NARRAGANSETT BAY HIGH SPEED NETWORK
PHASE 2—MARKETING, OCEAN ENGINEERING, AND SITE
SELECTION EXPANSION

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University of Rhode Island

June 2005

URITC PROJECT NO. 000592

PREPARED FOR

UNIVERSITY OF RHODE ISLAND
TRANSPORTATION CENTER

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The premise of this student design project was to establish conceptual, site specific, layouts of a ferry terminal building serving as a welcome center and ticket kiosk. Additional landscape site plans were developed for sites not considered in Phase 1. East Providence, Bristol, and Prudence Island were addressed in this Phase 2 project to compliment the Phase 1 sites of India Point Park (Providence), Narragansett Landing (Collier Point Park - Providence), Rocky Point (Warwick), Quonset Point/Davisville (North Kingston), and Warren Harbor (Warren).

A marketing plan and advertising campaign were developed with regard to the ferry routes and site plan designs from Phase 1. This demonstration project also developed ocean engineering layout (environmental impact, wave attenuators, dredging needs) for the Phase 1 Scarborough Beach ferry landing.

The students learned how to apply classroom curriculum to a real-life, transportation, design scenario while they developed valuable Inter-modal planning documents that can serve as a central database for further consideration by the public and private sectors.

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PREFACE

This report is intended to be a continuation of the, “Rhode Island Waterborne Passenger Transportation Plan,” dated August 1998, prepared by the Rhode Island Department of Transportation (RIDOT) and published by the State Planning Council. The conclusions of the, “Rhode Island Waterborne Passenger Transportation Plan,” Part 09-03-03 Facility Improvements, recommends RIDOT to, “develop policies and regulations, in cooperation with the Coastal Resource Management Council and the Department of Environmental Management, that encourage the development of environmentally compatible marine terminals for tourist and commuter use.”

This report was prepared by the Rhode Island Design Studio consortium of high school and collegiate student design programs to develop site specific, conceptual site plans with marine terminals for tourist and commuter use. These site plans are presented for reference only as student conceptualization to the Coastal Resource Management Council (CRMC), the Department of Environmental Management (RIDEM), the Department of Transportation (RIDOT), Public Transit Authority (RIPTA), Economic Development Corporation (RIEDC), and respective town/municipal Planning Departments. The student generated concepts are not intended for implementation but rather to provide a design exercise for the students on a transportation related topic.

Funding support was provided by the University of Rhode Island Transportation Center (URITC). High school and collegiate student design programs significantly contributed to the development of this report as a research, education case study consistent with the theme of the URITC which is “Surface Intermodal Transportation systems and Advanced Transportation Infrastructure with special reference to the Marine Environment.”

Please visit www.ridesignstudio.org for student presentations and additional student generated information not included in this report.

Pertinent Publications and Studies:


2) “India Point Park Ferry Terminal, Remote Parking Options for Providence to Newport Ferry Service,” dated November 2001, by Edwards & Kelcey, Inc. for the Rhode Island Public Transit Authority,

3) “Boston Inner Harbor Passenger Water Transportation Plan,” dated January 2000, by TAMS Consultants, Inc. for the Boston Redevelopment Authority and the City of Boston,


CHAPTER 1 – Executive Summary

The “Narragansett Bay High Speed Ferry Network Phase 2: Marketing, Ocean Engineering, Site Selection Expansions” project was undertaken to focus the energies of high school and collegiate students onto transportation related issues and professional fields. This fostered the establishment of a consortium of high schools and colleges with robust student design programs involving a student generated design. This report compliments last year’s project entitled, “Narragansett Bay High Speed Ferry Network Phase 1: Site Selections and Site Designs”

The talents of students throughout the State of Rhode Island have been routinely exercised independently of each other on diverse topics. The Rhode Island Design Studio functions as a consortium of schools contributing their respective elements to this year’s common subject of waterborne transportation on Narragansett Bay. Each classroom participating in the Consortium was facilitated by the consortium’s Executive Director so as to streamline the incorporation of the topic into the classroom without disrupting the established curriculum requirements.

The goal of exposing students to transportation related professional fields was achieved by integrating student design programs that could relate to one another and widen the sphere of influence beyond a single industry. Student design programs; such as, landscape architecture/architecture/engineering, web design classes, and tourism & marketing classes were chosen to be associated with this project to develop a full service product that correlates the physical design of a ferry network system to its operational “personality” that would be reflected in transportation marketing/advertising.

The site plan designs produced by the University of Rhode Island landscape architecture, Roger Williams University architecture, and University of Rhode Island ocean engineering students provided the graphics and text to populate project webpages. The webpages were created by a Bishop Hendricken High School web design student so as to reflect the modern, internet based, project websites commonly used by architecture/engineering firms working on transportation projects.

Cranston Area Career & Technical High School students and Charlestown Area Career & Technical High School students learning how to utilize Computer Aided Design (AutoCAD) software applied their lessons so as to develop ferry landing site plan drawings from the collegiate design concepts. The first annual assembly of Consortium high school students was conducted at the University of Rhode Island. The students were given a tour of the Landscape Architecture Department where the site plan concepts originated. They were also presented with a program that explained how their interest in AutoCAD could lead to careers in transportation, community planning, landscape architecture, architecture, and engineering.

A Bryant University marketing analysis was augmented with an advertising campaign developed by Charlestown Career & Technical High School tourism and marketing students. This enhanced the transportation project with a business marketing conceptualization.

The culmination of this multi-industry approach (arch+engin/web/marketing) is a ferry network product identity with a tangible physical site plan layout. This enabled a very diverse exposure of transportation planning not only to landscape architecture, engineering, and architecture students but also to web students and marketing students. The traditional collegiate and high school course curriculum was satisfied; as required, while the transportation theme of using ferries for mass transit in conjunction with land based bus routes, automobiles, bikepaths, and pedestrian traffic flows was injected into their team discussions as designs for site plans, advertisements, and webpages were refined.

A secondary benefit enabled the students to serve the State of Rhode Island. The students were excited to conceptualize a site plan design for a ferry landing that may be of interest to transportation planners, city/town planning offices, and legislators. Students were excited to develop advertisement flyers that could interest transportation planners, city/town planning offices, and legislators. Students were excited to develop webpages that are being used to present these site plan designs and marketing plans so they could be referred to by interested transportation planners, city/town planning offices, and legislators.

This project also enabled the Rhode Island Design Studio Consortium to further invent and establish the operational processes that enable a common subject to be addressed by several schools located throughout the State of Rhode Island. An operational budget was established along with web hosting services and assembling design information databases. Business Planning has been furthered so as to establish this Consortium as an educational, non-profit entity.
CHAPTER 2 – Computer Aided Design (CAD)

The participation of high school students enrolled in Computer Aided Design (CAD) enables the collegiate concepts to be accentuated with either 3-dimensional (3D) modeling or 2-dimensional (2D) drawings. Most college level designs are conceptual and lack traditional drawing borders and text that move a design conceptualization into a construction drawing package.

The role of the high school AutoCAD student is to transform the collegiate conceptual designs into a traditional construction drawing. The fundamental high school course curriculum was satisfied while the transportation theme of using ferries for mass transit in conjunction with land based bus routes, automobiles, bike paths, and pedestrian traffic flows was injected into their team discussions as conceptual designs for site plans were refined into construction drawings.

Chariho Career & Technical Center AutoCAD students developed 2D drawings which are presented in Appendix 2. The Cranston Area Career & Technical Center AutoCAD class utilizes 3D modeling techniques now becoming prevalent in the design industry. This expands the robustness of the project since 2D drawings and 3D renderings of a ferry terminal building can be made utilizing the collegiate site plan designs. Rodrigo Cespedes developed renderings and drawings for the respective sites conceptualized by the collegiate students.
CHAPTER 3 - Market Demand Analysis & Advertising Campaign

3.1 Market Demand Analysis

Prepared By:

Meghan Campbell, Wing Yi Chan, Caitlin Morin, Danielle Ruth, Kathryn Thurber, Robert Woodworth

Bryant University, Marketing Department, Marketing Research 312, Fall 2004

Summary

Our main goal in this project was to determine the demand for a park-and-ride ferry to various beaches and islands in the Narragansett Bay area. We wanted to gain an understanding of the attributes a successful ferry should have in order to satisfy potential customers. Our objective was to gather and analyze data through secondary and qualitative research, including the administration of a survey.

First, our group sifted through binders provided by our contacts which contained valuable information pertaining to existing ferry operations and the necessary aspects of running a successful ferry service. We also examined a survey previously conducted by RIPTA with the intent of identifying what areas to focus on and build upon in our own survey. Next, we conducted interviews on the Providence-Newport ferry in order to gain a general understanding of what ferry passengers like about the experience and what they would change. We also interviewed the crew members in order to gain information on the technical aspects of successful ferry operations. We used the information we gathered from our secondary and qualitative research in order to develop survey questions. Surveys were administered to high school students, family and friends of these students, and faculty members at Bryant University.

Based on our survey results, we found that there is a demand for this ferry service. However, we recommend that further research be completed before a final decision is made on whether or not to implement this ferry service. This report will further elaborate on the methods we used to gather data and the significance of our findings.

Introduction

We were given the task to determine the demand for a park and ride ferry that runs from Providence to the Narragansett Bay area. Our primary contact for this project was Brian Hanley. He provided us with relevant information, including two large binders that held the bulk of our secondary research, as well as support and guidance throughout the duration of the project.

Through our contacts with Brian, he communicated our research objectives. These objectives include: to determine the demand for a park-and-ride ferry, to determine the important attributes a ferry must have in order to be successful, and to analyze our data through SPSS and make recommendations as to the feasibility of the implementation of such a service.

Our initial hypothesis was that there would be little to no demand for this ferry. This hypothesis was based upon information we received in our initial meeting with our contacts. At this time it was explained to us that the current ferry RIPTA is operating is not profitable and is operating in the red.
We encountered a few problems along the way; the most significant of these being the difficulty in the distribution of our survey. Initially we had planned to distribute our survey via a convenience sampling at the Providence Place Mall. However, we were unable to gain permission to do so. As a result we had to hand out our survey to the Bryant Community and various high schools throughout the state of Rhode Island.

This study was conducted over the fall 2004 semester, beginning in September and concluding in December. We began our secondary research in September, conducted interviews with riders and crew of the existing RIPTA ferry in October, and administered our survey in the beginning of November. We made our final presentation of our findings to Brian on Friday, December 3, 2004.

Secondary Research
There are two forms of secondary research. The first being internal sources, when examination of internal records are performed, and external sources, which could come in the form of commercial publications or government documents. Based on what our research objective was there were no external sources that would be relevant to our research. Therefore, our secondary research is primarily based on internal sources. At our first meeting with our contacts we received two binders that were full of past research done about ferries, from the design of the boat to the history of ferries. In these binders we did find sections that were beneficial in developing our qualitative research methods and survey questions. In addition to the binders we also received a past survey conducted by RIPTA that we planned to analyze and see what was done well and what should be changed to help in developing our survey (See Figure 3.1).

The Report to the Division of Public Utilities and Carriers section of the binders included criteria that are important to passengers who would be riding a ferry. Under service criteria the ferry needs an attractive fare and amenities. The section stresses that it is important for the ferry to provide an affordable and competitive price to compete with other modes of travel. Under terminal facilities the first need the ferry must satisfy is having comfortable terminals. It should be well lit and have safe walking paths to parking, nearby destinations and the dock. Lockers would also be beneficial to tourists. The next facility that should be provided to meet travelers' needs is adequate parking so that all who wish to ride the ferry are able to do so. Next would be adequate waterfront facilities which would mean a pier sufficient to dock vessels during all weather conditions. Finally there needs to be a seamless connection to transit/parking/pedestrian areas. This can be done in the form of bus shelters for trolley services, and transit stops should be located nearby. This section of the binders helps set priorities for what this ferry should accomplish since it will be entering the tourist setting instead of just for commuters.

The section entitled Rhode Island Waterborne Passenger Transportation Plan mentioned important attributes a ferry system should have that were not included in the previous section. The first point the section made was that ferries have operated in some locations in Rhode Island over long periods of time; this indicates the persistence of markets for water transportation systems. It also suggests looking into a place that has a history of ferries to look for markets for present services. Areas that once had shipping ports would be easy to convert into docks for ferries. This point is relevant in our research because it puts into perspective what this industry is like. This section also warns of the greatest competitor, which are highways and bridges. Sometimes, ferries have not been able to keep up with this competitor and have been discontinued. Extra steps must be taken by the ferry industry to prove that riding a ferry is a better alternative to driving. This can be done by coordinating the bus and ferry schedule so people will be able to travel with ease and not feel trapped by the schedule of the ferry. Also, an increase in parking lot security would ease the fear some people would have about leaving their cars somewhere for an extended period of time. Another idea is to provide a direct and fast route to destinations which would appeal to people considering whether it would be better to ride a ferry or drive their car. This section also makes a note that care should be given to the location of ferries. Ferry terminals should be located near residential zones or populated areas. This is because the people riding the ferry will be without their cars and will be walking to other locations. Individuals will not walk a great distance just to get to a populated area. Also, in order to attract people to the ferry, places of interest should be included in the ferry routes.

The past survey that was developed and distributed by RIPTA had some flaws in its design. First, it lacked an introduction which would have helped clarify the purpose of the survey. A clear, informative introduction may have reduced the number
of unanswered questions. Without such an introduction, respondents would have no way of knowing what their responses would be used for and therefore might be hesitant about revealing personal information, such as gender, age, or income. Another design flaw was that the survey did not include a scale on a question that asked people what they like about a ferry. It simply provided a list of different aspects of a ferry and asked respondents to check those that were important to them on some level. This is significant because when people just check a feature that they like it cannot be determined how important they consider each particular feature to be. On the other hand, if someone did not check a feature it cannot be determined how little importance they place on that feature. Therefore, by having a scale that measures the degree of importance, a more accurate understanding is achieved on what is really important to the people taking the survey. From the analysis of the past survey we determined that we needed to come up with a survey that is clear so that people understand what they are being asked and why. Further, we recognized the necessity of including a series of scales in order to determine how strongly people feel about their responses.

Qualitative Research
Before diving into the heart of our project, our group wanted to first gain a general understanding of the ferry business as a whole. Why do people ride ferries? What do they like about them? What would they change? We had many questions that could be best answered in one way. In order to gain a more thorough understanding of opinions about ferries, passengers on the existing Providence-Newport ferry were interviewed.

On October 21, the passengers on the 4:45 ferry to Newport and the 6:15 ferry to Providence were asked a series of questions about their experiences with the ferry. In all, six passengers were asked the same set of questions regarding their motives behind riding the ferry and what they liked and disliked about the experience. Through talking with the individuals on this ferry, our group intended to identify key areas that needed to be addressed in order to successfully implement this new ferry. We compiled a list of questions to ask the passengers based on the information we found in our secondary research and upon recommendations made during our initial meeting with our contacts. These questions can be viewed in (See Figure 3.2).

After reviewing the responses to these questions, we found the following questions to provide us with the most information and insight:
1. Do you find riding the ferry to be an enjoyable experience? Why?
2. How did you hear about this ferry?
3. Do you prefer taking the ferry to driving? Why?
4. Is there anything you would like to see implemented to make this ferry ride more enjoyable?

Although the passengers all had different reasons for riding the ferry, they all identified it as an enjoyable experience. When asked whether or not they found the ferry to be an enjoyable experience and why, the responses included, “It is very comfortable and relaxing,” “I enjoy the cabin as well as being up top. Also, the view,” and “I love it. It’s quick, comfortable, and not rough.” In asking this question we wanted to gain an understanding of what individual’s liked about their ferry experience. We had anticipated these responses based on our secondary research and our communications with our contacts. The fact that our interview subjects confirmed these views allowed us to identify the main reasons why people ride ferries. Due to the consistency of this response, we knew it was something to further explore in our surveys to see if this trend held up. Further, these responses allowed us to identify certain characteristics of ferries that should be emphasized to potential customers of the new ferry in order to increase the number of riders.

Through asking the passengers how they heard about the ferry we wanted to determine the most effective way to advertise and/or promote a ferry service. The most common response we received was through word of mouth. One passenger informed us, “My friend knew about it. She took me sightsee for fun.” Word of mouth can be one of the most beneficial means of advertising a ferry service. If an individual enjoys the ferry ride, they are likely to recommend it to their family and friends. This should be kept in mind when developing the new ferry service. It should be a main priority that all passengers love their experience. By accomplishing this, not only will current passengers be satisfied, but the number of riders will increase as a whole. Along with word of mouth, individual’s also responded that they just knew about the ferry because they were from Rhode Island. In addition, two interview subjects, who were visiting from upstate New York, identified their hotel as the source of the information about the ferry. Hotel guests are able to obtain information about tourist attractions from their concierge or through brochures in the hotel lobby. This information could be used when implementing the new ferry in order to develop effective advertising strategies to maximize the number of riders. They key would be to make sure the initial riders love their experience so that they recommend the ferry to others.

The ferry passengers were also able to further solidify our understanding of the impact traffic has on individuals taking ferries. Our secondary research indicated that it is necessary to prove taking a ferry is advantageous over driving in order for
the ferry to be successful. Further, our contacts indicated at our initial meeting that they intended to use this as one of the main strategies in attracting people to the ferry. They want to be able to show that taking a ferry is a better experience than driving in the summer beach traffic. All of the individuals interviewed on the ferry preferred traveling by ferry versus driving because it is more relaxing. One of the women visiting from upstate New York responded, “Directions are stressful and we don’t know our way around.” However, those interview subjects from Rhode Island did not seem as enthusiastic about this alternative mode of transportation. One individual from Smithfield responded, “I prefer it, but I wouldn’t usually do it.” Other passengers gave similar responses, all identifying convenience as the influencing factor in this decision. It is much easier to take a car from one’s driveway and go than try to coordinate transportation to and from a ferry with the ferry schedule. This will be an obstacle to overcome if the new ferry is started. Just because people may prefer to travel by ferry does not mean it is the decision they will make. In order for people to choose to ride this service over simply getting in their cars and fighting the traffic, they will need proof that the ferry service is a better option. The possibility of targeting individuals not familiar with Rhode Island should also be considered because the ferry could trigger them to visit places they would not bother to find in a car. Because of the conflicting responses we found in our interviews and what we learned from our secondary research and communications with our contacts, we decided to further explore the impact traffic has on the likelihood of taking a ferry on our survey.

Through asking what individual’s would change about the Providence-Newport ferry, we hoped to identify existing strengths and weaknesses of an already operational ferry service to learn from its successes and mistakes. One of the most common recommendations offered from the interviewees was to have a tour guide during the ferry ride. This suggestion came from individuals not from the area who are interested in finding out history and fun facts throughout the duration of the ferry ride. However, individuals from Rhode Island may not be interested in such a service, and it could even deter them from taking it. People who already know the fun facts and history could find it bothersome to have it blaring through speakers during the ride. Before making a final decision on whether or not to have entertainment, the target market should be identified and researched further to see if this is of interest to them. Other recommendations that should be considered before starting the new ferry service include, “The schedule should be changed. The hours aren’t right for commuters,” and “I’d like to see parking with a reasonable charge and perhaps a shuttle.” All of these recommendations can be useful in developing the most attractive ferry service to a target market and should be kept in mind once further research on the target market, potential ferry sites, parking facilities, etc. have been determined.

In addition to interviewing the passengers on board, we also took the time to observe the behaviors the passengers were engaged in throughout the duration of the trip. Some of the behaviors exhibited made it difficult to conduct interviews. However, we were still able to draw valuable conclusions through observing these people. When many of the passengers boarded the ferry, they immediately made themselves comfortable somewhere inside, closed their eyes, and remained this way throughout the duration of the trip. Based on these observations it is safe to conclude that these individuals, along with those interviewed, found the ride relaxing and comfortable enough to take a short nap.

Along with questioning the passengers, our contacts also requested that we ask several questions to the crew. These questions, along with the responses, can be viewed in (See Figure 3.3). The questions provided us with information about the technical aspects and requirements of operation a successful ferry that must be met before starting up a ferry service, such as how fast a ferry can go or the minimum docking depth required. This information can be used to ensure that the new ferry service meets the necessary criteria in order to avoid potential problem areas in designing ports, choosing a boat to use, developing a schedule, determining costs, etc.

1. How fast can the ferry go?
   26-27 knots

2. Is it feasible to land a ferry in beaches with rough water conditions?
   Yes but it may make docking a little harder.

3. What is the minimum water depth for docking a ferry?
   7-8 ft

4. What is the minimum time required to make an intermediate stop for a ferry?
   How long to dock, unload passengers, load passengers and leave dock?
   20-30 min

5. How many passengers does this ferry hold?
   149

6. How many boats are currently in operation?
   Just this one
1. Why are you on this ferry today?
   I am working at the library for my dissertation.

2. How often do you ride on the ferry?
   I have ridden it several times this season.

3. How did you hear about this ferry?
   I'm from Rhode Island.

4. How convenient is it for you to get on the ferry?
   I live on the East Side so it was easy.

5. Do you find riding the ferry to be an enjoyable experience? Why?
   Yes, it is near Newport and I don't need to drive.

6. Is there anything you would like to see implemented to make this ferry ride more enjoyable?
   It is quite well. It has a good schedule and it is frequent. I work at home so it is a good change of atmosphere.

7. Do you prefer taking the ferry or driving? Why?
   Yes.

8. What city/town are you from?
   Providence, East Side

9. Why are you on this ferry today?
   To visit Providence.

10. How often do you ride on the ferry?
    This is my first and only time.

11. How did you hear about this ferry?
    At the hotel on the Harbor.

12. How convenient is it for you to get to the ferry?
    It was very convenient.

13. Do you find riding the ferry to be an enjoyable experience? Why?
    Yes, it's enjoyable, relaxing, and comfortable.

14. Is there anything you would like to see implemented to make this ferry ride more enjoyable?
    As it is.

15. Do you prefer taking the ferry to driving? Why?
    Yes. Directions are stressful and we don't know our way around.

16. What city/town are you from?
    Upstate NY

17. Why are you on this ferry today?
    For pleasure.

18. How often do you ride on the ferry?
    This is my first time.

19. How did you hear about this ferry?
    My friend rode it and enjoyed it.

20. How convenient is it for you to get to the ferry?
    It's convenient cause driving isn't faster.

21. Do you find riding the ferry to be an enjoyable experience? Why?
    Yes, I enjoy the view as well as being up on top. Also, the view.

22. Is there anything you would like to see implemented to make this ferry ride more enjoyable?
    Unfortunately you can't improve the noise. I'd like to see parking with a reasonable charge and perhaps a shuttle.

23. Do you prefer taking the ferry to driving? Why?
    Yes.

24. What city/town are you from?
    Middlesex
1. Why are you on this ferry today?

   I am visiting from the West Coast, just for fun and to sightsee.

2. How often do you ride the ferry?

   This is my first time on this ferry.

3. How did you hear about this ferry?

   My friend knew about it. She took me to sightsee for fun.

4. How convenient is it for you to get to the ferry?

   It's easy to get to, very easy to find.

5. Do you find riding the ferry to be an enjoyable experience? Why?

   I take ferries all the time. I live on an island near Seattle so we have to. I love it. It's quick, comfortable, and not rough.

6. Is there anything you would like to see implemented to make this ferry ride more enjoyable?

   I wouldn't change anything. No.

7. Do you prefer taking the ferry to driving? Why?

   Yes, I prefer it.

8. What city/town are you from?

   I'm staying in Point Judith, but I'm from Seattle.

1. Why are you on this ferry today?

   I have a boat in Newport. I'm going to Newport to get my truck.

2. How often do you ride the ferry?

   Not regularly, usually to get to my boat. I've been on it 2 or 3 times.

3. How did you hear about this ferry?

   I heard it advertised on the radio, and I see it while I'm out on my boat.

4. How convenient is it for you to get to the ferry?

   It's very convenient.

5. Do you find riding the ferry to be an enjoyable experience? Why?

   It's very enjoyable. It's a nice ride up top.

6. Is there anything you would like to see implemented to make this ferry ride more enjoyable?

   It's good the way it is. I just wish more people would take it. But the schedule should be changed. The hours aren't right for commuters.

7. Do you prefer taking the ferry to driving? Why?

   I prefer it, but I wouldn't usually do it.

8. What city/town are you from?

   Smithfield
Survey Design
The survey we designed consisted of twenty-three specific questions. In order for us to fit our survey onto one page, we combined many of these questions together using semantic differential scales. This allowed us to organize our survey into 8 main questions, with some consisting of sub-questions. A semantic differential scale uses bipolar descriptors as endpoints, usually with an odd number of response options on the scale, which leaves a middle number as a neutral response. Its purpose is to portray a respondent’s attitudes or feelings about a specific subject. A copy of our survey can be viewed in Figure 3.4.

The first four main questions were asked using semantic differential scales with seven response options. The last four questions were basic fill-in-the-blank demographic questions. By using the semantic differential scales we were able to fit the survey onto one page, using legal sized paper, due to the reduction of questions. This also created a more aesthetically pleasing and organized appearance and made it easy for the respondents to follow.

The first question asked, “How likely would you be to use a ferry for your transportation needs to get anywhere in Rhode Island?” We used a semantic differential scale with “very likely” to “very unlikely” as the endpoints, with 1 being very likely and 7 being very unlikely. The main objective of this question was to get an understanding of how much of a demand there would be for this ferry service.

The second section combined six questions into one using the semantic differential scale. This question asked, “How likely would you be to use a ferry to get to:?” with the following list of locations: Scarborough Beach, Roger Wheeler Beach (Sand Hill Cove), Patience Island, Hope Island, Hog Island, and Prudent Island. The endpoints used here were again “very likely” to “not at all likely” with 1 being very likely and 7 being very unlikely. This question was asked to get an understanding of where people would be interested in taking a ferry to.

The third section combined eight questions into one by using the semantic differential scale, as well. This question asked, “How important are these factors to you when riding a ferry?” This question was followed by a list of eight factors including: enjoyment of the ride, relaxing atmosphere, scenery, convenience, length of trip, schedule, cost, and avoiding traffic. The endpoints used were “very important” to “not at all important” with 1 being very important and 7 being not at all important. The purpose of this question was to understand which factors would be most important to the respondents when using a ferry service.

The fourth section included three questions which were also asked using a semantic differential scale. These questions asked, “How likely would you be to take a ferry under the following conditions:?” with the proceeding options of a direct one-hour trip, one stop adding twenty minutes, or two stops adding fifty minutes. “Very likely” to “very unlikely” were the endpoints used with 1 being very likely to 7 being very unlikely. This question was asked because the length of the trip could have a substantial impact on whether or not a person would take the ferry.

The last four questions were asked to obtain some basic information about the respondents. The fifth question asked, “Have you ever used a ferry service for your transportation needs?” A “yes” and a “no” option were given here from the respondent to choose from. This was asked to see if the respondents have ever experienced any ferry service. The sixth question asked, “What City/Town and State are you from?” The purpose of this question was to understand what areas ferry riders were coming from in order to pinpoint those areas with the highest interest or demand. The seventh question asked for respondents to indicate their gender. This question was asked in order to understand which gender made up the majority of our target market. The final question asked for the respondent’s age. We wanted to know this to understand the age ranges that would be likely to use the ferry service. The age and gender information was important because these demographic variables might have an impact on which factors were more important and which locations they were likely to go to.
Data Collection

One of the most important aspects of this research project was to gain a general idea of whether or not people will take a ferry to different beaches and islands around the Narragansett Bay area. In order to obtain this information we developed and distributed surveys and, from the results, it will be easier to determine whether or not this ferry service should be implemented in the future. Before beginning this project, we assumed that people who would be the most likely to take this ferry would be those who live north of Providence or in Providence. This is mainly due to the geographic layout of Rhode Island. It is very unlikely that people from the middle or southern sections of Rhode Island would drive north to Providence in the opposite direction of the beaches in order to take a ferry back down to their destinations. However, these assumptions do not rule out the possibility of targeting those individuals who live in the southern or middle parts of the state. These people who do not live near or in the Providence area would be able to take the ferry from the beaches to Providence instead. From the data we collected, we also wanted to determine which age groups would be the most likely to use a ferry service in order to identify potential target groups to market the service to.

Although it would have been most effective to distribute the surveys to the census population, this task was impossible due to the fact that it is time consuming and expensive. Instead, the sampling design we used for our research was nonprobability sampling. With nonprobability sampling, the probability of being selected to take the survey is unknown and cannot be statistically measured; therefore, the information gathered from the survey can only offer insights about the target population. The information cannot make general inferences about the whole population.

The two nonprobability sampling methods we used to collect our data were convenience sampling and snowball sampling. Convenience sampling is used at the convenience of researchers. For this project, we distributed the surveys to faculty members and administrators at Bryant University. We assumed that the Bryant community was a homogeneous group and was similar to the target population in regard to where they live and their interests. The benefits of using convenience sampling were the high response rate and the short amount of time required to collect the data. After completing this portion of our data collection, we received a total of sixty surveys from the Bryant University community.

Our second method of sampling, snowball sampling, is a sampling method in which respondents who took the survey also help researchers by finding additional respondents for their study. Our surveys were distributed to high school students who then brought additional surveys home to their family and friends to complete. This resulted in a higher response rate in addition to collecting data from a different group of the population. However, since over one-hundred fifty of our completed surveys came from a high school in Barrington, Rhode Island, the majority of our data is from that area.

One important factor we found out from our contacts was that Scarborough Beach is a very popular hangout for teenagers. Therefore, we wanted to include this demographic in our data collection process in order to determine their potential as a target market for the ferry service. We distributed surveys to high school students because not only is this group rumored to have an interest in Scarborough Beach, but many of them do not have a driver’s license. The ferry service could provide these students with a means of getting to their popular hangout spot.

As noted before, nonprobability sampling method cannot make general inferences about the whole population. However, the results of our data gave us a rough estimate of users and an idea of what aspects of a ferry service are important to riders.
Data Analysis
In analyzing our data, we began by running frequencies on all of our questions. A frequency test shows how many times each response was recorded by the total group of respondents. The question of how likely one would be to use a ferry for transportation purposes provided the basis for the rest of our analysis. While coding the surveys, we had made the prediction that the demand for this type of ferry would be little to nonexistent. However, after running a frequency test on this question, we found that we were wrong, not completely wrong, but wrong nonetheless. We found that 23.4% of our respondents would be very likely, likely, or somewhat likely to use a ferry for transportation service. While this is a significant percent, our finding that 25.1% of the respondents indicated that they would be not at all likely to use a ferry is even more significant (See Figure 3.5). This does not completely discourage the implementation of the ferry as 23.4% is a high percentage. Based upon a 2003 Rhode Island population estimation of a little over 1 million, this translates to 3 in 10 Rhode Islanders as potential passengers. However, with the closeness of the frequencies, it is imperative that the target market is clearly defined so as not to waste resources on those who are not at all interested in this service.

Also, with frequency tests we found that 21.8% of the respondents would be somewhat likely to very likely to take the ferry to Scarborough Beach. 19.6% of the respondents would be somewhat likely to very likely to take the ferry to Roger Wheeler beach. However, more people were more likely to take the ferry to one particular island over the beaches. The most popular island was Prudence Island with 42% responding that they would be very likely, likely, or somewhat likely to use the ferry service to this destination.

Frequency tests also told us some demographic information about our respondents. Our distribution of female and male respondents was fairly even with 59.8% and 40.2% respectively. Also, most of our respondents, 33.1%, were 18 years old and under. The next most frequent age bracket was that of 44-51 with 22.9%. Almost half of our sample, 48.5%, was from Bristol County. Also of importance was the 72.7% of our respondents that had previously used a ferry for their transportation needs.

We also ran crosstabs on our data. A crosstab is used to compare two or more variables and measures how many have responded to two or more variables consecutively. Specifically, we looked at the relationships between gender and the important factors that people consider when deciding whether or not to take a ferry. These important factors, as stated earlier, included enjoyment of the ride, relaxing atmosphere, the scenery, convenience, the length of the trip, the ferry schedule, the cost, and avoiding traffic. From our crosstabs we learned that there is not a significant difference between the genders on any of the factors, except scenery. We found that 40% of females considered the scenery a very important factor in riding a ferry while only 27.3% of men did. Using this data, we ran a one-way analysis of variance and found that there is significant difference of .022 between the genders on this one factor, and women found the scenery much more significant than men did.

We also ran a crosstab comparing the likelihood of people to use a ferry with the number of stops the ferry makes. For this test, we only included the people who responded that they would be very likely, likely, or somewhat likely to use a ferry. We found that there is no significant difference between usage and both a direct trip and one stop. However, when the number of stops increased to two, there was a significant difference of .043. This number was determined from the Pearson Chi-Square using a one-way ANOVA test.

We also ran crosstabs to find out where three age groups most likely to use the ferry would like to go. The three age groups most likely to use a ferry service are: 18 and under, 19-25, and 35-43. The destination that 18 and under was most likely to go to was Prudence Island with 51.3% of respondents being at least somewhat likely to go there. The second most likely destination for this age group was Scarborough Beach. However this percentage is not significantly different from Roger Wheeler Beach at 29.5%. The age bracket of 19-25 was most likely to use a ferry to go to Prudence Island, with 54.2% of

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1 http://quickfacts.census.gov/qfd/states/44000.html
this group being at least somewhat likely to go there. The second most likely destination for this age group was Scarborough Beach with 37.5% being at least somewhat likely to go there. The last age group we looked at was 35-43. This group had 40% of respondents at least somewhat likely to use a ferry to go to Prudence Island, and 35.5% of people at least somewhat likely to go to Scarborough Beach.

In order to find out which factors each age group found most important we ran a crosstab comparing these two elements of our survey. Ages 18 and under felt that schedule and cost were the most important aspects, with 74% and 71.8% of respondents marking these factors either important or very important, respectively. The age bracket of 19-25 felt that convenience was the most important factor with 75% of respondents marking either important or very important. Schedule and cost tied as the second most important factor with 58.4% of respondents. Lastly, the age group of 35-43 year-olds felt that convenience and enjoyment were the most important aspects of a ferry. 58.1% and 54.8% of this age bracket marked that they thought that these factors were either very important or important.

Lastly, we ran a test comparing the mean of ferry usage with the age brackets. We found that the age bracket of 44-51 was the least likely to use the ferry based on the group mean of 5.55 with a standard deviation of 1.553. The age bracket that was most likely to use the ferry was 35-43 with a mean 4.62 and a standard deviation of 1.86. However, this age bracket consists of only 29 people. Based on population size, 18 and under are the most likely to use the ferry with a mean response of 4.76 and a standard deviation of 1.958 (See Figure 3.6).

<table>
<thead>
<tr>
<th>Age</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 and Under</td>
<td>4.76</td>
<td>75</td>
<td>1.958</td>
</tr>
<tr>
<td>19-25</td>
<td>4.73</td>
<td>22</td>
<td>1.956</td>
</tr>
<tr>
<td>26-34</td>
<td>5.13</td>
<td>15</td>
<td>1.457</td>
</tr>
<tr>
<td>35-43</td>
<td>4.62</td>
<td>29</td>
<td>1.860</td>
</tr>
<tr>
<td>44-51</td>
<td>5.55</td>
<td>51</td>
<td>1.553</td>
</tr>
<tr>
<td>52-64</td>
<td>4.85</td>
<td>27</td>
<td>2.088</td>
</tr>
<tr>
<td>65 and Over</td>
<td>4.00</td>
<td>4</td>
<td>2.562</td>
</tr>
<tr>
<td>Total</td>
<td>4.94</td>
<td>223</td>
<td>1.868</td>
</tr>
</tbody>
</table>
Conclusions and Recommendations

First and foremost, we recommend that more extensive research must be done before making a final decision on whether or not to implement this ferry. We believe that a convenience sample was not the best method of gathering data because it left us with data that was skewed towards one county and one age group. In the future we recommend using a sampling method that would give a more equal distribution of both location and age. We would also recommend that this research be conducted during the beach season. This would help because data collection could be done at the locations in question. However, we believe that from our data we can make some recommendations that will help move this project in the right direction.

From our data we can conclude that when marketing this ferry, three main age groups should be focused on: 18 and under, 19-25, and 35-43. All age groups indicated that they would be most likely to take this ferry to Prudence Island, and the second most likely place they would take the ferry to was Scarborough Beach. The age group of 18 and under felt that the most important factors of the ferry are schedule and cost. The age group of 19-25 indicated that the most important factors to them are again schedule and cost, as well as the convenience of the ferry. Lastly, the age group of 35-43 indicated that the most important factors are enjoyment of the ride, avoiding of traffic, and convenience. We believe that when promoting to these different age groups the focus should be on these factors that they felt were most important.

Our data analysis also showed that the ferry should not have more than one stop en route to its final destination. Because of the overwhelming popularity of Prudence Island, we would recommend that, if feasible, this one stop should be at Prudence Island. We realize that this stop would not be likely to pick up any additional passengers. However, considering the overwhelming amount of people that would not be likely to take a ferry if there was more than one stop, and since the majority of the people want to go to Prudence Island, we believe that this should be the only stop the ferry makes.

Our finding of the popularity of this ferry with the 18 and under age group is very significant. Scarborough Beach is a popular spot for teenagers during the summer months. It is also safe to assume that a good portion of these teenagers do not have access to their own vehicles and/or transportation. A ferry would provide an alternative mode of transportation in order to get to their popular hang out spot. A ferry could eliminate the parental embarrassment factor. Teenagers are sensitive to looking “cool” in front of their peers. A parent picking you up at the beach is not very cool; however an outing with just you and your friends is cool. Therefore, the ferry would be an attractive means of transportation for these teenagers.

Limitations

There were a few limitations we encountered throughout the completion of this project. First of all, each member of our group was challenged by this project because none of us are from the Rhode Island area. Therefore, further investigations were necessary on the geography of Rhode Island as well as popular locations. We had virtually no knowledge of the destinations and attractions mentioned by our contacts.

The time of year in which this research was conducted was not ideal because beaches were closed and the ferry services were coming to an end for the year. We did not have the opportunity to question individuals at the beaches and islands. These individuals could likely be a key part of our target market. Also, ferry usage was down when we conducted our interviews. Therefore, there were not as many passengers on the ferry to interview as there would have been during the summer months.

Another limitation that we experienced was the difficulty of collecting data. We initially wanted to conduct our surveys at Providence Place Mall, but were unable to obtain permission in order to do so. Many public places do not allow solicitations. Therefore, it was impossible to distribute surveys in such locations. Also, because of the fact that none of the group members are from the area, we found it difficult to identify other potential locations to conduct our survey.

Due to the time constraints of this project, the distribution of our surveys was not ideal. The majority of the surveys we received were from Bristol County because Barrington High School was one of our biggest participants. Because of this, our data was not very representative and, as a result, we were not able to analyze as many correlations as we had originally anticipated. We initially wanted to determine the demand for the ferry based on geographic location. However, if we had run this test, we would have found that people from Bristol County would be the most likely to take the ferry because the majority of our respondents were from this area.
3.2 Advertising Campaign

The participation of high school students enrolled in Travel, Tourism, and Hospitality enabled the findings of the Bryant University market demand analysis to be accentuated with advertising paraphernalia.

The students at Chariho Career & Technical High School developed the following layouts for billboard advertising and informational pamphlets for each respective site serving the destination of Scarborough Beach landing and Prudence Island landing:
NEED A LIFT TO THE BEACH?

Take the

Gansett Line

Rhode Island Bay Transit System

Departing From:
Quonset Point
Rocky Point
Providence
East Providence
Warren
Bristol

Daily Trips to:
Scarborough Beach
Prudence Island

FREE PARKING!!

More information at Gansett.com
CHAPTER 4 - Park-n-Ride Site: East Providence Ferry Landing

Prepared By: Graham Gardner, Kate Venturini, Matt Wills

University of Rhode Island, Community Planning & Landscape Architecture Department, LAR 344, Spring 2005
Program Elements

- Ferry Terminal
- Boardwalk
- Public Dock
- Bike Path
- Parking
- Pedestrian Paths
- Sculpture
- Playground
Prepared By: Shane Lougee, Meghan Ruch, Jonathan Burgess

University of Rhode Island, Community Planning & Landscape Architecture Department, LAR344, Spring 2005
Bold Point Park

Proposed Design 1

[Diagram of Bold Point Park with various sections labeled: Gateway, Intermodal Travel, Park and Marina, Fusion and Ferry Landing, Interactive Tidal Pools, Rockland and Amphitheater, Playground]
CHAPTER 5 - Park-n-Ride Site: Bristol Harbor Ferry Landing

Prepared By: Michael Wedge

Roger Williams University, School of Architecture, Art, and Historic Preservation, Spring Studio 2005
The terminal appears to be too "blocks," are slightly raised and divided. This project represents a balance between the tourist and the commuter. The waiting area is essentially a square angled toward its destination, Providence, as well as providing a clear view of the approaching ferry. This area is distinctly different than water's surface, its glass walls and the ceiling allowing light to enter from above, providing a comfortable departure point for commuters and visitors. The visitors enter opposite the company to Bristol, a second point for commuters and the tour office. Set on axis with the ferry, it is the building's direct shape only Thomas Street and into Bristol's historic district. The parking garage across the street offers convenient parking for commuters while remaining relatively unknown.

The near broadcast, extending from Independence Park, wrap around the outside of the building for enjoyable coastal views and also acts directly through the site as a shed out. Other provide access to Bike Rentals.
The parking is located on an empty lot across Thames street from the terminal. The low profile, two-floor design is meant to be as unobtrusive as possible in the historical district.
PROPOSED HIGH SPEED FERRY TERMINAL SITE AT 125 THAMES STREET IN BRISTOL, RHODE ISLAND

SITE DESIGN STRATEGIES

RENOVATE EXISTING ROBIN RUG BUILDING INTO A COMMERCIAL DESTINATION AND A PARKING FACILITY
DEMOLISH EXISTING ELKS LODGE TO MAKE WAY FOR NEW TERMINAL AND PARKING STRUCTURE MEANINGFULLY
REHABILITATE LANDSCAPE SURROUNDING ROBIN RUG

FIRST FLOOR PLAN
1/18" = 1'-0"
HIGH SPEED FERRY TERMINAL FOR RHODE ISLAND PUBLIC TRANSIT AUTHORITY APPROXIMATELY 48,000 SQUARE FOOT FOOTPRINT APPROXIMATELY 174,000 GROSS SQUARE FEET A NEW DESTINATION IN BRISTOL PROVIDING: COMMUTER FERRY SERVICE TO PROVIDENCE AND NEWPORT PARKING FOR 170 AUTOMOBILES NEW OFFICE SUITE FOR RIPTA NEW LODGE SPACE FOR THE ELKS SPACE FOR FOR WELL KNOWN RETAIL SPACE FOR HIGH QUALITY RESTAURANT 6 SMALL RETAIL SPACES FOR LOCAL MERCHANTS

SECTION 4
1/16" = 1'-0"

SECTION 6
1/16" = 1'-0"

SECTION 5
1/16" = 1'-0"

VIEW OF PEDESTRIAN EXPLORATION CIRCUIT PASSING THROUGH HIGH-END RETAIL SPACE THIS WALKWAY NOT ONLY ALLOWS PEOPLE TO BYPASS THE NOISE OF A PARKING GARAGE, BUT ALSO SERVES AS AN EXCELLENT OBSERVATION POINT FOR LOOKING OUT INTO BRISTOL WHILE ENJOYING A WALK FREE FROM THE EFFECTS OF THE WEATHER

SECOND FLOOR PLAN
1/16" = 1'-0"
45 PARKING SPACES

NEW ELKS LOUNGE

HIGH END NATIONALLY KNOWN RETAIL

OPEN TO BELOW

RESTAURANT

THIRD FLOOR PLAN
1/16" = 1'-0"
66 PARKING SPACES
This is an area for waiting for the ferry, but it is also a very pleasant place to eat lunch and meet friends.

THAMES STREET ELEVATION

BRISTOL HARBOR ELEVATION

CONSTITUTION STREET ELEVATION

VIEW OF PEDESTRIAN CORRIDOR

These pathways traverse the perimeter of the terminal building on the facades facing Thames Street and Constitution Street.
CHAPTER 6 – Destination Site: Colt State Park Ferry Landing

Prepared By: Tony Capriccio

Roger Williams University, School of Architecture, Art, and Historic Preservation, Spring Studio 2005

WALK ROUTE MAPS

Ferry Site #1

Roger Williams University

TWO ROUTES ARE USED TO FORM CIRCULATION SPACE, OCCUPATIONAL SPACE, AND INTERIOR SPACE.

Sectionally, visibility is given via different "platforms" within the space. This allows almost no blocking of the scenic harbor.
CHAPTER 7 - Destination Site: Prudence Island Ferry Landing Sites

University of Rhode Island

Prepared By:
University of Rhode Island, Community Planning & Landscape Architecture Dept, LAR344, Spring 2005

INTRODUCTION
During the spring semester, 2004, the junior design studio in landscape architecture (LAR 344) at the University of Rhode Island completed the Narragansett Bay High Speed Ferry study. This study focused on ferry transportation for commuter and recreation travel along Narragansett Bay. The final outcome of this study was the development of suitable ferry routes along the Bay. This work is in a report format and located online at http://www.ridesignstudio.org/projects/HighSpeedFerryNetwork/PostedFiles/FinalReport_DesignStudio.pdf

In the spring semester, 2005, the junior design studio in landscape architecture (LAR 344) at the University of Rhode Island was assigned the task to develop ferry connections for three potential locations/destinations on Prudence Island, which could eventually tie into the Narragansett Bay High Speed Ferry Network. Three design teams were formed to determine where the potential ferry terminals could be sited on Prudence Island. Additionally, programming for these destinations was also required. The preliminary phases of this study required inventory and analysis of existing and proposed transportation systems related to Narragansett Bay and also an inventory and analysis of Prudence Island for ferry terminal along with proposed development ideas which related to the terminal and overall island. This work led to the selection of three suitable ferry landing sites and facilities, as well as development of program requirements for these facilities.

Transportation
Alternative transportation modes in and around Narragansett Bay were the driving forces behind the ferry terminal study for Prudence Island. The need for unified ferry connections to proposed and existing destinations and points of interest along the bay became evident as a result of this study. During the early stages of the study it was noted that the existing ferry system is fragmented, and included Providence-Newport, Newport-Block Island, Newport-Jamestown, Narragansett-Block Island, and Quonset-Martha’s Vineyard routes. As a result of this finding, this study supports the ferry network system as proposed in the 2004 ferry study, with destinations to Prudence Island.

The positive impact within the state and region of a planned ferry network would encourage commuter travel, tourism and economic development. A route from Providence to various points along Narragansett Bay would parallel existing state highways. Ferry travel would serve as an alternative form of transportation to vehicular travel on major state roadways, and work to reduce traffic congestion.
The existing Rhode Island transportation system consists primarily of vehicular roadways. Bicycle and pedestrian pathways have been introduced over the last two decades. The first bicycle path developed by the State of Rhode Island, the East Bay Bike Path, was developed in the early 1990s to provide a healthful and scenic bike trail for exercise, travel and enjoyment of the state's beautiful coastline. It runs from Providence to Bristol and connects eight parks in its 14.5 miles of trail. The path ends approximately a quarter mile from the Bristol ferry landing, which is the only existing connection to the Prudence Island ferry. This relation provides an excellent link to additional trails on Prudence Island. Improving these trails to establish a bike path around Prudence Island will create an exciting extension of the East Bay Bike Path and also make Prudence Island a passive recreational destination. A map of the existing ferry connection between Bristol, RI and Prudence Island as well as the location of the East Bay Bike Path and a proposed Prudence Island Bike path. It should be noted that the proposed Prudence Island bike path encircles the island, including points of interest such as Potter Cove and the southern tip.

Process
The following is an outline of the process employed in this study:
- Visit existing ferry terminals to understand their operations and program requirements.
- Develop ferry terminal templates which incorporates findings from site visits.
- Apply templates to potential ferry terminal sites (Prudence Island Study), by:
  - Completing an inventory of island's natural and cultural conditions.
  - Analyzing potential sites for their development suitability.
  - Determining ferry terminal locations based on analysis of suitable sites.
  - Developing programmatic elements for terminal locations.
  - Develop conceptual designs using programmatic elements.
  - Develop schematic plans based on conceptual designs.

Prudence Island Proposed Ferry System
It was determined following our site visit to Prudence Island that four possible High-Speed Ferry sites should be analyzed for development. Potter Cove, Downtown (Homestead), Sandy Point, and the T-dock site were considered. Sandy Point, the present location of the Prudence Island lighthouse, seemed an appropriate and viable location for a High-Speed Ferry Connection. However, after studying the site further, it was determined that no public right-of-way existed at Sandy Point, nor could one be created, as it is bordered by privately owned property. Thus, this location was eliminated.
BACKGROUND INFORMATION
Prudence Island is located in the geographic center of Narragansett Bay. The closest point to the mainland is at the northern end of the island, 1.5 miles southeast of Warwick Neck and one and three-quarter miles southwest of Peppasquash Point, Bristol. The Island is part of the town of Portsmouth located in Newport County.

Prudence is comprised of 3,627 acres of land. It is seven miles long and 1.47 acres at widest point. Prudence boasts a unique atmosphere of simplicity and peace where eye contact amongst residents is commonplace. While the year round community is predominantly fixed and low income, the demographic of island residents is diversified during the summer months. This is due in part to the fact that fifty percent of year-round residents are over the age of sixty, retired, and living on fixed incomes. Of the four hundred and fifty homes on the island, most are summer residences.

Currently there is a movement to "winterize," which would mean upgrading homes to occupancy beyond the summer months. In terms of commerce, there is one small general store, a seasonal fruit and vegetable stand, and a Bed and Breakfast. There are no public or visitor facilities on the island.

History
Narragansett Indians referred to Prudence Island as Chibehnoyesa, "a place apart." Deeds show the island was turned over to Roger Williams and Governor Winthrop of Massachusetts around 1637. During Colonial times, Prudence was largely agricultural. The island was abandoned during the Revolutionary War. Once residents returned, agriculture was restored. In the late 1800s, the island began to attract summer residents along the western shore. Until the early 1900s, less than two-dozen families resided on the island permanently. In 1904, Henry Chase, an island hotel owner, started a ferry from Bristol. The Prudence Island Navigation Company, chartered in 1921, began new era of development including cottages on the Eastern shore. The United States military use of Prudence Island began during WWII, and was concentrated in the southern part of the island. The U.S. Navy abandoned the land in 1947, and it was turned over to state of Rhode Island in 1972. This same parcel was designated a National Estuarine Research Reserve in 1980. Presently, 70% of the island is designated as estuarine reserves or acquired by local conservation organizations.
LAND OWNERSHIP
Approximately 34% of Prudence Island is privately owned residential property. The remainder (approximately 66%) is held as publicly owned land by the State of Rhode Island and the Prudence Conservancy. This publicly owned & trust land is evenly distributed throughout the island with the largest holdings at both the northern and southern tips of the island. The map below illustrates land ownership patterns on the island.

Prudence Conservancy
The Prudence Conservancy is a land trust "committed to ensuring the ecological health of our land, preserving its historical nature and providing the island community with opportunities to enhance the quality of life and ensure their legacy to future generations on Prudence Island (NBNERR website)." Of the 725 acres protected and preserved from future development, the conservancy owns 208 acres, manages another 277, and holds conservation easements for another 240. Their mission is to provide educational opportunities that "foster appreciation and understanding of the environment and conservation of natural resources...and, [additionally] to strengthen the sense of community on the island (NBNERR website)." The conservancy is in charge of: construction & maintenance of 10 miles of island trails; the upkeep of Sandy Point Lighthouse; continued renovation of Farnum Farm; the newly established water quality monitoring system; a community garden; hosting summer camp children; other community activities throughout year at Farnum Farm.

Flora/Fauna
According to the Narragansett Bay National Estuarine Research Reserve, vegetation on the island includes bayberry, blueberry, arrow wood, shad bush, red cedar, red maple, black cherry, Oaks, and pitch pine. Invasive species include green brier, phragmites and Asiatic bittersweet.

White-tailed deer overpopulates the island, and as a result, there are significant ecological, herd health, and human health impacts. Also found on the island are raccoons, squirrels, eastern red fox, eastern cottontail rabbits, mink, and white foot mice. From September to May, Prudence serves as a haul out site for harbor seals. These seals can be viewed in small groups basking on rocks or remote beaches and sometimes popping their heads up in the waters nearby.
SITE VISITS
Transportation modes and trends were examined to determine the need for potential ferry connections to Prudence Island. To become familiar with ferry operations and facilities, members of LAR 344 visited three local ferry terminals, which included (1) the Newport Ferry Terminal, (2) the Bristol Ferry Terminal, and (3) the Prudence Island Ferry Terminal.

Newport Ferry Terminal
Located on America's Cup Boulevard in Newport, RI, this terminal provides seasonal access for the high-speed ferry service to Providence, RI. It was noted that the site is successful both aesthetically and functionally. The site features Newport's Harbormaster office with a second floor observation deck, a small seating area, passenger gather area, small park area, paved walkways, and a floating dock system. The Newport Ferry Terminal's location is convenient for tourists, locals, and commuters alike because of its downtown location and proximity to Thames Street, local hotels, and the scenic Newport waterfront.

Bristol Ferry Terminal
The Bristol Ferry Terminal, located on Church Street in downtown Bristol, was noted to be a purely functional facility. The ferry provides year-round service to residents of Prudence Island, and is capable of carrying vehicles on its deck. The terminal incorporates a small parking lot with vehicular access to the ferry, which is adjacent to a small Community park with a playground. There is no ferry terminal, bus drop off, provisions for bicycle parking or organized passenger waiting area.

Prudence Island Terminal
On the east side of Prudence Island, a privately owned ferry is operated from the Homestead area, which is considered the island's "downtown". Aside from the ferry loading dock at Homestead, there is a +/- 75 car gravel parking lot and a small, privately owned country store on the premises. The ferry terminal here is purely utilitarian, with no ferry terminal, bus drop off, provisions for bicycle parking or organized passenger waiting area.
FERRY TERMINAL TEMPLATES
Ferry terminal templates portraying ideal facilities were developed to gain insight into the physical layout of an ideal ferry terminal. This process began with a programmatic list of needs for site amenities and functional components. Ranging from pedestrian and vehicular circulation patterns to docking systems, each component became part of the template. The following is a list of program elements for the ferry terminal templates:

- Vehicular Drop-off
- Pedestrian Walks and Pedestrian Plaza adjacent to Vehicular Drop-off
- Handicap Accessibility
- Terminal Ticket Sales, Information and Restroom Facilities
- Passenger Waiting Area with Shade Structure and Seating
- Passenger Waiting Area with Open Lawn and Shade Trees
- Ferry Landing with Ramps and Floating Docks
- Landscape Amenities

Two examples (on the next page) of ferry terminal templates illustrate the relationship of the facility program elements and physical requirements for terminal operations. With a better understanding of ferry terminal operations and layout members of LAR 344 applied this knowledge to the development of ferry terminal sites on Prudence Island.
POTTER COVE

Prepared By:
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University of Rhode Island, Community Planning & Landscape Architecture Dept, LAR344, Spring 2005

INTRODUCTION
Potter Cove, located on the Northern portion of Prudence Island, is an area used primarily by local recreational boaters, fishermen, and avid outdoorsmen. It is known as a serene environment rich with flora and fauna, and generations of people have enjoyed the tranquility and uniqueness of the cove.

There is a delicate balance of bay, saltwater marsh, and land communities in and around Potter Cove, and it is not uncommon to see great egrets roosting in the trees bordering the cove. Over the years, the cove has become a popular mooring spot for boaters and shell fisherman, as well as a great location for bird watching.

Due to the effects of tidal erosion, in the 1940's the Navy placed large culverts in between Potter Cove and Potter Pond to regulate the amount of passing tidal water.

Site Location:

Existing Conditions
Being relatively undeveloped, the area surrounding Potter Cove has retained its wild and natural state. This environment provides an ideal habitat for migratory bird breeding, local deer grazing, and an abundance of marine life in and around the cove and marsh.

Because of this prosperous ecosystem, the massive deer and small mammal population contribute to the island's severe infestation of deer ticks carrying Lyme Disease. Consequently, human interaction with the flora and fauna on this site, as well as throughout Prudence Island should be carefully monitored. Education about Lyme disease prevention and detection should be available to visitors.
SITE ANALYSIS
Data including soil conditions, topography, and property ownership of the island, was analyzed for the Potter Cove site. We determined that while the majority of land is publicly owned and open to development, large-scale structures and extensive development is not appropriate.

Several features exemplify the dynamic aspect of coastal geologic processes. A bay spit is moving into the salt marsh at a rate of about one meter per year. A re-curved spit, Gull Point is continually growing and being re-shaped by the northeast and northwest winds.

There are extensive salt marshes on the west side of the island. These marshes, like most salt marshes in the northeastern United States, are believed to have been formed in the past 3,000 to 4,000 years, a time when relative sea level has been slowly rising at approximately one mm per year. These marshes were ditched during the 1930s in order to control mosquitoes.

Conceptual Design
After completing an inventory and analysis of Potter Cove, the conceptual design phase began. Two concepts are presented:

The first conceptual design introduced a dock-less ferry landing. A use of habitat stations and estuarial awareness was also implemented, from which a strong wildlife sanctuary theme was derived. A strong design base was created integrating education (i.e. habitat stations), natural features (i.e. preserved waterfront), and cluster development within the ferry terminal complex.

A second conceptual design was prepared with waterfront recreation as a main focus and theme. The design used a deep-water T-dock landing for ferry docking, as well as picnic area landings. These areas were designed with sensitivity to the deer tick population by reducing much of the existing to mown grasses.

Design Theme
Based on research and site evaluation, it was determined that there were two possible design theme options for Potter Cove. Since the area is unique and ecologically sensitive, it seemed appropriate to plan for a seasonal wildlife refuge/education center or a recreation area. Through the schematic design phase, it was possible to merge these two design themes and integrate education of the environment with physical health and recreation.
SCHEMATIC DESIGN

The final schematic design was created with sensitivity to environmental issues. Each program element was developed and implemented to minimize the extent of environmental disturbance. The preliminary and schematic design process integrated the strongest elements from the conceptual designs.

A main element within the final design was the dock-less ferry landing and ferry terminal. After studying the bathymetry of Narragansett Bay adjacent to Potter Cove, it was determined that the depth of the water was less than five feet. Therefore, a dock-less landing to accommodate a high-speed ferry were needed. The existing conditions and environmental sensitivity of Potter Cove suggested a smaller scale and compact facility. Thus, a cluster development for building layout was implemented to minimize the scale of the development and environmental impacts.

The following is a summary of program elements integrated into the master plan:
- 700+ acre wildlife refuge
- Ferry terminal (cluster development)
- Dock less ferry system
- Nature trails
- Habitat stations
- Learning theme/education
- Wildflower meadow
- Open space
- Fishing areas
- Swimming areas
- Bird watching stations
- Interactive oyster farm
- Boardwalk system
- Wildlife footprints

The image to the right is a conceptual proposal for the North End Wildlife are which includes pedestrian hiking trails and observation areas which connect to the proposed ferry terminal and Potter Cove.

The image to the left is the Final Schematic Design for the 26 acre site adjacent to the proposed ferry terminal.
INTRODUCTION
The proposed Downtown Prudence Island site (currently known as "Homestead") is located at the site of the existing ferry terminal. Downtown Prudence Island is as its name suggests the village center. It accommodates the island's only store, post office and ferry terminal. It serves as the island's prime connection to the rest of the State.

Existing Conditions
Downtown Prudence Island is located on the eastern shore of the island as indicated on the map to the right. The site is made up of a traditional ferry dock, a general store/post office, and a large gravel parking lot, which accommodates approximately seventy-five cars. The vegetation on the site is minimal, consisting mainly of beach grass and some low herbaceous plants. Eighty percent of the residences on the island lie to the west. Revitalization of this site to a village center would be beneficial to both the residents and also visitors.
SITE ANALYSIS
Data, which included topography and soil drainage, was collected in order to analyze the site for community development. The analysis concluded that the site has some limitations for community and ferry terminal development. However, when considering the existing development (Homestead) it is feasible, with sensitive engineering, that the site can be developed with buildings, parking and open space with minimal impact to the environment.

Using a Soil Conservation Service (SCS) Soil Survey of Rhode Island the slope analysis was mapped out. The slope map below (left) shows the majority of the site with slight to moderate limitations for community development. Gentle slopes lend themselves well to any type of development and allow for easier construction. The only area with increased slopes is the area to the North.

Permeability was also analyzed for community development; the drainage map below indicates that the majority of the site is on a poorly drained soil, which does not lend itself well to community development.

![Slope Analysis](image1)

![Drainage Analysis](image2)
DESIGN THEME
The inspiration and underlying theme for the revitalization of Downtown Prudence Island was to create an historic coastal village. Details such as widow walks, shingle style buildings, cobblestone walkways and a common community space were integrated into the design to recreate the atmosphere of an early 20th century New England coastal village.

The development of downtown Prudence Island requires the integration of the existing ferry along with a high-speed ferry, to create a dual-docking system. While the demand for two ferry systems may seem a bit elaborate, it is necessary to provide for the existing Bristol-Prudence Island ferry service and also for the future needs of a high-speed ferry to connect to the Narragansett Bay ferry network.

Conceptual Designs
The first concept (right) introduced a semi-circular design, centering from a vehicular drop off area with plantings, walkways and bike paths radiating away from it. This design utilized smaller picnic areas as well as open space including volleyball court. The downtown area was limited to one building for transportation services.

The second concept (left) introduced a dual docking system connecting the existing ferry with a vehicle line up area from the parking lot. Open space is prevalent in this design and is divided on either side of the drop-off area. Though a drop off area is incorporated it is placed closer to the road leaving the cobblestone plaza and buildings as a focal point for the design.

The final concept to the right illustrates a cluster of buildings creating a village like atmosphere. A drop off area has been placed closer to the terminal for easier handicap accessibility. The dual docking system is utilized and connects directly to a parking lot designed for the storage of electric and full-size vehicles. Open space is provided to the north of the site and defined by both trees and pedestrian path.

SCHEMATIC DESIGN
The schematic design, shown below, was chosen from the initial concepts. It reinforces the village center theme. This design provides tourists with a destination and members of the local community with a village/transportation center for gathering and socializing. In addition to the village center, a farmers market has been integrated to reflect the island's cultural past.

Bike rentals will also be incorporated in the downtown area. By making Prudence Island an extension of the East Bay bike path and creating a bike path around the island there will be a need for bikes.

A quaint waterfront bed and breakfast has been introduced along with a seaside café, general store and ferry terminal. The ferry terminal acts as a visitor information center as well as ticket sales area. All of the proposed development will be utilized year round. In addition to the village center a community park was added as recreational gathering space for visitors as well as the inhabitants of Prudence Island.

Proposed parking would accommodate both electric cars and conventional vehicles. The size of the new parking lot will be reduced in size due to smaller dimensional requirements for electric cars. To ensure that the smaller parking lot would be
effective during increased traffic periods such as the summer months, cars will not be allowed from the mainland for day visits. The proposed parking lot will be constructed using a product such as Grass Crete. This will limit run-off, provide proper drainage and maintain a solid parking surface while maintaining an ecologically friendly parking surface.

Circulation on the site provides for a meandering pedestrian and bike path at wider widths to accommodate the increase usage during peak summer months and provide a comfortable recreational area for tourists.
T-DOCK  The Learning Seascape

Prepared By:
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University of Rhode Island, Community Planning & Landscape Architecture Dept, LAR344, Spring 2005

INTRODUCTION
The southern point of Prudence Island, dubbed Prudence Park by locals, has a unique history. Privately owned until the 1940s, the US Military purchased the southern point for use as a base for searchlights and light artillery storage. In 1947, the magazine was deserted. The military turned the land over to the State of Rhode Island in 1972. This area was designated a National Estuarine Research Reserve in 1980.

Site Location Maps

Existing Conditions
A mixed deciduous and evergreen forest surrounds the seven-acre site. One paved roadway enters the site from the north, connecting the southern point to the rest of the island. There is a disposal area north of the site. This area includes three landfills, two underground 10,000-gallon petroleum tanks and pipelines, and several closed buildings and sealed bunkers.

There are two public beaches located at Prudence Park. Only the eastern beach is used as a swimming area because the peninsula to the T-dock shelters the coast. The western beach is subject to higher winds and currents and is unsafe for recreational swimming.

Aerial View of Prudence Park and its Surroundings

The southern most point has a 250' dock that expands into the Bay with a horizontal 'T' section reaching a distance of 120'. Presently the dock is used as a fishing and coastal viewing area. The dock is in stable condition and can handle boats and large ships. The land connection to the T-dock was built up with rock for erosion control to ensure the future of the T-dock.

The southern point of the island is a highly visible and accessible site, which has the potential to become one of Prudence Island's most notable features, both from land and the Bay.
SITE ANALYSIS

An analysis of the existing slope and drainage conditions at the southern point showed the site's suitability for development. The favorable areas in both maps shown to the right include the perimeters of the T-dock site.

CONCEPTUAL DESIGNS

Before engaging in conceptual design, several guidelines for site development were established. The following is a summary of these guidelines:

- Programs for reducing deer tick populations would be implemented for visitor and resident safety. This would be accomplished through the use of open space and deer stations.
- Develop an educational and research center for all ages. The research would focus on the surrounding native coastal environment.
- With a scarcity of fresh water on Prudence Island, a desalination system should be developed to replenish the island's fresh water supply.
- Development on the site would have minimal environmental impact on the island.

The three Conceptual designs below were developed based on these guidelines.

A golf course concept was introduced to reduce the deer tick populations. Deer ticks do not survive in well-maintained grass, so the use of expansive turf is beneficial in deterring the growth of tick populations. A golf course also will provide a recreational attraction for the area.

An education center concept would provide a learning resource and would use the Bay as a "Learning Seascape." Students of all ages would use the center for educational and scientific research. It would also incorporate a water treatment plant that is much needed on the island.

The final concept included a state beach and ranger station. It proposed concessions for a public beach facility, and incorporated a DEM ranger station for the environmental management of the entire island. The overhead structures would draw attention to the site and make it an attractive destination to boaters and visitors.
DESIGN THEME
Elements from the three concepts presented were combined to create the final design. The theme to this design centered on creating a strong educational link to the University of Rhode Island Graduate School of Oceanography. The GSO utilizes a research vessel, called the Endeavor, which could dock at the end of the existing T-dock at the site. There would also be a building dedicated to the GSO to host classrooms, holding tanks and other equipment for research.

Year-round education opportunities will not be restricted to graduate students. The site will also provide a school-age friendly environment, including an outdoor classroom space perfect for field trips. The focus of these field trips would be coastal processes and island environments. The outdoor classroom will be an amphitheatre-like space open year round for the residents of Prudence Island to utilize as a community gathering space. There also will be a program for volunteer educators to lead nature tours of the site, giving local residents a chance to exercise their Prudence pride.

Another part of the program is to introduce a saltwater treatment facility, using desalination turbines. The purpose of this is to create a demonstration water treatment system. A proposal could be made to the residents to extend the water treatment to an island-wide project.

The final element of this design is to establish deer tick stations in wooded areas. The intent would be to educate the general public on deer ticks and also to conduct research on deer tick populations and control.

Schematic Design
With the programmatic elements in mind, a master plan was created for the educational center and its connection to the T-dock and access roads. A vehicular turnaround was developed for pedestrian pick-up and drop-off. The overhead structures presented in the ranger station concept were developed for their aesthetic value. They host a pedestrian pathway that connects the ferry terminal to the educational building. The main building in the master plan will host several classrooms as well as research tanks and laboratory equipment for the Graduate School of Oceanography.
The GSO building will also host a system for the desalination of salt water from Narragansett Bay. Several storage tanks and turbines would be placed in the building, to allow students to observe the process, and eventually develop progressive methods to replenish Prudence Island's fresh water supply.

An open-air amphitheater was also introduced, as an outdoor classroom and community-gathering center for special occasions, like the Fourth of July. A removable canvas tent over the amphitheater would provide shade and protection from rain and wind.

A learning path was also developed to extend from the rocky shoreline at the ferry terminal to a native plant garden on the east side of the GSO building. This will give students of all ages the opportunity to observe and interact with the native coastal ecosystems of Prudence Island.

A rock play structure in the shape of Prudence Island serves as a child's climbing haven, and provides information about popular destinations and points of interest on Prudence Island. A ticket booth and public restrooms would be available under the eastern shade structure.

The public swimming beach will be maintained by students and could host several educational events, like a scavenger hunt for marine organisms amongst the seaweed and shoreline. A seal sculpture on a rock in the protected cove will be a year-round attraction for boaters and students that come to the southern point.
CHAPTER 8 – Ocean Engineering: Scarborough Beach Ferry Landing

Prepared By:

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Geo-Structural Team: Christopher Voorhis, Nathaniel Kirmmse, Christopher Duffy, & Darren Flynn

University of Rhode Island, Ocean Engineering Department, OCE495/496, Fall 2004/Spring 2005

This ocean design is a continuation of Scarborough Beach Ferry Landing site plan design developed by Landscape Architecture students at the University of Rhode Island. The site plan design is presented in the Phase I Final Report, dated June 2004. This Chapter presents the ocean engineering that would be needed to compliment the landscape architecture site plan.

Site Locations and Important Design Considerations
The site for the proposed ferry network is located at the north end of Scarborough Beach, in Narragansett, Rhode Island, as shown in Figure 8.1. The design site will also include the Black Point fishing area north of the beach. The public currently uses Scarborough Beach for recreational purposes during the summer months and the overall goal of this project is to bring patrons to the South County region, while maintaining the natural beauty of the coast. This location is a particularly difficult construction site; it is directly exposed to the ocean, being at the west side of the mouth of Narragansett Bay. Due to the extreme nature of the open ocean environment, the design criteria for the project depends on the maximum wave forces that are possible at the design site. A design wave height must be generated that gives the engineer a value describing the wave that will only allow minimal damage to the structure over the course of its lifetime. This site is not only undesirable because of its harsh wave climate; the beach bathymetry and geology also raise important design considerations. Scarborough Beach is a long sand beach that has a very mild slope. This extremely mild slope is a design consideration that must be addressed. If the proposed ferry terminal is to be near shore, there is a definite possibility that dredging the false harbor would be necessary. In theory, this may appear to be a good plan; if the entire design site were to be located on a sand deposit. This would make dredging the area inexpensive and simple. In actuality the site is only partially composed of sand. Black Point is also composed of boulders, cobbles and bedrock. The rock that is visible from the shore would not present a large problem if the site were to be dredged. The problem however is the bedrock in the design area. The bedrock is close to the seabed surface, therefore blasting is the only way to remove bedrock to create an artificial harbor with a sufficient depth to support the passenger ferry. Research of the bathymetry in the area and the proposed ferry specs shows that Design Site B is a sufficient depth and no dredging would be required.

![Figure 8.1: Site location of proposed high-speed ferry network](Reference: www.ridesignstudio.org)

Ferry Description and Specifications
The first step as a group was to choose a ferry that would be incorporated in the design aspects. A Gladding-Hearn 25 meter Fast Catamaran Ferry, shown in Figure 8.2, was chosen for this project. This ferry is extremely economical and is composed of a low maintenance composite hull and aluminum superstructure. It is recommended as a harbor commuter ferry or for use in partially protected excursion services, and it is capable of either bow or side loading with a passenger capacity of 149. The ferry will be powered by a Kamewa A45 Hamilton 52 water jet propulsion system to limit the required draft of the vessel is 3 feet. The complete ferry specifications are shown in Figure 8.2.
Conceptual Design Plans
After assessing the site throughout the previous semester, two conceptual design plans were developed. Design A (Fig. 8.3) is located south of the Black Point fishing area incorporating the north end of Scarborough Beach. This proposed site will require dredging activities to provide adequate water depths to accommodate the draft of the ferry. This dredging may be costly due to the underlying bedrock. Design site B (Fig. 8.3) is proposed to extend eastward of the tip of Black Point. This location was chosen primarily because of the existing bathymetry. Design B is proposed to be in water depths that will meet the requirements of the ferry, therefore it is expected that no dredging will be necessary. Another benefit of Design B will be a reduced amount of environmental impact on Scarborough Beach, as the design will not be utilizing the existing beach property.

The chosen site for the proposed high speed ferry terminal is Design Site B, located directly off of Black Point. The false harbor will be composed of a rubble-mound breakwater, along with a northern partially submerged breakwater. This site has been deemed the recommended site through the analysis of numerous factors:
- The design will impose the least amount of environmental impact on the existing coastline, in particular the long shore sediment transport at the site.
- The breakwater will not utilize the existing beach front of Scarborough Beach.
- The current depth of the site is sufficient for the chosen ferry to dock; therefore no dredging will be required.
ENVIRONMENTAL STUDY

The past Fall 2004 semester objectives for the environmental team were to investigate any pertinent environmental regulations, such as the necessary approval process that would be approached for the project to be permitted. Also, a preliminary environmental impact study was undertaken in order to back the proposal of the project. A complete outline for project approval processes has been produced in the previous Fall 2004 semester report, as set forth through the Coastal Resource Management Council’s (CRMC) environmental codebook, the Redbook. Following the overview of approval procedures, necessary environmental impact studies are discussed that have been the primary focus of the Spring 2005 semester. The impact studies that have been deemed fit for this project include; disruption of longshore sediment transport due to the structures presence and scour processes induced by the operation of the ferry. The necessity to confront these topics is stated by the CRMC and will ultimately lead towards the success of the project has while being cycled through approval procedures. With sufficient evidence of site studies and proven project benefits, the environmental team will be prepared to present the project proposal in hopes of success in approval.

During the current Spring 2005 semester, the environmental team has been primarily tasked to continue in researching the environmental impact studies that had been focused on during the previous semester. Emphasis has been put upon studies involving the littoral transport and the possible affects that this project could have on the areas sand transport processes. By recommendation of the Army Corp. of Engineer’s Shore Protection Manual (SPM), a combination of historical data and calculations through the energy flux method will allow for estimates to be made on littoral processes. Also important to the project’s environmental studies is the environmental impact that is induced by the operation of the ferry. Concluding this research will be a ferry operational track and ferry operational speeds throughout Narragansett Bay. In order to back this project and prove the overall benefits outweigh the adverse affects, the above impact studies along with examining local marine habitat, impact of construction, South County Rhode Island tourism, ferry operational schedule and transportation rates, and public benefits, will be touched upon. The compilation of the above mentioned topics and impact studies will allow for ample background information in order to promote the project and cycle the project proposal through approval processes.

Approval Processes for Coastal Construction

For a more in-depth outline of approval processes refer to the previous Fall 2004 final report. In summary, the Rhode Island Coastal Resources Management Council (CRMC) is the main management agency to which a project in the coastal zone of the state of Rhode Island would obtain permits for work. CRMC was developed with the following mandate: “...to preserve, protect, develop, and where possible, restore the coastal resources of the state for this and succeeding generations through comprehensive and coordinated long-range planning and management designed to produce the maximum benefit for society from such coastal resources; and that the preservation and restoration of ecological systems shall be the primary guiding principal upon which environmental alteration of coastal resources shall be measured, judged and regulated.” CRMC has a coordinating and oversight role for all other state agencies who do not consider coastal zone management issues in their mandates. The CRMC Redbook is the source in which CRMC defines the coastline of Rhode Island and the permitting processes for individual areas, coastal features, and activities that may be desired to be performed. Scarborough Beach is part of the Narragansett Pier quadrangle and is considered a Type 1 coast, which is a conservation area, and is shown in Fig.8.4.

To maintain the scenic features of these conservation areas many construction activities are restricted or prohibited. “The Councils goal is to preserve and protect Type 1 waters from activities and uses that have the potential to degrade scenic, wildlife, and plant habitat values, or which may adversely impact water quality or natural shoreline types.” Restrictions include the construction of recreational boating facilities, dredging, dredged materials disposal, and grading and excavation on abutting shoreline features. An exception would be considered if the primary purpose of the activity were to preserve or enhance the area as a natural habitat for native plants and wildlife or a beach nourishment/replenishment project. An exception may also be considered if a strong case is made to show that the project will result in an overwhelming public benefit. In order to receive a special exception for the proposed construction at this site, the positive affects of a high speed ferry terminal at Scarborough Beach must be established and documented. The Redbook states, “special exceptions will be granted to projects, which show a compelling public purpose, providing benefits to the public as a whole.”

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COMPELLING PUBLIC SERVICE
Ferry Course and Speed Regulations
The proposed ferry route from India Point in Providence to Scarborough Beach is shown in Figure 8.5. The route is approximately a total distance of 47.8 km, the catamaran ferry proposed for the project travels at a maximum speed of 30 knots when at maximum capacity of 149 passengers. The ferry will travel at a slower speed in the upper Narragansett Bay area and as it approaches the ferry terminal at Scarborough, but it is expected to travel at maximum speed throughout the rest of the route. These speed approximations are generalized, as the ferry may encounter inclimate weather, boating traffic, etc. As the ferry departs from India Pt. it will be traveling at an averaged speed of 10 knots (5.7 m/s) for a distance of approximately 8 km, therefore it will take 23 minutes for the ferry to exit the Providence River. Again, as the ferry arrives at the proposed destination, it will travel at a slower speed for about 3 km and take about 9 minutes to enter the harbor. Assuming the ferry is at maximum speed for the remaining 36.8 km, the travel time will be 36 minutes once underway. The total estimated travel time is 1 hour 8 minutes, estimating 1 hour 15 minutes to take into account any complication that may arise.

The typical time allotted for boarding and off-loading of passengers is 30 min., 15 min. to board and 15 min. off-loading. Therefore, the roundtrip time for the ferry is estimated to be 3 hours 15 minutes. The proposed ferry schedule is shown in Figure 8.6, this will be the daily schedule from Memorial Day to Labor Day.
Transportation and Tourism - An intense demand arises in the summer months for transportation from northern Rhode Island areas to the southerly coastline. This demand causes highways and local South County roads to be congested, which may be decreased by a high-speed ferry with the capability of transporting 149 passengers at one time. These passengers would be able to enjoy a summertime boat ride to southern Rhode Island, opposed to a traffic filled car ride. The current high-speed ferries available in Rhode Island include ferries: from Providence to Newport, Quonset Point to Martha’s Vineyard, Galilee to Block Island. These ferries demonstrate that passengers are able to avoid traffic congestion, experience convenient parking at the terminals, and reduced mileage on their personal vehicles. The proposed ferry from Providence to Scarborough Beach would appear to prove the same benefits to the public traveling North to South.

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<tr>
<th>Depart India Pt.</th>
<th>Arrive at Scarborough</th>
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</tbody>
</table>

Figure 8.6: Proposed Ferry Schedule

South County Tourism - The second largest industry in the state of Rhode Island is the tourism industry. The Rhode Island Economic Development Corporation (RIEDC) markets statewide environmental attractions in a manner known as ecological tourism (ECO-tourism). There is always room for product development in the program, to which the ferry terminal could be marketed as a concept to increase tourism in the state and prevent beach-goers from visiting other New England locations. Scarborough Beach has been known as the principal destination for a "day at the beach" for thousands of Rhode Islanders every year. As the state’s most popular and well-known beach, located 35 miles south of Providence, the site is a 26-acre facility with over 2,300 feet of beach frontage. Scarborough Beach has been referred to as “one of the finest, if not, the finest saltwater beach and recreational facility in Southeastern New England.” Narragansett Chamber of Commerce hopes that this facility will help maintain the positive image of the state’s saltwater beaches and continue to provide a quality “day at the beach” experience for this generation and future generations. The addition of a high-speed ferry terminal at Scarborough will help make this possible by making the journey to the beach easier and more accessible for Northern Rhode Islanders. In addition to the sandy beach, a newly renovated pavilion is available for picnicking and other beach related activities satisfying any beach-goers “day at the beach” wishes. In addition to increased tourism, the ferry project could contribute to job creation and business development in the areas close to the Scarborough ferry terminal. Jobs will be created during every step of the process. Engineers and construction firms will be needed to build the terminal and the shipbuilder will benefit through purchase of the new high-speed ferry. During the actual utilization of the ferry network, captains, crews, boat maintenance, etc. will all be necessary. Third parties in the South County area will benefit from additional tourists in and about Scarborough Beach, such as restaurants and gift shops.

Traffic Reduction - Beach-goers congest numerous Rhode Island highways, such as I-95 and Route 4, along with South County Route 138, 1, and 1A. Traffic occurs during the morning hours as people head to the beach and again in the evening as they travel back to Northern Rhode Island areas. By utilizing a ferry network from Providence to Scarborough a large portion of this traffic could be decreased. The Gladding-Hearn 25-meter Fast Catamaran Ferry, proposed in this project, has a passenger capacity of 149 and travels at a maximum capacity speed of 30 knots (17.2 m/s). The passengers on the ferry, along with drivers on the aforementioned Rhode Island roads, will be benefited by the use of the proposed project.

Public Transportation to Access State Benches - An alternative way for patrons to utilize the ferry will be Rhode Island Public Transportation Authority (RIPTA) bus routes. RIPTA beach routes are currently in place, but would additionally be scheduled to stop at the Providence and Scarborough Beach ferry terminal. The combination of the public transportation provided by the ferry itself and the additional RIPTA routes will decrease the gasoline consumption and reduce the emission of fossil fuel exhaust.

Public Benefits - As previ0usly discussed, for the hypothetical beach ferry service to become a reality the “compelling public service” of great economic impact, significant traffic reduction, and minimum environmental impact must be proved. A benefit to the public as a whole can be proved as follows:
• The longshore sediment transport at Scarborough Beach will not be affected by either design proposal.
• The down-drift beach, Narragansett Town Beach, will not be deprived of littoral material.
• The presence of the breakwater at Design A could possibly result in accretion of the beach, yielding a greater beach frontage.
• The randomly placed rubble-mound breakwater will maintain the natural beauty of the coastline.
• The environmental impact of the fast ferry wash and jet propulsion system will be low or even a benefit to the area.
• Increased tourism in South County, which will increase business for local companies.
• Reduced traffic on Rhode Island roads leading to Scarborough Beach.
• Narragansett Bay will be utilized as a transportation asset to the state of Rhode Island.
• Supporting the state's ECO-tourism program.

Preliminary Environmental Impact Assessment
Environmental impact studies that were preliminarily investigated during the Fall 2004 semester include; scour processes induced by the operation of the ferry, and disruption of the longshore littoral transport processes in the area. The environmental impact studies will be useful in backing the underlying purpose of the project, along with promoting the overall benefits that will come along with the approval of the project. The study of these topics have been continued in the Spring 2005 semester, along with other topics that have been deemed fit for study. The compilation of these topics will cover a broad range of environmental impact possibilities, to be sure that the environmental impact assessment covers all possible adverse impacts.

Impact of Breakwater on Littoral Processes
For the environmental impact assessment, the important end result of the littoral drift approximation is to realize the impact on these processes due to the placement of a breakwater structure. The breakwater will protrude into the surf zone, ultimately disrupting the littoral processes in the surrounding area. The disruption of the littoral drift can potentially deprive down-drift beaches of littoral material, which the beach depends upon. For design proposal A, located on the northern edge of Scarborough Beach, the potential impact of the breakwater on littoral processes seems to be little. The presence of the breakwater will simply accrete material on the seaward side of the breakwater. This will be similar to the current situation existing at Scarborough Beach. The breakwater’s seaward edge will act as the cove is currently without the presence of the structure. The accretion of the northerly section of the beach will be shifted slightly southward due to the presence of design proposal A. The littoral material confined by the breakwater will not be lost to down-drift beaches, this material has never been supplied to down-drift beaches it is presently trapped within the cove. Design site B, located to the tip of Black Point, is also expected to have little effect on the littoral processes in the surrounding area. At present, the littoral material is being held within the cove south of Black Point, the assumption is that most to all of the littoral drift occurring in this area does not drift beyond the cove. From local knowledge, Dr. Stephan Grilli, it is known that there is clay material present directly to Black Point. This proves that there is no sand accumulation in this area. Therefore the existence of design proposal B will have no resultant effects on the existing littoral processes. The accretion that is currently occurring south of Black Point will continue to occur uninterrupted. Little accretion at the seaward 20 facing side of the breakwater is expected, this is due to the fact that very little littoral material will ever be in drift at that point, it will have already been lost within the cove. The littoral material confined within the cove is not lost to down-drift beaches, the beaches down-drift have never been reliant upon this supply of material. The effect the two designs will have on down-drift beach areas is also an environmental impact consideration. The most apparent down-drift beach is Narragansett Town Beach. The town beach’s littoral processes seem to be independent of Scarborough Beach's littoral processes. Most of the littoral material produced along Scarborough Beach is not in drift past the point of the cove south of Black Point. Narragansett Town Beach gets much of its littoral material from the outlet of Narrow River. The Narrow River outlet is located at the very northern tip of Narragansett Town Beach, constantly transporting sediment into the littoral zone of the beach.
Accumulation and Subsequent Dredging/Redistribution
At Scarborough Beach's present state, accumulation is occurring along the northerly portions of the beach. As discussed before, this accretion is due to the presence of the cove to the north of the accreted beach. After speaking with the manager of Scarborough Beach, Bernie Hawkins, it was found that every year, prior to the summer season, redistribution of sand from this northerly accreted portion of the beach to southerly eroded portions takes place. The beach manager stated that each year the sand redistribution is achieved by bulldozing sand from this northerly beach section and evenly distributing the material about the eroded areas. With the presence of either breakwater design A or B at their respective design sites, the yearly redistribution would still need to be implemented. For design A, the accretion will occur more southerly than at present. The accretion from this design proposal could continue to be redistributed about the beach, alternatively this accretion could be used to accrete the beach profile, producing more beach area for beach goers. For design B, the redistribution of the material accreted will still need to be implemented. With very little effect on the littoral processes from the design B, a similar accretion will be expected along Scarborough Beach. It will be expected that the yearly redistribution will still take place in the same manner as it presently does.

Environmental Impact of Fast Ferry Wash
The environmental impact of fast ferry wash in shallow water has previously been studied in other locations, which can be applied to the proposed design site. The general conclusion of a study in Loch Ryan is that “fast ferry wash does not necessarily have a greater effect on the mass transport of sediment in comparison to natural phenomenon such as wind waves and tidal currents.” (Bell et al) Erosion in the coastal zone is dependant on many factors, such as sediment size and distribution, so each shoreline should be modeled individually.

Wash Waves
The majority of work relating to this area has concentrated on the physical properties of the wash waves produced by fast ferries. The wave characteristics of fast ferries are not naturally occurring and in shallow water a 'super-critical' wash wave pattern is developed. This pattern contains leading waves that are non-dispersive, resulting in energy being contained in individual waves.

Figure 8.7 shows a plan view of super critical wave pattern, as shown in The Maritime and Coastguard Agency (MCA) Research Project 457. Figure 8.8 shows an aerial photograph of a catamaran fast ferry at super-critical speed. It has been shown that Figure 8.7:

Figure 8.7 Plan View of Super Critical Wave Pattern (Reference: The Maritime and Coastguard Agency, Research Project 457)

"the two leading waves diverge at an angle which is maintained with distance from the sailing line resulting in periods up to 40s, 3,000m form the track of the ship.” (Whittaker et al) They are found to produce considerable horizontal fluid particle motion at the seabed due to the aspect that they are long period shallow water waves.
Effect of Water Jet Propulsion

The effect of water jet propulsion is different than that of the wash waves. A different pressure field beneath the hull is produced compared to propellers. When looking at a catamaran style fast ferry, which is wide overall in relation to its length, a different pressure field is developed. A study by the Maritime and Coastguard Agency states that high-speed craft with jet propulsion operating at sub-critical speed in a navigation channel or shallow water have very little effect on the seabed. At a sub-critical speed the wash pattern exists with a series of transverse and divergent waves at the cusp locus, as shown in Figure 8.9. There is little effect on the seabed because the flow through the jets is very little, for example one ferry investigated only pumps 4 percent of the water through the jets at 12 knots compared to its full speed. It also stated that that general perception of jet propulsion units sucking in water underneath the ship is incorrect. The intake of a water-jet is designed to pressurize water under normal operation, so the velocity in the intake is lower than the ship speed. Meaning that only water near the hull gets pushed into the jet because of the intake duct shape.

Figure 8.8: Aerial photograph of catamaran at super-critical speed (Reference: The Maritime and Coastguard Agency, Research Project 457)

![Figure 8.9: Plan View of typical Sub-Critical Wash Pattern (Reference: The Maritime and Coastguard Agency, Research Project 457)](image-url)
Maritime and Coastguard Agency Study
Some of the general conclusions regarding environmental impact of fast ferry wash from the Maritime and Coastguard Agency study concluded that:

- On beaches with fine to medium size sediment the long period wave wash of high speed operation will always cause an initial increase in sediment transport. The long term development however depends very much on the magnitude of attack and the composition of the sediment.
- Each shoreline needs to be modeled individually. It is essential to obtain up to date information on the beach morphology and sediment grading to predict the sediment transport generated by fast ferries as well as an overall picture of the natural littoral paths.
- The leading long period waves in fast ferry wash tend to move larger material than the shorter wind seas particularly further from the shore. In comparison the short steep waves produced by conventional ferries tend to move material closer to the shoreline.
- The impact of high speed wash depends very much on the morphological state and situation of the shoreline. The wave wash has less impact on a beach that is naturally well balanced (only transport but no erosion or transport with little erosion) than on a beach where the natural equilibrium is already disturbed or destroyed due to coastal works or sediment removal.
- The increased wave attack on less erodible cliffs due to fast ferry operation can be a benefit to the coastal system, as the additional eroded material could nourish other locations, depending on the local bathymetry and wave climate.
- Fast ferries operating at comparable speeds to conventional ferries in very shallow water tend to disturb less sediment due to their lower displacement and more streamlined hulls. The disturbance caused by the hull of a high speed craft itself is in general less than compared with the transport capacity of conventional ships.
- The plumes of jet propulsion systems are likely to increase the oxygen concentration in the shallow areas on warm, calm summer days and therefore improve the overall water quality.

Environmental Impact of Fast Ferry Wash Conclusions
By applying the research developed from the above mentioned case studies to the proposed project at Scarborough Beach it can be concluded that the fast ferry wash produced will not have a significant impact on the coastline at either site. Though, individual results from a study at the site would have to be developed to determine the definite environmental impact. Utilizing previous research, it is known that: any sea bed scour due to the water jet propulsion system will be localized, erosion due to the fast ferry is similar to that of naturally occurring erosion, the leading long period waves will move larger material away from the shoreline, the increased wave attack on less erodible cliffs can be a benefit to the coastal system, fast ferries disturb less sediment than conventional ferries, and the jet propulsion systems improve the overall water quality by increasing the oxygen concentration in the shallow areas. All showing that the effects of a high speed ferry operation at Scarborough Beach will be of low environmental impact and may even be seen as a benefit to the area.

Environmental Team Summary and Conclusions - The environmental impact study, combined with the tourism and economical research, will allow the environmental team to prove that the proposed high speed ferry terminal will be of compelling public service. With research and studies to support the itemized public benefits, it is shown that the project can be considered an asset to the public as a whole. This would have to be presented to a CRMC council to officially receive a special exception for development of the site. From an environmental aspect, we would recommend Design Site B. The most important factor of this site is that no dredging will be required. A secondary reason for choosing Design Site B is that the current littoral transport at the site will not be affected. Therefore, maintenance of the beach can continue to occur as it presently does with yearly sand redistribution. In general, a high speed ferry terminal at Scarborough Beach will benefit the tourism and economic aspects of South County and the entire state of Rhode Island. The link between Providence and the southerly coastline will directly utilize Narragansett Bay as an alternative means of transportation for Rhode Islanders and tourists.
GEOTEchnical and Structural Study

Survey of Design Site Locations - Background and Specific Survey Requirements
In order to help decide which potential site to use (Site A or Site B), several factors needed to be determined. First, the presence of bedrock had to be determined, because if bedrock was located within the dredging area designated for the shallow water site, the relatively inexpensive dredging operation would be transformed into a much more involved blasting operation, which would involve greater expense and greater liability. Also, the presence and location of the bedrock (in proxy to the exposed seafloor) could affect the settlement of the breakwater proposed for either site. Second, an investigation of the characteristics of the seafloor (specifically, its composition and geometry) were of interest, both to identify potential hazards to safe navigation and to identify the sand characteristics of the area which could contribute to littoral drift. With these questions in mind, it was determined that a survey of the area was desirable. The most profitable survey possible with the means at hand was decided to be a shallow water investigation using the university’s Edgetech unit, a composite sidescan sonar and subbottom profiler. The sidescan is used to provide high-resolution images of the seafloor, while the subbottom profiler is able to provide a seismographic image of the composition of the floor and the materials immediately underlying it. Because of these capabilities, it was able to address the concerns of seabed geometry as well as the location of bedrock.

Equipment Description and Constraints
The Edgetech unit consists of two parts: a "towfish", which is package of transponders that is contained within a submersible waterproof housing and a CPU, which drives the transponders and displays and records the resultant data. The CPU also correlates the data with a GPS signal, creating a position log that is displayed simultaneously alongside the images. Normally, the towfish is towed behind and below a research vessel, such as the CT 1 or the Cap'n Bert, while the CPU is housed and operated inside an enclosed wheelhouse. Unfortunately, the relatively deep draft of these vessels prohibited their use in our areas of interest, so an alternative was needed. Fortunately, the GSO posses a third vessel, a shallow draft, outboard powered catamaran with a moon pool and a small instrument shack which was graciously lent to us by Dr. John King.

This vessel proved to be far more suited to our needs than the other two, both in light of its shallow water capabilities and its significantly smaller turn radius, due both to the shorter length of the vessel and to the ability to suspend the towfish in the moonpool, instead of towing it behind. Its only drawback was that because of its small size, it was much more subject to weather conditions than the other two. Because of the shallow nature of the area to be surveyed and the potential of navigational hazards (the identification of which being part of the need for such a survey), it was decided that a preliminary survey was needed to identify a safe area of operation for the catamaran. Therefore, a preliminary hazard assessment survey was conducted using two sea kayaks and a portable GPS. The entire area was examined at low tide, and the depth of potentially hazardous rocks was measured manually, and their locations marked on the GPS. This data was then superimposed onto a USCG navigational chart and a "safe operation boundary" was established for the catamaran.

Data Analysis and Implications
Although the amount of data was less than was hoped for, it was still enough to form positive conclusions about the nature of the site. The side-scan images show detailed features of the seafloor, starting in the area immediately adjacent to Black Point, and going on through the proposed deep-water and shallow-water sites. As was suspected, there is a significant bedrock outcropping extending out from and around the Point itself, with occasional rocks and sand extending further. This visible bedrock formation is limited to the immediate proximity of the point, and does not extend far into the proposed shallow water site. The presence of sand confirms predictions that the bedrock is covered with a sandy layer of varying depth that could be subject to littoral transport.
The subbottom profile of the area confirms that there is indeed bedrock close below the seafloor surface. A comparatively thick initial boundary line indicates the presence of a sandy bottom, and the first, fainter reflection below it shows the location of underlying bedrock. The subsequent reflections can be dismissed as aliasing. This evaluation is born out by comparing the subbottom data to the sidescan data: where the bedrock is observed to emerge from the sand, the subbottom profile clearly shows the two layers converging, and the initial reflection is much less clear where the exposed bedrock affects the reflection (see Fig. 8.12). The subbottom data goes on to indicate (through the method described previously) the continuing presence of bedrock beneath the seafloor throughout both proposed sites.

**Bedrock Survey Conclusions**
The survey allows us to conclude the following about the site: as was anticipated, there is a great deal of exposed rock in the immediate proximity of Black Point. Also, surrounding this rock is a sandy bottom that extends from deep water to the beach. This sandy bottom is a relatively thin covering of concealed bedrock that extends throughout both proposed construction site locations, with two major implications. First, the deep-water construction site is more suitable for our needs; despite its closer proximity to rocks near the point, the water depth is suitable for our purposes without any additional dredging. The shallow site, while not near exposed bedrock, is entirely located above covered bedrock that would require blasting, rendering the site much less financially attractive for construction. Second, the presence of deep bedrock will provide a stable foundation for the proposed breakwater, mitigating some settlement concerns that would otherwise need to be addressed.
Settlement Conclusions
It is clear the breakwater will not undergo a significant amount of settlement. It is known that the bedrock is not at a distance "infinity" below the foundation. It is also evident that the entire length of the breakwater is not of uniform cross section, the portions in shallower water will be smaller. With these conditions in mind it is safe to say the settlement of the breakwater, if any, is an insignificant amount.

Bearing Capacity
The foundation of the breakwater is a shallow foundation and was considered to be a strip footing. A strip footing resting on medium-dense sand will settle as the load is gradually applied to the soil. The settlement will continue to increase until a load corresponding to the ultimate bearing capacity at which point the settlement of the foundation will occur in sudden jerks. Because the settlement determined was considered negligible it is assumed the soil beneath the breakwater will not incur a bearing capacity failure.

Scour Conclusions
Design Site A - Design site A is located in the shallow waters of Scarborough Beach, the bottom at this location is a sandy mild sloping beach. The breakwater is connected to the shore and extends much past the surf zone. The scour protection for the portion of the breakwater that exists in the surf zone will be constructed by placing two armor unit stones at the toe of the breakwater. The surf zone for the significant wave height for 10 years of data extends to average distances o shore of 112 m. After this depth smaller quarry stone of no less then 0.3 m may be used for the toe apron material. The head apron length is calculated to be 2.75m.

Design Site B - Design Site B is located off of Black Point fishing area, the bottom conditions for this design site are much more adverse than for Design Site A. The bottom is composed of a sandy bottom with frequent smooth bedrock outcroppings and scattered boulders. These conditions lead to an unstable structure toe, to prevent this the trench method discussed in Section 3.6.7 is used. As with Design Site A the breakwater is located in both very shallow water and shallow water. The surf zone is estimated to be 45 m o the beach, quarry stone of no less than 0.3 m may be used outside of the surf zone. The scour protection at the head of the breakwater is calculated to be 2.75m wide.

Wave Modeling Conclusions
Surface water modeling is an important aspect breakwater design. The purpose of a breakwater is to minimize or eliminate surface waves, thus providing a protection for the ferry dock. For years the use of powerful modeling software programs have been developed to maximize the computational speed of computers allowing for long term modeling. Due to the complexity of ocean kinematics, the software can solve the complex equations of motion, linear wave theory, shoaling, breaking and refraction with relative ease. The down side to modeling programs are that they can be difficult to use and sometimes involve training and extensive experience to understand the relationship of the input parameters to the output. In the case of SMS, it was difficult develop the scatter density mesh, and define boundaries properly. The mesh development was often difficult to define due to the low density of actual bathymetry from the base Auto CAD file. Often times the boundaries failed to contain the desired area, and in many instances the simulation parameters for wave, and tide forcing are in terms of proprietary algorithms, that are not well defined. The final conclusion on using SMS is that although the program was successful in generating an output, the results upon inspection are questionable. The circulation pattern suggests some problems throughout the seaward side of the structure. The problems seen in the ADCIC module are believed to carry to STWAVE, wave modeling. The initial assumption is that the mesh density around the breakwater is dense enough to accurately develop the scatter density mesh used for simulation. The data in the immediate proxy of the breakwater will be better than other areas of the simulation. However, the fact that the data looks suspicious, and the inexperience of using the software requires additional investigation.

Geo-Structural Conclusions
The extensive study of the area yielded several conclusions. First, it is our recommendation that, due to the presence of bedrock beneath the shallower site that would require blasting, the deeper site is the more economically practical of the two. Not only is blasting more expensive than dredging, it involves a much more costly and extensive environmental impact assessment study. This promises to raise the cost of developing the shallower site several orders of magnitude than the deeper site, additional breakwater construction costs notwithstanding. The breakwater construction specifications were determined according to Hudson's equation, and were enumerated in the Phase One report, submitted in the fall of 2003. In brief, the breakwater should be constructed with a 3.3 meter thick cover layer, composed of approximately 10000 individual stones, each with a weight of around 11500 N. This armor layer should be placed randomly on top of two primary layers of smaller stone: the first consisting of stones weighing approximately 1150 N in a 1.3 M thick layer and the second consisting of stones weighing approximately 60N in a .3m thick layer. Once completed, this breakwater will be approximately 200 m in length, with a top width of 4.9 m. Next, the presence of a sandy bottom was confirmed, and sand ripples visible in the sidescan images indicate active littoral drift as well as scour potential in the area. Therefore, in order to protect the breakwater, standard toe protection measures (as outlined in the CEM) should be incorporated into the breakwater during construction,
rather than follow the more usual (and more expensive) course of remedial action. Because of the rocky composition of the seafloor at the deep-water site, a trench should be excavated alongside the in order to ensure the stability the breakwater toe. This trench may, in some places, extend as far as the bedrock, and will alleviate the usual need to physically anchor the armor units to the rocky slope. Over the length of the structure, it is our determination that the seafloor has sufficient strength to support the mass of the structure. Using elastic settlement calculation methods we have determined that, even in a worst case scenario, any settlement that may occur will be negligible, and harmless due to the flexible nature of the recommended structure. The final design in plan view can be seen in Fig. 8.13.

Figure 8.13: Final Design of Breakwater in Plan View
Appendix 1

Bryant University is investigating the demand for a Narragansett Bay ferry system. Your responses will help determine whether or not such a service could be started in the future. Your time and opinions are greatly appreciated.

1. How likely would you be to use a ferry for your transportation needs to get anywhere in RI?
   Very Likely 1 2 3 4 5 6 7 Very Unlikely

2. How likely would you be to use a ferry to get to:

<table>
<thead>
<tr>
<th>Location</th>
<th>Very Likely</th>
<th>Not at all Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scarborough Beach</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Roger Wheeler Beach (Sand</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Hill Cove)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patience Island</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Hope Island</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Hog Island</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Prudence Island</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
</tbody>
</table>

3. How important are these factors to you when riding a ferry?

<table>
<thead>
<tr>
<th>Factor</th>
<th>Very Important</th>
<th>Not at all Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyment of the Ride</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Relaxing Atmosphere</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Scenery</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Convenience</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Length of Trip</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Schedule</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>Avoiding Traffic</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
</tbody>
</table>

4. How likely would you be to take a ferry under the following conditions:

<table>
<thead>
<tr>
<th>Condition</th>
<th>Very Likely</th>
<th>Very Unlikely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct, 1-hour trip</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>1 stop, adding 25 minutes to the</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>trip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 stops, adding 50 minutes to the</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>trip</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Have you ever used a ferry service for your transportation needs? Yes____ No____

6. What City/Town and State are you from? __________________________________________

7. What is your gender? F____ M____

8. How old are you? ________

orado Thank you for participating ☺
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