that one is true... an astounding amount of organisms colonized the reef in a very short amount of time. Algae within a week, small fish and larger fish in a month. A year or so after it was installed we saw crabs, small sharks, and one time the whole reef was literally covered with hundreds of lobster.

5. *Is there any evidence that the ASR is economically justified (i.e., a benefit-cost ratio greater than one)?*

That is a loaded question given the overall bad design of Pratte's. It would have been, if it had been built right, but it wasn't, so it didn't, you understand?

The stretch of coast that Pratte's is situated on is ideal for a reef. The beaches are straight, non-eroding and compartmentalized between groynes and storm water outfalls. The site receives many days of clean, long period swell and has nearly daily morning offshores or calm winds.

6. *Retrospectively, are there any apparent lessons or insights to be garnered from the Pratte's Reef ASR project that might drive more favorable benefit-cost ratios at prospective ASRs?*

Build it right the first time. Get people who know what they are doing to design it. Make sure the proper analysis has been done. These are all things that we (ASR) do normally or design projects. I am a native Floridian surfer, I will be part of the design team (along with John). We both have extensive knowledge of Florida's wave and beach environment.

Email Exchange: March 2008



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FOCUS: PRATTE’S REEF ASR

The Surfrider Foundation is a non-profit grassroots organization dedicated to the protection and enjoyment of oceans, waves and beaches. Founded in 1984, the Surfrider Foundation maintains over 50,000 members and 80 [chapters](#) worldwide. Pratte’s Reef ASR evolved from a mitigation agreement between Chevron and the Surfrider Foundation in which Chevron was held responsible for adversely impacting a surf locale with the introduction of a jetty.

Selected Bibliography:

Nelsen, C., Pendleton, L., Vaughn, R. (2007). A socioeconomic study of surfers at Trestles Beach. *Shore & Beach* (75)4: 32-37.
Borrero, J.C., **Nelsen, C.** (2003). Results of a comprehensive monitoring program at Pratte’s Reef. Proceedings of the 3rd International Surfing Reef Symposium: Raglan, New Zealand.

Chad Nelsen’s pre-survey comments:

- I have answered your questions below. Many of this issues are addressed more thoroughly in the attached paper, draft white paper and on this website: www.surfrider.org/artificialreef/artificial_reefs.htm
- I have cc’d Rob Nixon, from our South Texas Chapter, who has been doing extensive research on ASRs as well. I think it would be well worth your time to contact Rob.
- I have also cc’d Ericka D’Avanzo who is Surfrider’s chapter coordinator in FL.

Chad Nelsen’s Q&A:

1. *Did the Pratte’s Reef ASR significantly improve surfing conditions?*
No – the reef did not create any surf at all. It was clearly too small.



2. *Did the ASR attract more visitors and economic expenditures in the surrounding region?*

Nothing beyond a few curious surfers during the first few months. The part of the beach where Pratte's reef lies is not used by surfers very often (almost never).

3. *Did the ASR benefit local erosion control efforts?*

No – we did 2 years of pretty serious monitoring and found the reef had no effect. It was way too small.

4. *Is there any evidence of enhanced biological diversity around the ASR?*

Yes – early on we saw a cluster of lobsters at the reef and there is some growth on the exposed bags. Whether or not this is actually contributing in any significant way to the health of the local marine ecology is not clear.

5. *Is there any evidence that the ASR is economically justified (i.e., a benefit-cost ratio greater than one)?*

No – this was a mitigation for a lost surfing area. Chevron who constructed a groin/beach fill that resulted in the loss of the surfing area obviously didn't pay enough (~\$300K) to compensate for the loss of the surfing area.

6. *Retrospectively, are there any apparent lessons or insights to be garnered from the Pratte's Reef ASR project that might drive more favorable benefit-cost ratios at prospective ASRs?*

Yes. Don't trade an existing surfing area for the promises of a newly created one. If you are going to build a reef it needs to be at a much larger scale.

Email Exchange: March 2008



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FOCUS: PRATTE’S REEF ASR

Dave Skelly, who designed and constructed the Pratte’s Reef ASR project, is an expert in coastal processes and regularly performs coastal hazard and wave run-up studies for shoreline development. Prior to joining GeoSoils, Mr. Skelley was a research engineer at the Center for Coastal Studies at Scripps Institution of Oceanography.

David Skelley’s Q&A:

1. *Did the Pratte’s Reef ASR significantly improve surfing conditions?*

I always love the use of the word "significant." If you increase the number of surfable days by 10% or the quality of the wave by say 20% in my mind that would be significant. BUT this is likely not significant to the general surfing public. They want much more!!! A MFAR may be a significant improvement yet one may only be able to notice changes in a statistical (data representation) format. That is ... more plunging waves up 10%, longer ride by 20%, one may not notice over time because the near shore environment is highly diverse and changing. There is a good point here in that of you make a MFAR you better establish what you expect it to do. If it does what it is expected to do, regardless of how "significant" the surf improvement then I would argue that it is 100% successful. Pratte's reef did pretty much what I expected, small improvement, no adverse coastal impacts, and habitat improvement. I never said that the reef would make the Banzai Pipeline in El Segundo. However, the public expectations where, in some cases, that great.

2. *Did the ASR attract more visitors and economic expenditures in the surrounding region?*

For Pratte's A few surfers know where it is (it is small) and more fishermen know, no real economic impact.

3. *Did the ASR benefit local erosion control efforts?*

The reef is too small to notice any changes that are beyond the normal variability of the shoreline. It did not, however, cause noticeable erosion (or accretion).



4. *Is there any evidence of enhanced biological diversity around the ASR?*

Pratt's did establish a critter gathering place and "food chain" hierarchy. However, there are those in the environmental community that say that a gather place does not necessarily enhance biodiversity

5. *Is there any evidence that the ASR is economically justified (i.e., a benefit-cost ratio greater than one)?*

From Pratte's project ... no evidence. However, from other MFARs it is justifiable from a shoreline management viewpoint. The U.S. is far away from building recreational only reefs. The U.S. is much closer to a reef that slows down erosion or a reef that work in conjunction with a beach nourishment project, that will not adversely impact surfing and possible have a secondary surf enhancement component.

6. *Retrospectively, are there any apparent lessons or insights to be garnered from the Pratte's Reef ASR project that might drive more favorable benefit-cost ratios at prospective ASRs?*

Make sure you have realistic expectations and defined goals, don't let the general public define what success is (even though they may ultimately).

Email Exchange: March 2008



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FOCUS: CABLES ASR

In conjunction with the Ministry of Sport and Recreation, Dr. Pattiaratchi conducted a monitoring program at Cables ASR and authored the assessment studies listed in the bibliography.

Selected Bibliography:

- Pattiaratchi, C.** (2007). The Cables artificial surfing reef, Western Australia. *Shore & Beach* (75)4: 80-92.
Pattiaratchi, C. (2003). Performance monitoring of the Cable Station Artificial Surfing Reef: 1999-2001.
Report prepared for Ministry of Sport and Recreation: Reference WP1732 CP.

Charitha Pattiaratchi's Q&A:

1. *Did the Cables ASR significantly improve surfing conditions?*
Yes - see papers published. It raised the number of surfing days from < 20 per year to > 150.
2. *Did the ASR attract more visitors and economic expenditures in the surrounding region?*
Yes, it does attract visitors - but cannot quantify economic expenditures as no such surveys have been undertaken.
3. *Did the ASR benefit local erosion control efforts?*
The reef was built for recreation purposes only and the site was selected so that there would not be any adverse erosion in the local beaches. This condition has been satisfied. There have not been any coastline changes (erosion and/or accretion) as a result of the ASR. It is built on a rocky coast and some distance away (400m) from the beach.
4. *Is there any evidence of enhanced biological diversity around the ASR?*
Yes, a diverse marine system has been created.
5. *Is there any evidence that the ASR is economically justified (i.e., a benefit-cost ratio greater than one)?*
I am sure there has been but cannot be quantified as no surveys have been undertaken.
6. *Retrospectively, are there any apparent lessons or insights to be garnered from the Cables ASR project that might drive more favorable benefit-cost ratios at prospective ASRs?*
Not really - more marketing perhaps - but the surfers are aware of the reef.

Email Exchange: March 2008



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FOCUS: CABLES ASR

Geoff Trigg's Q&A:

1. *Did the Cables ASR significantly improve surfing conditions?*

The reef was built in 1998/99. No significant surf improvements are obvious.

2. *Did the ASR attract more visitors and economic expenditures in the surrounding region?*

Little to none.

3. *Did the ASR benefit local erosion control efforts?*

The location is just to the south of the southern boundary of the town of cottesloe. No major erosion controls appear to have been generated.

4. *Is there any evidence of enhanced biological diversity around the ASR?*

No.

5. *Is there any evidence that the ASR is economically justified (i.e., a benefit-cost ratio greater than one)?*

No.

6. *Retrospectively, are there any apparent lessons or insights to be garnered from the Cables ASR project that might drive more favorable benefit-cost ratios at prospective ASRs?*

The works were not funded by this town. The site of the works were and are still not near any commercial outlets or activities. There are a number of naturally occurring surf sites in the area which have always been well used. The artificial reef area is now 'out of site, out of mind'.

Email Exchange: March 2008



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FOCUS: MT. MAUNGANUI ASR

Stephen Town is the Chief Executive Office of the Tauranga City Council, the local jurisdiction of Mt. Maunganui. The Tauranga City Council is a key stakeholder and substantial donor towards this project. The following questions were posed to Mr. Town; his email reply did not directly address those questions but did provide some comments for which the Council would go on record.

The Questions Posed to Stephen Town:

1. *Did the Pratte's Reef ASR significantly improve surfing conditions?*
2. *Did the ASR attract more visitors and economic expenditures in the surrounding region?*
3. *Did the ASR benefit local erosion control efforts?*
4. *Is there any evidence of enhanced biological diversity around the ASR?*
5. *Is there any evidence that the ASR is economically justified (i.e., a benefit-cost ratio greater than one)?*
6. *Retrospectively, are there any apparent lessons or insights to be garnered from the Pratte's Reef ASR project that might drive more favorable benefit-cost ratios at prospective ASRs?*

Stephen Town's Email Response:

Hello Michael, Thank you for your contact.

Please note that while the Council is a key stakeholder in this project the contract with ASR Ltd for the design and construction of the reef was let by an independent trust. You can contact this trust via the website to ask the trust some of these direct questions.

<http://www.mountreef.co.nz/>



I am able to provide the following comments on behalf of Council about the reef project.

- Council is a substantial funder of the reef project.
- Council has been supporting the ongoing fund raising effort to make sure the reef can be completed.
- It was fully understood from the beginning that the reef design was experimental in nature - Council accepted this risk being the first design of its type in NZ.
- The reef is not completed to its design - there is stabilization and bag filling still to complete.
- There is speculation that the performance of the reef will not meet the predicted performance stated in the design.

Best wishes for your project's success.

Kind regards

Stephen Town
Chief Executive
Tauranga City Council

Email Exchange: March 2008



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FOCUS: MT. MAUNGANUI ASR

Craig Hadfield is a trustee of the Mount Maunganui Reef Trust.

Craig Hadfield's pre-survey comments:

As stated by Stephen Town from the Tauranga City Council in his initial response to you the ASR is unfortunately not in a completed state, it is approximately 70% finished, the balance of work required includes reinstallation of one of the main bags that burst during filling and 'top up' filling of other bags to bring them up or close too specification.

Craig Hadfield's Q&A:

1. *Did the Pratte's Reef ASR significantly improve surfing conditions?*

We remain confident, when conditions allow the reef will prove to provide significantly improved surfing options

2. *Did the ASR attract more visitors and economic expenditures in the surrounding region?*

The project has certainly raised considerable interest, however, in its incomplete state it is too early to evaluate the economic benefits

3. *Did the ASR benefit local erosion control efforts?*

Part of the environmental approval process is to monitor the impact on the beach; we've certainly monitored considerable build up of sand around a localized spot



4. *Is there any evidence of enhanced biological diversity around the ASR?*

Yes, the bags that are in place are covered in a combination of shell fish and sea weed, there have been cray fish living between the bags and there are schools of fish attracted by the smaller life now resident on and between the bags.

5. *Is there any evidence that the ASR is economically justified (i.e., a benefit-cost ratio greater than one)?*

Early investigation certainly demonstrated considerable economic benefit, this cannot be realized until the project is complete

6. *Retrospectively, are there any apparent lessons or insights to be garnered from the Pratte's Reef ASR project that might drive more favorable benefit-cost ratios at prospective ASRs?*

The Trust contracted a local contractor who had experience in various forms of underwater recovery and repairs however no experience in this type of construction, its fair to say no one had the experience. Whilst specific experience was impossible to find I believe the contractor failed to plan for the possible problems that can occur when working under water and did not take charge and problem solve quickly when required. The calibre (get references) of the lead contractor and their ability to work with a project manager is of paramount importance. I believe one of the keys to a cost effective outcome lays with the contractor and the project manager. Community projects of this nature rely on voluntary financial and operational support; clearly if it possible to secure significant resources to prior project commencement operational matters can be concluded in a more timely manner allowing benefits to be realized earlier.

Regards,

**Craig Hadfield
Trustee Mt Reef**

Email Exchange: March 2008



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FOCUS: OPUNAKE ASR

Craig Steveson is the Chief Executive Officer of the South Taranaki District Council (STDC), the local jurisdiction of Opunake. The STDC is a key stakeholder and substantial donor towards this project.

Hello Michael.

Sorry about the delay in replying, I was out of the office for much of last week.

Our ASR here has had quite a chequered history and as you note, it is not finished yet so I cant give you much in terms of actual results. The good news however, is that it grows closer by the day.

[CS] In response to your questions:

1. Did the Opunake ASR significantly improve surfing conditions?

[CS] Unknown at this stage. According to locals there is a noticeable swell off the almost complete reef but I have not heard it is producing consistent tubular waves at this stage.

2. Did the ASR attract more visitors and economic expenditures in the surrounding region?

[CS] Again it is too early to tell. Our Council funded an Economic Impact Report some years ago and this showed a moderate increase in economic benefit would result but we will see what transpires. What has happened however is a significant increase in the value of property in the Opunake area. From the time the Council announced its grant to enable the ASR to be built, property prices started to increase and have continued to do so ever since. I do not have the exact percentages to hand but we could find these if you are interested. I would suggest that the increases would be in excess of 100% in the last 4 years and a large portion of this is directly due to the perceived impact the ASR will have.

3. Did the ASR benefit local erosion control efforts?

[CS] The Council funded a full Environmental Impact Report some years ago and the conclusion was that there would be no negative impacts on the foreshore and surrounding environs. Interestingly. The bay at Opunake is actually accreting rather than eroding.



4. Is there any evidence of enhanced biological diversity around the ASR?

[CS] I have heard anecdotal evidence (from the divers) that the sealife is rapidly adapting to the new environment. The Environmental Impact report suggested that this would happen and the ASR would become a haven for various forms of sealife.

5. Is there any evidence that the ASR is economically justified (i.e., a benefit-cost ratio greater than one)?

[CS] Not at this stage. There will be huge interest to see what happens over the next 12 months however. See also answer to Q2.

6. Retrospectively, are there any apparent lessons or insights to be garnered from the Opunake ASR project that might drive more favorable benefit-cost ratios at prospective ASRs?

[CS] All parties have learnt many lessons during the development of this ASR but not necessarily ones that might drive a more favourable BC ratio. My personal view is that an ASR could well have genuine economic benefit in the right environment eg ... at an existing tourist mecca (such as yours?) where there are larger numbers of potential users. It is "another reason to come" and until they become commonplace, an ASR still represents a reasonable point of difference.

In summary, our Council made a significant grant (\$1.1million) to a local community group to enable the ASR to be built. It was a calculated gamble made by a courageous Council with a desire to do something that would "make a difference" for the Opunake community and our district. We were aware ASRs were (and still are) reasonably new and experimental and there are a number of unknowns surrounding design, and construction. For two summers the weather thwarted progress and it looked like we had invested in a "white elephant". Happily, progress over the last two months has given cause for renewed optimism.

Michael, there is much more information and advice we could provide on lessons learnt during this project. I have not been the person closest to this but would be happy to gather a few more relevant people to enable a conference call with you, if this would be of use.

Kind regards
Craig Stevenson

Chief Executive
South Taranaki District Council

Email Exchange: April 2008



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FOCUS: OPUNAKE & MT. MAUNGANUI ASRs

The engineers of record - ASR designed and supervised construction of both the Opunake and Mount Maunganui ASRs.

Selected Bibliography:

- Mead, S. T.**, Black, K.P. (1999). A Multi-Purpose, Artificial Reef at Mount Maunganui Beach, New Zealand. **Coastal Management Journal** 27(4).
Black, K.P., **Mead, S.** (2001). Artificial surfing reefs for erosion control and amenity: Theory and application. **Journal of Coastal Research** (special issue 29): 115-30.
Black, K.P., **Mead, S.** (2007). Sand bank responses to a multi-purpose reef on an exposed sandy bank. **Shore & Beach** (75)4: 55-66.

With respect to the questionnaire, I would like to take this opportunity to provide answers to your questions in a similar capacity to the other designers, engineers and stakeholders involved with reef projects as you have already included in your assessment.

1. Did the Mt. Maunganui (or Opunake -- please specify) ASR significantly improve surfing conditions?

Neither reef is complete yet, which could be interpreted as "too early to objectively judge the effectiveness of the reefs". Even so, the Mount Reef is approximately 70% complete while the Opunake Reef is about 60% complete as of 2 April 2008; 4 more containers need to be placed, and currently few of those in place are completely filled, 3 weeks of pumping will be required over the next few months – work started 20 February 2008, prior to that there were only 3 containers in the water and none completely filled (over the past 2 days we have had a clean swell at Opunake and have monitored the results of the Opunake Reef's performance - I can say that we are pretty happy with results at this stage; after next weeks construction window, it will be left over the winter to compact and settle and re-evaluated late this year as to where the final containers will be placed). The difficulties encountered in reef construction at Mount are addressed in separate items listed below, which was undertaken by the lead contractors Bay Underwater Services (BUS) - some of this was discussed over the teleconference. ASR personnel have regularly surfed the Mount Reef in its unfinished state, and also have a robocam of the site which can be accessed at any time to watch the surfers on the reef, so we feel qualified to respond (if access to the robocam would help with your data collection, we can send you the online site and access codes?). The Mount Reef produces very hollow fast waves during favorable conditions. Photos and videos of these waves have been posted on several New Zealand web sites and the Trust and ASR also have footage and photographs of surfing/surfers utilising it - there were a number of surfers getting barrels on the Mount reef yesterday and 2 people surfing it as I write this e-mail. The sand bars created by the reef also produce good surfing waves inshore and adjacent to the structure.

No reef, no matter how well designed, will create perfect waves all the time. Three of the primary factors determining wave quality; swell, wind and tide are beyond human



control. The only factors that can be controlled are the shape and gradient of the seabed over which the waves break. ASR limited is recognized as the world authority on the science of surfing. We have presented the results of our original research in over 100 articles published in peer-reviewed technical journals, coastal conference proceedings, and the mainstream press. The basic concepts behind an artificial surfing reef are two-fold. First the reef should increase the gradient of the seabed such that the waves break with greater intensity than they would on the original seabed (there is a good comparison 15 January 2007 on www.caughtonradar.co.nz that shows waves on the reef and waves on the beach within an hour of each other and the 'fat' beach break compared to the reef is obvious – select the Mount in the left side-bar). Secondly the reef should realign the seabed so that the wave will peel along the reef rather than closeout. In order for a reef to be successful it must be sufficiently shallow to induce wave breaking under the desired conditions and it must have a well defined focus or take-off zone. The geobags of the Mount Reef have never been completely filled and the focus is not in place (indeed, the opposite is true, there is a channel between the halves). In addition, the contractors split a very large (60 m long x 5 m wide x 3 m high) container in the middle of the right-hand side of the structure that was removed and has still not been replaced. Consequently the reef is not yet performing as well as designed, although still regularly produces fast hollow waves for surfing. ASR Limited has only recently taken over the construction of the Mount Reef and we expect to finish it this year (see subsequent items for more details). We would ask that final judgment on the effectiveness of the reef be withheld until it has been completed. Additionally, there is the unreal expectation of surfers to get a perfect wave any time they turn up since it's a man-made break. Even though they may turn up for a few days when it's flat or onshore (the Mount is in the Bay of Plenty, NZ's most sheltered coast) an artificial reef will be judged a failure, although the same person could stay at Raglan for 3 weeks and not get a good wave, but still consider it a world-class break. This is also linked to the time required to build a reputation, i.e. Raglan has a reputation for long quality waves, the Mount is still not complete and only 18 months since the second half went in. The Nazz (Narrowneck reef on the Gold Coast) is a good example of this – wannasurf has blogs back to 2001, they start out negative due to people turning up and not 'scoring' and in the last few years are very positive, 'best break in the world', 'best break on the coast', arguments who surfs it best surfers or boogers, etc, etc, i.e. kids and whingers posting rubbish, but interesting with respect to changing opinion with growing reputation/knowledge of the break.

2. Did the ASR attract more visitors and economic expenditures in the surrounding region?

It is extremely doubtful that anyone would be able to objectively answer this question - it would require a targeted socio-economic investigation - the Gough 1999 may provide some useful information for the Mount? Again neither reef is complete so it is too early to judge. Socio-economic studies were undertaken pre-construction by Gough 1999 (Mount) and Tourism Resource Consultants 2002 (Opunake) – with the TRC report being the driving factor behind the Opunake reef (i.e. , the South Taranaki Regional Council undertook the project based on the results of the study). Interestingly, the Bournemouth Borough Council's tourism branch stated at a Council meeting (and in the minutes) that the media exposure they had received due to the project would comparable to GBP 10,000,000 had they paid an advertising agency (I can provide Roger Brown's contact (Head of Leisure Services at BBC) if wanted?).

3. Did the ASR benefit local erosion control efforts?

This question is irrelevant, since neither the Mount Maunganui and Opunake reefs were not designed for coastal protection – Mount was built too close to the shore to have a pronounced effect due to the location of the inshore port dredging dump site and the need to minimize construction costs (Mount Maunganui Beach has been accreting for the past



100 years), although there is a beach dynamic beach and seabed response which is detailed in last Fall's issue of Shore and Beach; Opunake is built on rocky reef in an enclosed bay with rocky cliffs behind and is no erosion problem on the beach (they regularly have to truck wind-blown sand away). There is only one Multi-Purpose Artificial Reef in the world which has been designed and built for coastal protection as the primary aim, the Narrowneck Reef on the Gold Coast of Australia. The answer for the Narrowneck Reef is yes. Data on the coastal protection benefits of the Narrowneck Reef is readily available from the Water Research Laboratory (WRL) at the University of New South Wales, Australia and can be found in several peer-reviewed publications - some are incorporated in the review document.

4. Is there any evidence of enhanced biological diversity around the ASR?

Worldwide, marine fouling costs millions of dollars and anti-fouling is a multi-million dollar industry – unless the reef was painted with TBT, it will be colonized by marine life. In addition, the large difference in biodiversity of mobile sandy substrates (i.e. sandy seabeds) and comparatively complex stable substrates is well documented, with the latter having far higher biodiversity. The Mount Reef has performed extremely well as a new ecosystem for marine life, with seaweeds, sponges, bryozoa, crustacea, cephalopods, bivalves and a variety of reef and schooling fish now present at the site (compared to the sandy seabed dominated by polychaete worms, amphipods and biscuit stars (documented in Mead et al., 1998, and subsequent monitoring studies undertaken by the Bay of Plenty Polytechnic and ASR). The geotextile bags have proven to be a very good substrate for marine organisms, as they did at the Narrowneck Reef - more than 270 species have been identified on or associated with the GC reef. There are several studies of this for the East Coast of the US, which will be passed onto Dave Snyder.

The majority of the Opunake Reef has only been in the water less than a month. Marine flora has been observed on the reef in recent dives and it will be colonised relatively quickly by the local marine flora and fauna, as happens anything solid and stable that is dropped into the sea - general principles of exposure vs colonisation rates and monitoring of the shore and oil rigs around the Taranaki coast indicate that full coverage will occur in under 1 year and that a dynamic climax community will be established within 3-4 years.

5. Is there any evidence that the ASR is economically justified (i.e., a benefit-cost ratio greater than one)?

ASR Limited is not aware of any economic studies which have been performed since the New Zealand reef projects began. It is doubtful that anyone would be able to objectively answer this question at the present time, without a targeted study. Again neither reef is complete so it is too early to judge (house prices rose dramatically in Opunake with the news of the reef project, although at the same time, the same was true for many coastal locations around NZ, so it could be hard to distinguish?). The benefit-cost ratio of the Narrowneck Reef and associated beach re-nourishment project was estimated between 60:1 and 80:1 prior to its construction (Raybould and Mule, 1998) and according to GCCC engineer John McGrath (2002) has achieved 70:1 benefit:cost ratio. Of the independent socio-economic assessments that we have, benefit:cost ratios for improved beach amenity range from 20:1 to 500:1 – we have at least a dozen of such reports (there is even a massive one on Florida's artificial reefs for fishing (Johns et al., 2001), many in electronic copy have been sent.

6. Retrospectively, are there any apparent lessons or insights to be garnered from the Mt. Maunganui (or Opunake -- please specify) ASR project that might drive more favorable benefit-cost ratios at prospective ASRs?



How could a surfing forum possibly answer this question in any sensible way? From our experience, perhaps the most important element in the construction of any Multi-Purpose Artificial Surfing Reef (MPASR) project is proper coordination between the design and construction teams. Many of the problems associated with the Mount projects could be attributed to a lack of coordination between those teams. It has become evident, that MPASR and their construction methods are new and innovative technologies which are beyond the experience base of many existing coastal engineering contractors that would undertake this scale of project, which falls into an 'immediate' size - the small contractors don't have the equipment (small dredges for marinas, mooring positioning, etc) and the large contractors are cost prohibitive (large dredges and vessels for moving very large quantities of sediment or construction of large facilities). Coordination with designers and contractors experienced with MPASR construction will be critical to the success of any future MPASR project - this has been the driving force behind the development of ASR Reefs, a subsidiary company to construction MPASR's. Another important lesson learned from Narrowneck reef, Mount reef and Opunake reef is that the media will over-hype such projects, which can lead to negative responses from some surfers, i.e. those that expect to turn up at a surfing reef site and score perfect waves – they are not wave pools, they become a 'natural' reef and perform when the conditions are right (they cannot create swell or turn the wind offshore). This is a common theme that comes through in forums/blogs, over-promised but under-delivered is how it is seen.

Please don't hesitate to ask for any information that we may be able to provide associated with MPASR's.

All the best
Dr. Shaw Mead
ASR Ltd

Email Exchange: April 2008



APPENDIX E: FACILITATORS

Virginia Barker	Brevard County Natural Resources Office	Florida
Bob Baugher	Cocoa Beach Surf Company	Florida
Meg Bernardo	Executive Manager, ASP North America	California
Jose Borrero	USC & Amalgamates Solutions and Research	California
Roger Brown	Head of Leisure Services, Boscombe	England
Eric Burggraaf	Mount Maunganui Surfer	New Zealand
Rob Campbell	Bay Underwater Services	New Zealand
Craig Carroll	Ron Jon Surf School	Florida
Dick Catri	Promoter, Easer Surf Festival	Florida
Bobbie Corbett	International Coast Management, Queensland	Australia
Ross Corbett	Tourism Resource Consultants	New Zealand
Steve Corkill	TSB Community Trust	New Zealand
Steve Crawford	Tourism Western Australia	W. Australia
Walker Dawson	Coastal Tech	Florida
Rob Dixon	Surfrider Foundation, South Texas Chapter	Texas
David Dunham	Reporter, Bay of Plenty Times	New Zealand
Tim Fletcher	Charter Fishing	Florida
Kyle Garson	Professional Surfer	Florida
Allen Goodhall	Mount Maunganui Resident	New Zealand
Craig Hadfield	Trustee, Mount Maunganui Reef Trust	New Zealand
Jim Hoare	New Zealand Surf School	New Zealand
John Hearin	Amalgamates Solutions and Research - America	Florida
Angus Jackson	International Coast Management, Queensland	Australia
Andy Jordan	Surfer/Surf Shop Owner	New Zealand
Matt Kechele	Former Professional Surfer, Quicksilver Promoter	Florida
Brian Kelly	Graduate, Florida Institute of Technology	Florida
Neil Lazarow	Griffith University, Queensland	Australia
Mike McGarry	Brevard County Natural Resources Office	Florida
John McGrath	Gold Coast City Council, Queensland	Australia
Shaw Mead	Amalgamates Solutions and Research	New Zealand
Allan Monday	Mount Maunganui College	New Zealand
Jo Mountain	Bournemouth Tourism	England
Chad Nelsen	Environmental Director, Surfrider Foundation	California
Richard Oliver	Community Development, S. Taranaki Dist. Council	New Zealand
Dan Osiecki	Surfbreak Engineering Services	Florida
Chari Pattiaratchi	University of Western Australia	W. Australia
Matt Pruett	Editor, Eastern Surf Magazine	Florida
Maria Ramsay	TSB Community Trust	New Zealand
Mike Raybould	Griffith University, Queensland	Australia
Mike Sharp	New Plymouth Underwater Services	New Zealand
Dave Skelley	Principal Engineer, GeoSoils, Inc.	California
Roy Stewart	Olosurfer - Wooden Surfboards	New Zealand
Craig Stevenson	Chief Executive, South Taranaki District Council	New Zealand
Greg Townsend	CEO, Surfing New Zealand	New Zealand
Stephen Town	Chief Executive, Tauranga City Council	New Zealand
Goff Trigg	Engineering Services Manager, Town of Cottesloe	W. Australia
Mitch Varnes	Promoter, O'Neill Sebastian Inlet Pro	Florida
Rob Varley	Executive Director, Space Coast Office of Tourism	Florida
Melanie Vass	Reporter, Daily Echo	England
Mike Walther	Coastal Tech	Florida
George Williams	Reporter, Post Newspapers	W. Australia
Steve Williams	Surfing Western Australia	W. Australia