ACADIA NATIONAL PARK ITS FIELD OPERATIONAL TEST

Island Explorer Data Analysis

April, 2003

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16. Abstract

This report is one in a series that presents the results of data used to assess the impact of the Intelligent Transportation Systems (ITS) that were part of a field operational test at Acadia National Park on Mount Desert Island off the coast of Maine. ITS deployed at Acadia integrates various components that support the region's needs for transit management, traffic management, and traveler information. Operational data collected as part of normal operations by personnel of the Island Explorer bus system were used to assess the impact of ITS on two goals areas: productivity and efficiency. Hypotheses were formulated in the two goal areas and tested with the data.

Analysis of the data show that the Island Explorer has been able to control per passenger costs while greatly increasing service and ridership. Ridership has grown by approximately 50% between 2000 and 2002, miles driven by 3%, and service hours by 20%. This was accompanied by an increase in the operating budget of DTI attributable to Island Explorer operations, but these costs were attributable to normal operating costs not influenced by ITS components. The Island Explorer was able to increase service hours, miles driven, and passengers while holding service denials at well under 1% of stops, an impressive accomplishment for a system that had drastic fluctuation in demands during the day and season.

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Executive Summary

This document is one of series that reports the results of data collected to evaluate the effectiveness of the Field Operational Test of an Intelligent Transportation System fielded on Mount Desert Island, Maine, from 1999 to 2002. This system was designed to relieve traffic congestion in and around Acadia National Park. This report addresses the operational performance of the Island Explorer bus system operated by Downeast Transportation Incorporated (DTI). The Island Explorer is a shuttle bus service made free to riders traveling to destinations within the Park and to communities on Mount Desert Island. ITS technologies aimed at improving the operations of the Island Explorer included two-way radio for voice communications between drivers and dispatchers, automatic vehicle location to track buses in real-time, and automatic passenger counters. Additional ITS technologies associated with the Island Explorer were aimed primarily at passengers and included the electronic real-time departure signs and on-board announcement about the next stop.

This report evaluates the impact of ITS using operational data from the Island Explorer, such as miles driven, passengers carried, routes run, and fleet size. Early in the design of the evaluation, stakeholder groups identified productivity and efficiency as the two primary goal areas in which they expected to see benefits to the Island Explorer operations. The Island Explorer operated during the summer tourist season from late June through Labor Day. Representative of the conditions prior to the ITS technologies, "before" data were collected for 1999 – 2001. Data from 2002 represented the post-deployment period that enabled a before/after assessment of the impact of the ITS technologies on Island Explorer operations.

Analysis of the data shows that the Island Explorer has been able to control per passenger costs while greatly increasing service and ridership. Ridership has grown by approximately 50% between 2000 and 2002, miles driven by 3%, and service hours by 20%. This was accompanied by an increase in the operating budget of DTI attributable to Island Explorer operations, but these costs were attributable to normal operating costs not influenced by ITS components. The Island Explorer was able to increase service hours, miles driven, and passengers while holding service denials at well under 1% of stops, an impressive accomplishment for a system that had drastic fluctuation in demands during the day and season.

ACADIA NATIONAL PARK ITS FIELD OPERATIONAL TEST

Island Explorer Data

1.0 INTRODUCTION

This report is one of in a series that examines the impact of the ITS deployment. It presents the operating data collected by Downeast Transportation Incorporated on operating costs and parameters for the Island Explorer bus system. The Island Explorer system was part of the deployment and operation of the ITS Field Operational Test at Acadia National Park form 1999 to 2002. The data were collected from company records that were part of routine business and transportation management practice.

1.1 Overview of the Overall Evaluation Strategy

The Intelligent Transportation Systems deployed at Acadia National Park integrate various components that support the region's needs for transit management, traffic management, and traveler information. The components are interrelated and depicted in Figure 1-1. The relationship between the individual system components, the functional requirements, the system elements, and the needs addressed are shown in Table 1.1. Further elaboration can be found in the Acadia National Park ITS Field Operational Test: Strategic Plan.[1] Based on the collective feedback of the stakeholders, the overriding impact of the ITS technologies should be to reduce vehicle congestion in Acadia National Park. Reduced congestion will have the added benefits of increased mobility of visitors and residents, aesthetic and environmental benefits of fewer vehicles parked on roads, and safety benefits of less traffic and better emergency response.

The evaluation strategy was developed in cooperation with local partners and representatives from the state and federal Departments of Transportation. Despite the diverse membership of the project team, the conclusions they reached were very similar. There was considerable agreement among team members that customer satisfaction and mobility were higher in priority than the other goals. However, other evaluation goal areas (safety, efficiency, productivity and economic vitality, and energy and environment) also held some level of importance among the stakeholder organizations.

The overall evaluation approach was based on several evaluation tests that combined primary and secondary data collection and analyses. Visitor on-site interviews, mail-back questionnaires to visitors and local area businesses, personal interviews, direct observation, and system and historical data analysis were performed. The visitor and business surveys collected primary data on user awareness and satisfaction. Personal interviews with Island Explorer and Acadia National Park staff and other key stakeholders provided in-depth perspectives on issues affecting deployment and use of the technology. The operational data of the Island Explorer are the subject of this report, and findings of the other tests are reported in other documents in this series of individual test reports.

[1] Acadia National Park ITS Field Operational Test Evaluation Strategic Plan, July 2000. Available at the ITS JPO evaluation Website: http://www.its.dot.gov/eval/docs_stateregionl.htm.

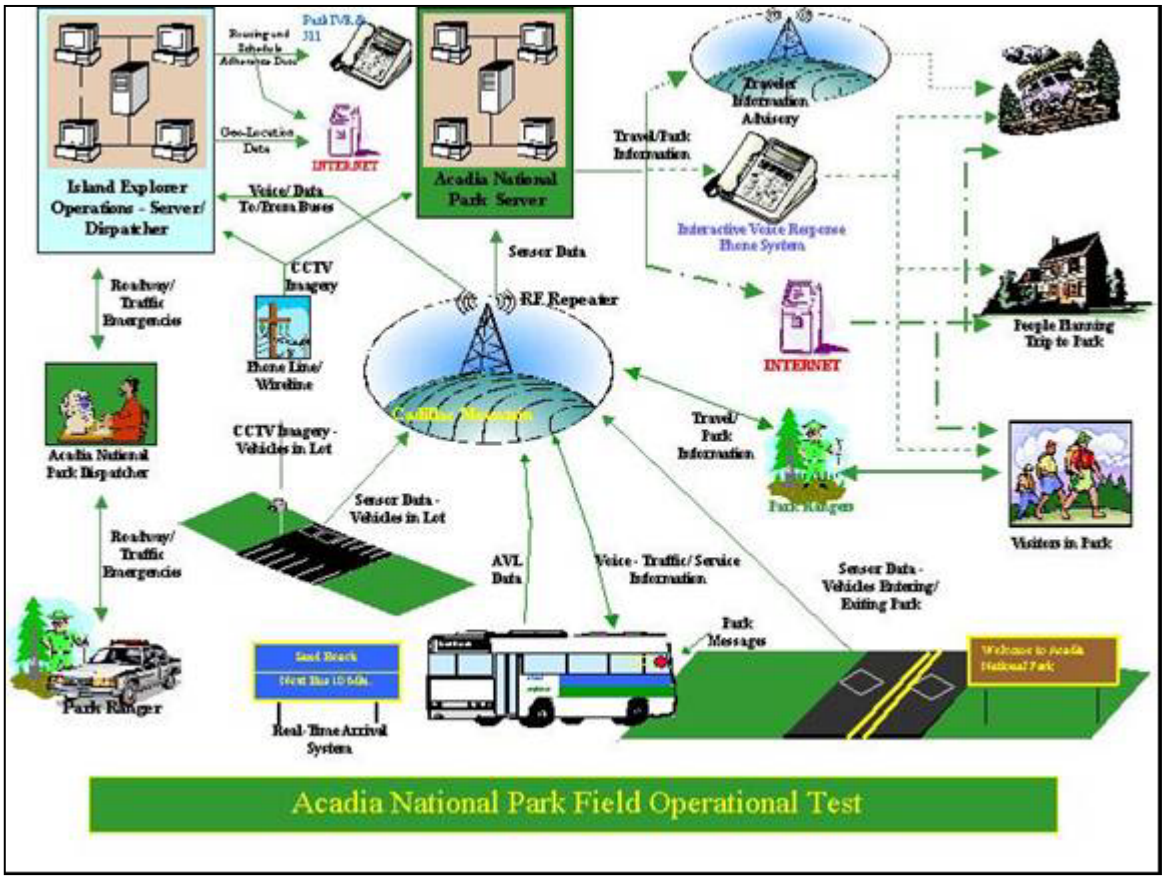


Figure 1-1: System Architecture for ITS FOT at Acadia National Park

Table 1.1: ITS System Components

System Component	Functional Requirements	System Elements	Needs Addressed
Island Explorer Two-way Voice Communications	Transmit and receive to/from/between vehicles and dispatch center	Transceivers; vehicle and base station Repeater to amplify signal	Improved efficiency Improved safety Real time traffic information for park staff, reduce crush load conditions, incident detection
AVL for Island Explorer	Compute and transmit vehicle location Integrate vehicle locations with departure signs, display vehicle locations[2], integrate into enunciator	Vehicle transmitter TCP/IP Network Connectivity, GPS Transceiver, GIS Applications, Travel Time Applications	Improved efficiency and performance Decreased use of POV's Improved safety and response Real time updates Increase ridership
Departure Sign for Island Explorer	Transmit location Compute departure Transmit to departure signs	Display sign, Software, Wireless/Wireline Communications	Improved scheduling information Increase ridership
Automated Annunciator for Island Explorer	Determine location Automatically play next stop and other pertinent announcements	Vehicle annunciator	Improve efficiency Reduce delays Increase safety Improve visitor experience
Passenger Counter for Island Explorer	Auto-count boardings/ dismounts at selected stops, Store information	Sensor to perform counts Data storage	Increase efficiency Improve planning Increase data options Reduce vehicle crush loads
Parking Lot Monitoring[3]	Record number of vehicles entering and exiting, provide slow scan video of parking area[4], transmit data, display video, store data from vehicle counts	Counting sensor Video camera Display monitor Wireless/wireline communications TCP/IP network connectivity	Decreased use of POV's Provide planning data Information for Rangers Decreased Response times
Automatic Ranger/Vehicle Geo-Location[5]	Determine location +-10 meters, transmit same to server, display locations on map	Transmitting unit GPS Transceiver Repeater for signal GPS/GIS Software	Information for Rangers Exact locations of Rangers Decreased response times Improved visitor safety, security
Entrance Traffic Volume Recorder[6]	Record and transmit number of vehicles entering and exiting, store data	Counting sensor Transmission unit	Count vehicles Provide Planning Data Decrease use of POV's
Traveler Information System	Collect and integrate data, disseminate data to appropriate audience	Interactive telephone messaging system[7], Web page, parking status signs	Increase availability and display options of information, Decrease use of POV's, Improve visitor experience

[2] Not operational during the Field Operational Test
[3] Because the loop detectors at parking lot entrances were not in operation in 2002, personal observation was used as an alternative to automated parking monitors as a way to communicate parking lot status to visitors through the website and specially created parking status signs
[4] Eliminated from the Field Operational Test
[5] Eliminated from the Field Operational Test
[6] Not operational during the Field Operational Test
[7] Not operational during the Field Operational Test

2.0 GOAL AREAS ADDRESSED

As part of the planning for the ITS FOT, project stakeholders were asked what were important goal areas for evaluation of the effectiveness of this FOT. The goal areas identified were safety, mobility, efficiency, productivity and economic vitality, energy and environment, and customer satisfaction. In order to evaluate how effective this FOT was in addressing these goal areas, a further breakdown was accomplished to identify objectives and hypotheses supporting those objectives.

The data collected from the Island Explorer records were intended for use in examining hypothesis related to productivity and efficiency in Island Explorer operations. Table 2-1 presents the hypothesized impacts of ITS technologies on productivity and efficiency of the Island Explorer.

Table 2-1: Hypotheses Related to Island Explorer Operations

Evaluation Goal Area	Objective	Hypotheses
Productivity and Economic Vitality	To reduce or optimize operating budget of IE	Better real-time data will allow IE management to react to dynamic changes
	To increase IE productivity	ITS will provide better operating information to enable better scheduling
Efficiency	To increase the number of customers served	ITS provides better operating information, which allows for more efficient deployment of resources
	To distribute the demand on ANP resources more evenly	Better information availability allows for visitor pre-and on-trip planning, whereby visitors will shift away from use of their own vehicles within the Park and rely more on the IE

3.0 DATA COLLECTED

The evaluation used data for the Island Explorer that are normally collected for operations and audit purposes. Staff of the Island Explorer assembled the data which were collected from 1999 through the 2002 operating seasons.

The data presented in this report differs somewhat from the hypothetical measures originally identified in the Island Explorer Baseline Report.[8] Due to the particulars of accounting practice, it was not possible to identify staff overtime, on-time arrivals and departures, schedule adherence, missed runs, denied riders, crush loads, and dispatcher efficiency. Surrogate measures for denied riders and crush loads are found in service denials and standing riders.

[8] Acadia National Park ITS Field Operational Test: Baseline Data Analysis, October, 2001. Prepared for U.S. DOT ITS Joint Program Office.

4.0 DISCUSSION OF RESULTS

The Island Explorer bus system was equipped with a suite of ITS technologies that were intended to improve operations by providing real-time data on bus location, schedule adherence, passenger loading, and voice communications with drivers. The anticipated outcome was an improvement in operations that would lead to cost savings (productivity) and better service with the current fleet of buses (efficiency)

To measure productivity and efficiency, a variety of operational data were obtained from Downeast Transportation, Inc., the owners of the Island Explorer. Whereas data such as vehicle mileage and passenger counts were obtained manually from 1999 to 2001, the ITS technologies automated such data collection in 2002. Table 4-1 presents the principal operational data by year from 1999 through 2002.

Table 4-1: Island Explorer Operational Measures

	1999	2000	2001	2002
Miles (000)	148	209.5	220.5	217.5
Ridership (000)	140.9	193.1	240	281.1
Operating Expenses ($000)	204.5	394.7	472.8	568
Service Denials (% of trip segments over capacity)	<1%	<1%	<1%	<1%
Standing Riders (% of trip segments with one or more standees)	8%	8%	11%	14%
Service Hours (000)	7.3	10.1	12.3	12.3
Routes	6	7	7	7
Number of Buses	8	17	17	17

The following sections analyze the implications of the data in terms of the evaluation goals of productivity and efficiency.

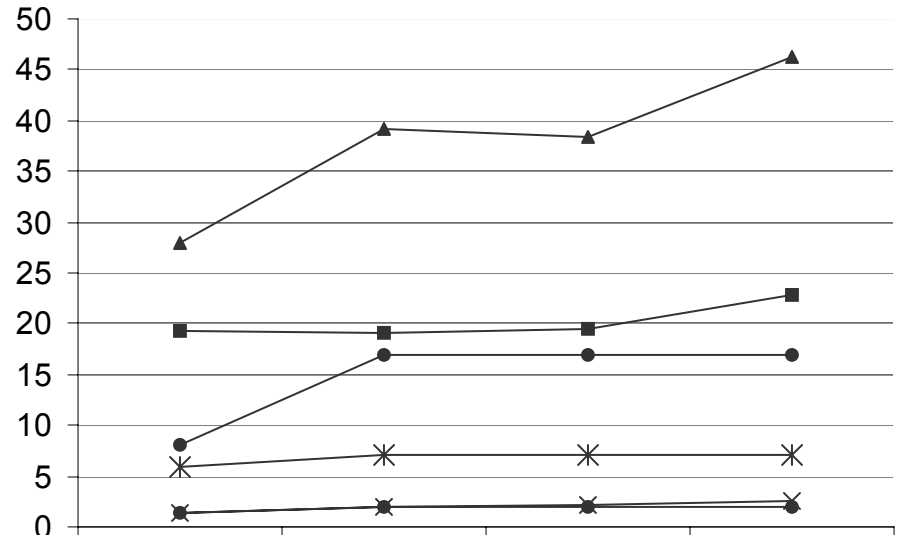
4.1 Productivity Impact of ITS

As the data in Table 4-1 clearly show, operating expenses of the Island Explorer have increased steadily in its four years of operation. From 2001 to 2002, the year that ITS was fully operational on the Island Explorer, it grew by 20%. However, ridership also grew significantly, swelling 17% from 2001 to 2002 leading to 14% of the runs having standing riders. Service hours, number of routes, and number of buses remained constant in the two years.

To assess the change in operational performance as the bus system grew over the four seasons of operation, Figure 4-1 presents unit measures. In terms of hours of operation, the number of riders remained fairly flat in the first three years, and jumped by 3.4 per hour riders in the 2002 season. Cost per rider was fairly constant from 2000 to 2002, but the cost per hour and mile of operation jumped significantly in 2002. Thus, while ITS may have contributed to attracting more riders to the Island Explorer, that growth came at a higher overall operating price.

To fully understand the factors behind these statistics, the evaluation team obtained additional budgetary information from Downeast Transportation. Because the fiscal year for bus operations is different than the calendar year, Downeast recommended that the more appropriate comparison is between 2000 and 2002. The additional information revealed that the expected improvements in productivity over the two-year period owing to ITS were not realized due to increased service hours, higher wages, assuming costs that were previously paid by Acadia National Park, vehicles no longer being under warranty, hiring professional year-round management, and increases in direct operating costs. Some details on specific operational costs included:

- 10% increase in the cost of insurance
- 344% increase in the cost of vehicle repairs: buses were not only older but were being used more
- Printing of the bus schedule and cost of a planning consultant that was previously paid by Acadia National Park
- 16% increase in operating wages, paralleling increase in service hours
- 8% increase in fuel costs.



	1999	2000	2001	2002
Riders per Hour	19.3	19.1	19.5	22.9
Cost per Rider	$1.45	$2.04	$1.97	$2.02
Cost per Hour	$28.01	$39.08	$38.44	$46.22
Cost per Mile	$1.38	$1.88	$2.14	$2.61
Routes	6	7	7	7
Fleet size	8	17	17	17

Figure 4-1: Island Explorer Productivity Measures

In addition, the Island Explorer experienced extra costs to continue to operate the ITS technology itself. An additional $100K was spent for a two-year extension to the warranty of the AVL system supplied by Avail Technologies, which is being split between the Maine DOT and Downeast Transportation.

Thus, the operating costs of the Island Explorer prior to 2002 did not fully reflect all the costs, owing to the assistance provided by Acadia National Park. In addition, the maturation of the bus operations along with the success in capturing a large volume of riders has been accompanied by additional expenses not required in the initial years. Finally, the ITS technologies themselves resulted in additional operational expenditures. It can be concluded, therefore, that while ITS technology undoubtedly entails some additional operating and capital cost for the Island Explorer, those costs are fairly minor when placed against all other costs of operating a growing, professionally run system.

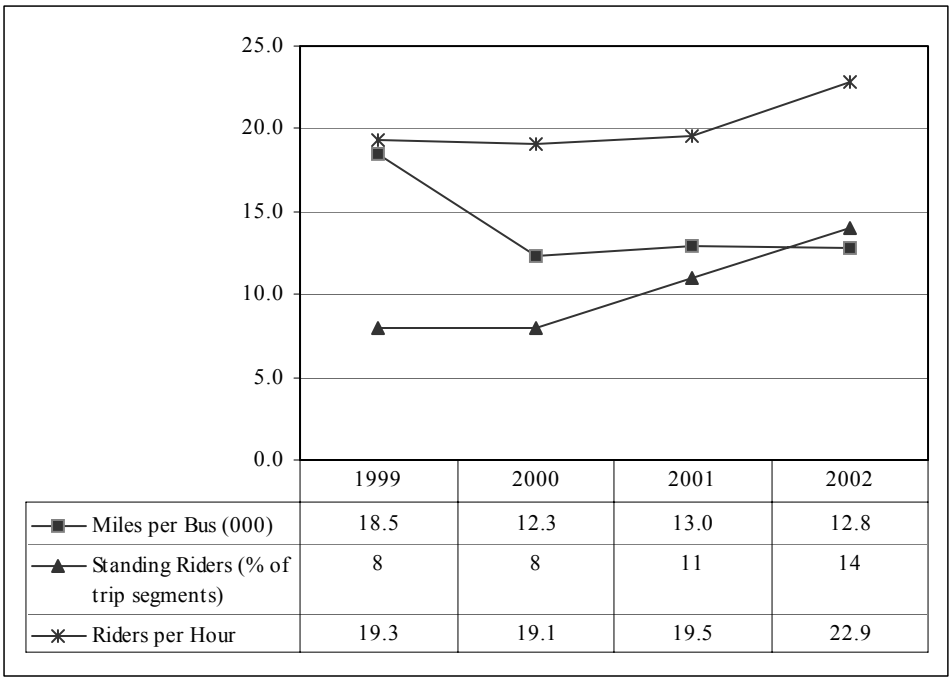
4.2 Efficiency Impacts of ITS

The ITS-based traveler information made available during the FOT was intended to help visitors plan their daily travel around the travel options available. It was anticipated that traveler information about the Island Explorer and parking conditions in the Park would encourage visitors to make greater use of the Island Explorer and less use of their personal vehicles. Consequently, the Island Explorer was expected to show an increase in ridership between 2000 and 2002.

The ITS technologies associated with the Island Explorer itself were intended to enable a variety of improvements in operation, such as better scheduling of buses to meet demand and better response to vehicle or driver problems, such as breakdowns, that could impact service. The ITS technologies that would most directly impact efficiency included voice communicators, automatic vehicle location, and automated passenger counters.

The bus service has experienced substantial increase in ridership over its four years of operation. With a better sense of the potential demand and with a year of operational experience behind them, Downeast Transportation doubled the size of the fleet from eight buses in the first year to 17 buses in 2000. Similarly, a seventh route was added in 2000. Fleet size and routes of service have remained constant since then. Hours of operation were also lengthened to provide better service for riders to participate in evening activities outside the Park. As a result, total service hours reached 12,300 in 2001 and stayed constant in 2002. To assess the impact of the ITS technologies on the operations of the Island Explorer, operational statistics presented in Table 4-1 above were analyzed.

Figure 4-2 shows three measures of operational efficiency from 1999 through 2002. Comparison of measures for 2002, when ITS was in operation, with the previous year suggests that ITS did indeed aid the efficiency of Island Explorer operations. Bus utilization, in terms of miles driven per bus, decreased slightly, even though overall ridership increased. The increase in the number of riders per hour from 2001 to 2002 was 17% higher with a corresponding increase in the percentage of trip segments (distance between two stops) with standing riders. It is significant to note that between 2000 and 2002 far less than 1% of all trip segments involved a stop where the bus driver refused service because of over-capacity. Thus, it can be concluded that purely on a quantitative basis that ITS had a positive impact on the efficiency of operations of the bus system.



	1999	2000	2001	2002
Miles per Bus (000)	18.5	12.3	13.0	12.8
Standing Riders (% of trip segments)	8	8	11	14
Riders per Hour	19.3	19.1	19.5	22.9

Figure 4-2: Island Explorer Efficiency Measures

5.0 CONCLUSIONS

Based on the data presented in this report, as well as the results from the key informant interviews and visitor surveys, it is clear that ITS technologies have contributed to the operational efficiency of the Island Explorer. Passengers and key informants both believed that the departure signs encouraged initial and repeat ridership. The increase in ridership is evident: approximately 17% between 2001 and 2002. The increase in ridership may be attributed to several factors, including increased print publicity, more bus routes, more miles driven, and repeat visitors who are veteran riders. Especially telling is the sustained increased in riders per hour, perhaps the best indicator of efficient vehicle utilization.

After the introduction of ITS, the Island Explorer was able to increase passengers carried, and hours operated, and slightly decrease miles driven, while maintaining a very high level of service (low service refusals) and virtually containing cost per passenger.

It should be noted that the Island Explorer bus service did not exist before 1999. It was started by a regional transportation company, Downeast Transportation Incorporated (DTI), that provided rural and school bus services to Hancock County, Maine. In 1999, DTI inaugurated the Island Explorer service with eight buses and six routes. In 2000, this increased to seven routes and seventeen busses, where it has remained. The nature of the service is also unique in that it operates between very crowded central business districts, sometimes crowded attractions, and through long stretches of rural areas with no stops. This unique blend of service requirements would provide a challenge to any transit property.

The ITS FOT did bring measurable benefit to the IE operation. The impressive increases in ridership and cost containment per rider are attributable to reliance on departure signs and operational personnel using passenger counts and vehicle locations to make dispatch and run cutting decisions. Operational personnel also believe that continued operation and refinement of the current ITS suite will enable even better fine-tuning and realization of efficiencies. The operational personnel with DTI did not have prior experience

with ITS components before 2000, and felt that as their working familiarity with these components grew, so would their innovation in use. With motivated management and innovative operational staff, those managing the Island Explorer will likely use ITS to even greater advantage in the future.

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