SOUTH SAN FRANCISCO

February 2006

Volume I **Draft** **Environmental Impact Report/ Environmental Assessment**

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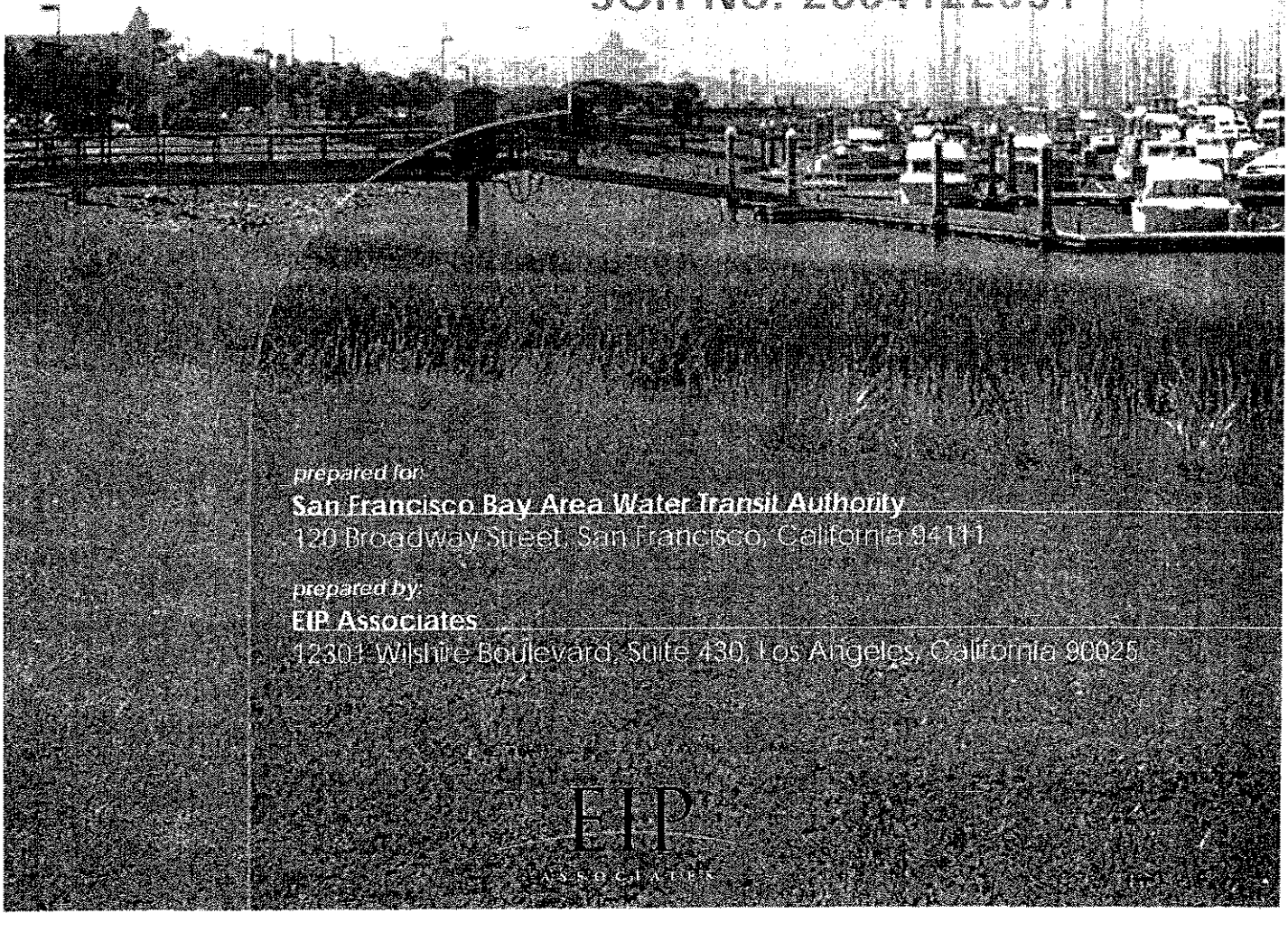

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CHAPTER 4 Other CEQA and NEPA Considerations

Section 15126 of the *California Environmental Quality Act* (CEQA) Guidelines and 40 CFR 1508.8 require that all aspects of a project must be considered when evaluating its impact on the environment, including planning, acquisition, development, and operation. As part of this analysis, the EIR/EA must also identify (1) significant environmental effects of the project, (2) significant environmental effects that cannot be avoided if the project is implemented, (3) significant irreversible environmental changes that would result from implementation of the project, (4) growth-inducing impacts of the project, (5) mitigation measures proposed to minimize significant effects, (6) cumulative environmental impacts of the project, and (7) alternatives to the project.

4.1 SIGNIFICANT ENVIRONMENTAL EFFECTS OF THE PROJECT

Table ES-1 (Summary of Environmental Impacts and Mitigation Measures), which is contained in the Executive Summary of this EIR/EA, and Sections 3.1 through 3.15 of this EIR/EA provide a comprehensive identification of the project's environmental effects, including the severity both before and after mitigation.

4.2 SIGNIFICANT ENVIRONMENTAL EFFECTS THAT CANNOT BE AVOIDED IF THE PROJECT IS IMPLEMENTED

Section 15126.2(b) of the CEQA Guidelines requires that an EIR describe any significant impacts that cannot be avoided, even with the implementation of feasible mitigation measures. Development of the project would not result in any adverse and unavoidable project-related impacts.

Many project-related impacts resulting from implementation of the project can be mitigated to a less-than-significant level; however, cumulative impacts would result from implementation of the proposed project in combination with the development of related projects in the area and projected regional growth. The project would not result in significant and unavoidable cumulative impacts.

4.3 SIGNIFICANT IRREVERSIBLE ENVIRONMENTAL EFFECTS

Section 15126.2(c) of the CEQA Guidelines *requires* a discussion of any significant irreversible environmental changes that would be caused by the project. Specifically, Section 15126.2(c) states:

> Uses of nonrenewable resources during the initial and continued phases of the project may be irreversible, since a large commitment of such resources makes removal or nonuse thereafter unlikely. Primary impacts and, particularly, secondary impacts (such as highway improvement which provides access to a previously inaccessible area) generally commit future generations to similar uses. Also, irreversible damage can result from environmental accidents associated with the project. Irretrievable commitments of resources should be evaluated to assure that such current consumption is justified.

Generally, a project would result in significant irreversible environmental changes if any of the following would occur:

- The primary and secondary impacts would generally commit future generations to similar uses
- The project would involve a large commitment of nonrenewable resources
- The project involves uses in which irreversible damage could result from any potential environmental accidents associated with the project
- The proposed consumption of resources is not justified (e.g., the project involves the wasteful use of energy)

Development of the project would result in the continued commitment of the City of South San Francisco to ferry terminal uses, thereby precluding any other uses for the lifespan of the project. South San Francisco has identified in its General Plan Transportation Element that providing or reserving a site for a ferry terminal in the Oyster Point Marina Park (Marina) area would be feasible and should be explored as part of any revision to the Oyster Point Marina Specific Plan (Implementing Policy 4.4-1-5). Although the project would commit the project site for ferry terminal uses for future generations, the project does not represent a change in commitment from existing and planned marina uses for the site. Further, the project is essentially urban infill and would not represent conversion of previously undeveloped land to developed uses.

Resources that will be permanently and continually consumed by project implementation include water, electricity, natural gas, and fossil fuels; however, the amount and rate of consumption of these resources would not result in significant environmental impacts or the unnecessary, inefficient, or wasteful use of resources. The ferry terminal would be a benefit as it increases non-vehicle uses. In addition, construction activities related to the project would result in the irretrievable commitment of nonrenewable energy resources, primarily in the form of fossil fuels (including fuel oil), natural gas, and gasoline construction equipment.

With respect to operational activities, compliance with all applicable building codes, as well as project mitigation measures, would ensure that all natural resources are conserved or recycled to the maximum extent feasible. It is also possible that new technologies or systems will emerge, or will become more cost-effective or user-friendly, that will further reduce the site's reliance upon nonrenewable natural resources; however, even with implementation of conservation measures, consumption of natural resources would generally increase with implementation of the project.

In addition, a long-term increase in the demand for electrical resources would occur. However, the project would not involve a wasteful or unjustifiable use of energy or other resources, and energy conservation efforts could also occur with new construction. In addition, the project will be constructed and operated in accordance with specifications contained in Title 24 of the CCR. Therefore, the use of energy on site would occur in an efficient manner.

4.4 GROWTH-INDUCING IMPACTS

As required by the CEQA Guidelines, an EIR must include a discussion of the ways in which the proposed project could directly or indirectly foster economic development or population growth, or the construction of additional housing and how that growth would, in turn, affect the surrounding environment (CEQA Guidelines Section 15126.2(d)). NEPA also states that federal agencies preparing an EA must consider indirect effects of the proposed action, including growth-inducing affects and other effects related to induced changes in the pattern of land use, population density, or growth rate (40 C.F.R. 1508.8) . Growth can be induced in a number of ways, including the elimination of obstacles to growth, or through the stimulation of economic activity within the region. The discussion of removal of obstacles to growth relates directly to the removal of infrastructure limitations or regulatory constraints that could result in growth unforeseen at the time of project approval. Under CEQA, induced growth is not considered necessarily beneficial, detrimental, or of little significance to the environment.

In general, a project may foster spatial, economic or population growth in a geographic area if it meets any one of the criteria identified below:

- The project removes an impediment to growth (e.g., the establishment of an essential public service, or the provision of new access to an area)
- The project results in the urbanization of land in a remote location (leapfrog development)
- The project establishes a precedent-setting action (e.g., a change in zoning or general plan amendment approval)
- Economic expansion or growth occurs in an area in response to the project (e.g., changes in revenue base, employment expansion, etc.)

If a project meets any one of these criteria, it may be considered growth inducing. Generally, growth-inducing projects are either located in isolated, undeveloped, or underdeveloped areas, necessitating the extension of major infrastructure such as sewer and water facilities or roadways, or encourage premature or unplanned growth.

4.4.1 REMOVE AN IMPEDIMENT TO GROWTH

The establishment of an essential public service usually refers to installation of infrastructures (e.g., utilities) and/or provisions of new public services (e.g., police protection, fire protection) while providing new access to areas is usually defined as new roads. An essential public service also could be defined as provision of new transit service. The project is intended to relieve existing congestion on Bay Area roadways and bridges. In addition, the 2001 South San Francisco General Plan Amendment assumes that total buildout in the area east of US 101 will grow from 12.82 million square feet (sf) in 2001 to 23.31 million sf in 2020 due mainly to the increase in office and R&D development. As the project is intended to relieve existing conditions, and provide for planned growth, the project would not be growth-inducing as a result of removing an impediment to growth.

Puget Sound Regional Council
2002 Regional Growth Centers Report

BREMERTON REGIONAL GROWTH CENTER

Community Context

Incorporated in 1901, Bremerton is the largest city in Kitsap County, with an estimated 37,259 residents and 27,683 jobs in the year 2000. Bremerton's population growth increased slowly until World War II when Naval activities, shipyard work, and population peaked at an estimated 72,500 people in 1945. Following the war, the city reduced its workforce with the cessation of wartime production, and settled back into a more conservative growth and population pattern. Nevertheless, today almost half the city's jobs are still associated with the Naval Shipyard, Naval Hospital and Naval Supply Center. Because of these facilities, Bremerton's growth patterns were substantially affected by military build-ups in wartime and during the Cold War. Bremerton is poised for growth again due to its share of regional population and employment growth forecasted for the next 20 years.

Bremerton City-Wide Snapshot	
Area (square miles)	23.7
Population (2000)	37,259
Population per square mile	1,572
Employment (2000)	27,683
Employees per square mile	1168
Housing units (2000):	16,631
Employees per housing unit	1.66

Source: US Census Bureau, Washington State Employment Security Department

Management Act was passed in 1990, the Bremerton Plan was only four years old. Rather than abandon it and embark on a new planning process, the City decided to build on the 1986 Plan, integrate GMA requirements, and ensure consistency with other plans. The revised Comprehensive Plan, adopted on April 5, 1995, lays out goals and policies for the next 20 years.

Bremerton is forecasted to grow by 20,000 additional residents by 2014, which would require approximately 11,700 new housing units to accommodate the increased population. The central part of the city represents most of Bremerton's commercial and industrial land. About 49 percent of the city's housing is in single-family units, substantially below the national average of approximately 73 percent for cities of its size. More than half of the city's households are considered low income. The city also has a smaller amount (seven percent) of its land area devoted to commercial uses than newer communities, but this reflects the higher density development found in the downtown and established neighborhood centers.

The Regional Growth Center

Background

The central business district is the historic core of the City of Bremerton. It has served as the site of the most concentrated area of jobs in Kitsap County for decades. Despite the continued presence of manufacturing jobs at the Puget Sound Naval Shipyard, downtown Bremerton has been struggling through a more than 15-year period, brought on primarily by new commercial development in the Silverdale area in the mid-1980s. Kitsap County's most important retail district has shifted from Bremerton's CBD to Silverdale and also to auto-oriented strip commercial areas. Downtown Bremerton is now working to establish a new identity and land use mix that will work effectively to increase the vitality of the downtown area. Studies conducted in the 1990s introduced new downtown and waterfront development concepts, stressed the importance of improved ferry service and an Intermodal transportation facility, and recommended the promotion of major new housing concentrations to create a more balanced, 24-hour downtown neighborhood.

The Bremerton Regional Growth Center covers several distinct subareas, including the Central Business District, the Charleston Business District, and neighborhoods to the north and west of the Central Business District. This area contains about 3,904 dwellings, and about 9,454 people. With Bremerton residents housed in Puget Sound Naval Shipyard (PSNS) military housing or on ships moored at PSNS, these residents represent about one-third of the city's total population. Much of the center's land is underdeveloped or vacant, and a series of economic development plans and redevelopment studies have had little impact. The city's comprehensive plan assumes an increase in cross-Sound travel will stimulate development of a mix of housing and employment opportunities within a ferryboat ride of Seattle.

See the aerial photo on the following page for a depiction of the Bremerton Regional Growth Center.

Redmond Regional Growth Center Transit Routes and Frequencies (AM Peak Period)			
Item	Route #	Destination	Frequency
1	15	MCWILLIAMS-SHTTL 15	30
2	11	CROSSTOWN EXP 11	36
3	21	PERRY AVENUE 21	30
4	22	WESTSIDE PARK SHUTTLE 22	45
5	27	EASTSIDE PARK SHUTTLE 27	45
6	20	NAVY YARD CITY 20	30
7	26	WEST PARK 26	30
8	25	EAST PARK 25	60
9	24	OLYMPIC COLLEGE 24	30
10	28	WEST HILLS 28	100
11	29	TRENTON AVENUE 29	60
			45.09

Source: Puget Sound Regional Council, Community Transit, Everett Transit, Kitsap Transit, Metro Transit, Pierce Transit, Sound Transit

Bremerton's ferry terminal is located in downtown Bremerton approximately 16 miles away from Seattle, a 50 minute crossing. The terminal includes bus transfer and automobile drop-off areas. Bremerton is a growing city with a strong desire to expand its ferry service to accommodate additional growth. However, maintenance of current service is in some doubt, and expansion of ferry service has been curtailed in recent years due to difficulties in funding additional service.

Parking

A recent parking survey in Downtown Bremerton revealed 3,365 off street parking spaces in the downtown area. Nearly 900 of these spaces were dedicated to retail customers, with the rest intended for employee, residential, and other uses.

Bremerton Regional Growth Center Off-Street Parking by Type								
Bremerton Total	Customer Only	Customer with other type	Employee Only	Employee with other type	Residential	Residential with some other type	Other	Other with some other type
3,365	64	815	93	N/A	N/A	N/A	2,693	N/A

Source: *Parking Inventory for the Central Puget Sound Region*, PSRC (2003)

Weighted hourly costs have risen for retail customer parking spaces to an average of $3.56 per hour, with daily rates at $6.76 and monthly costs at over $89. These were fairly average for area rates surveyed in the region.

Bremerton Regional Growth Center Parking Costs					
Regional Growth Center	Total Stalls	Average Occupancy	Weighted Hourly Cost	Weighted Daily Cost	Weighted Monthly Cost
Bremerton	3,665	65.1%	$3.56	$6.76	$89.61

Source: *Parking Inventory for the Central Puget Sound Region*, PSRC (2003)

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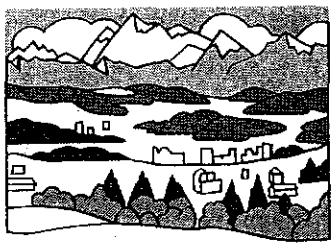

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DRAFT
TECHNICAL MEMORANDUM

To: Members of the Marine Transportation Association of Kitsap
From: Eric Toews, Principal
Date: January 2, 2007
Re: Kitsap Transit Draft Passenger Only Ferry Plan – Summary Assessment of Land Use Compatibility

INTRODUCTION

In 2003 the Washington State Legislature transferred the authority and responsibility to provide passenger only ferry (POF) service on Puget Sound waters to counties and local transit agencies. It also established how local governments could make this happen and authorized funding mechanisms and sources. Kitsap Transit has taken action in response to these legislative changes by issuing a Final Draft of its Passenger Only Ferry Investment Plan (December 2006). The Final Plan outlines a local approach to sustained and regular cross-Sound passenger only ferry (POF) service between Kingston, Bremerton, Port Orchard and Southworth in Kitsap County, to downtown Seattle.

The POF Investment Plan is intended to fulfill three basic purposes:

- To respond to the state's request for business plans for counties and transit agencies proposing to provide POF service;
- To serve as Kitsap Transit's business development plan for POF service; and
- To provide Kitsap County voters with the information necessary to make an informed choice as to whether or not to approve a ballot measure to raise the County's sales tax by 3/10ths of a percent to support the Plan.

In August and October 2006, the Marine Transportation Association of Kitsap (MTAK) and Kitsap Transit held a series of public meetings to share the POF Investment Plan with the public and solicit feedback. Additionally in October 2006, MTAK conducted a countywide telephone survey (involving 800

respondents) to access public response to key elements of the Draft POF Investment Plan. The findings from the public meetings and telephone survey were presented to the Kitsap Transit Board of Commissioners and informed deliberations on the Final Draft (December) Passenger Only Ferry Investment Plan.

The Context for the Supplemental Land Use Compatibility Analysis

The Final Draft POF Investment Plan provides a detailed discussion of service development and associated capital improvements necessary to support the Plan (Section II(C)(5) on pages 15-20).[1] This discussion included a description of the key environmental issues that will be necessary to address if the Investment Plan is to be successfully implemented. The MTAK, Kitsap Transit staff, and the interested public recommend that this discussion and analysis be further augmented by a review of the overall land use compatibility of the Southworth and Port Orchard components of the Passenger Only Ferry Investment Plan in relation to Kitsap County's recently updated Comprehensive Plan.

Accordingly, this summary technical memorandum addresses the following:

- The consistency of proposed Southworth and Port Orchard POF service with the County's recently updated policies and regulations;
- Strategies that might be employed to successfully offset potential land use and transportation system impacts; and
- Additional land use and environmental analyses that may be necessary, in the future, to support Plan implementation.

Readers should be mindful of the compressed timeframe provided to prepare this review and assessment, and should view this document as a useful starting point for future additional analyses and mitigation recommendations, rather than a definitive and final evaluation.

Information Sources

Due to time and budgetary constraints noted above, this memorandum provides a qualitative discussion of the land use and transportation impacts of providing POF service from Southworth and Port Orchard to Seattle. It cannot, and does not, seek to quantify those impacts. This compatibility assessment is based upon existing and readily available information sources rather than original (i.e., newly developed) data. The following documents were substantially relied upon in preparing this evaluation:

[1] Section II(C)(5)(a)(4) of the Plan outlines the key environmental issues that will likely be encountered during Plan implementation (see page 19 of the Plan). Section II(C)(5)(b)(2) and (3) of the Plan (see generally, pages 22-25 of the Plan) provides detailed descriptions of the docks, terminal sites and park and ride lots necessary to support the Plan, and identifies some of the environmental consequences that would likely be associated with this development.

to Seattle, will not have direct impacts on land use or the environment. Moreover, adoption of the POF Investment Plan would appear unlikely to necessitate significant changes to Kitsap County's newly adopted policy and regulatory framework (i.e., Comprehensive Plan and Zoning). Planning to provide POF service from these two locations to Seattle is broadly consistent with County policy and, in fact, facilitates implementation of the updated Comprehensive Plan.

Undoubtedly, adoption of the POF Investment Plan, and future expenditures and project-related development by Kitsap Transit to implement the Investment Plan will stimulate private real estate development decisions and attendant population growth in the South Kitsap County area. However, as earlier outlined in the discussion of the applicable provisions of the County's Comprehensive Plan (see above), this population growth and development is specifically anticipated and supported by the UGA designations, population allocations and policy direction of the new Plan.

To the extent that future provision of POF service linking Port Orchard and Southworth to Seattle serves as a catalyst for population growth and development in South Kitsap County, it will indirectly lead to general land use impacts related to new private development, including the following:

- Increased noise;
- Light and glare;
- Impacts to environmental resources;
- Changes in the aesthetic character of the area;
- Incremental development of heretofore undeveloped or underdeveloped lands within the Gorst, SKIA, ULID #6, and Port Orchard/South Kitsap UGAs; and
- Continued subdivision of land to permissible densities, as well as infill on substandard-sized legal nonconforming lots within the Rural Residential (RR 1:5) and Rural Protection (RR 1:10) zoned areas of the South County, particularly areas in relative proximity to the Southworth ferry terminal (i.e., south of the Port Orchard UGA and east of SR 16.

In sum, the provision of POF service from either or both Port Orchard and Southworth to Seattle would appear unlikely to pose more than a moderate impact upon existing land use within the South Kitsap area as a whole, and no impacts beyond those anticipated under the Comprehensive Plan. Without question, the availability of expanded POF service, in combination with comparatively low housing prices (i.e., in relation to the Seattle metropolitan area) will spur some growth in proximity to the new crossings. Because of the wider variety of housing choices and availability of other urban services and amenities, the majority of this growth and development would be expected to

that form the basis for the County's Plan are also the projections that were used by WSF to identify the ridership projections for its Draft Long-Range Strategic Plan (April 2006).

Southworth – Seattle POF Service

Consistency with Adopted County Policy

Cross-Sound POF service from Southworth is expressly consistent with the guidance provided in the CPP relative to "Transportation Hubs" located outside of UGAs. See CPP Policy C(3)(d). Moreover, such service is specifically anticipated and encouraged by the updated Kitsap County Comprehensive Plan (see policies T-58 and T-59).

Anticipated POF-Induced Growth

Although the provision of POF service from Southworth to Seattle would clearly be consistent with adopted County policy, and would not introduce a "new" use that deviates appreciably from the existing WSF ferry service to and from Southworth, it will likely result in modest levels of new rural residential development in proximity to the ferry terminal. Most of the area lying east of SR 16 and east of the Port Orchard/South Kitsap UGA is designated either Rural Residential (RR 1:5) or Rural Protection (RR 1:10). A review of the Comprehensive Plan Land Use Map (see page 11, infra), which includes a parcel layer, suggests that this area saw substantial parcel creation prior to the implementation of the GMA by Kitsap County. More specifically, the map suggests that a number of legal nonconforming lots (i.e., lots smaller than the present minimum lot size for subdivisions) may exist in this portion of the County, harboring the latent potential for infill residential development that could slowly and incrementally erode the rural residential character of the area over time.

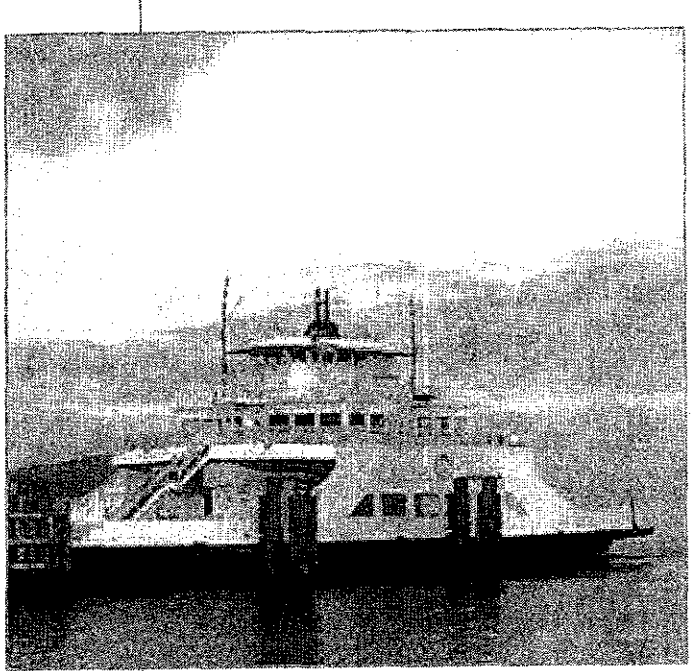
While some latent capacity for growth exists in the immediate vicinity of Southworth, its impact should not be overstated: the existing residential land use patterns and zoning in this area, along with environmental limitations to development (e.g., steep and unstable slopes, poor soils for on-site septic disposal, wetlands, etc.) will likely constrain such growth to a modest level.

When viewed on a broader geographic level, the potential effects of Southworth POF service might plausibly be viewed as serving a widely dispersed rider-ship from unincorporated rural areas all along the SR 16 corridor in South Kitsap County and extending to Gig Harbor in neighboring Pierce County. Thus, the Southworth POF service can be seen as catering to the existing and future population of rural South Kitsap County, while the Port Orchard and Bremerton POF services would be anticipated to draw more heavily from populations north

PIERCE COUNTY
Public Works & Utilities

Pierce County Public Works & Utilities
Transportation Services

WATERBORNE TRANSPORTATION STUDY



SUMMARY REPORT
October, 2003

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IBI GROUP

in association with the **Elliott Bay Design Group • Jacobs Civil**

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EXECUTIVE SUMMARY

Pierce County Public Works & Utilities – Transportation Services, provides ferry service between the Town of Steilacoom, Anderson Island and Ketron Island. Primary service is provided by the M/V Christine Anderson, a 54 car vessel. Back up service is provided by the M/V Steilacoom, a 30 car vessel that is now almost 70 years old.

The ferry system was last studied fourteen years ago in 1989. Since that time, the population of Anderson Island has increased 64%, the ferry is operating near full capacity in the a.m. and p.m. peak commuter periods, and the M/V Steilacoom has reached the end of its serviceable life. Responding to these changes, the four objectives of the Waterborne Transportation Study are to:

1. Project population changes and assess impacts on ferry service through the year 2025.
2. Identify changes to the ferry service to meet projected demands and provide efficient operations.
3. Identify opportunities to enhance customer service.
4. Achieve 80% recovery of ferry system costs from fares.

Findings from the demographic analysis and traffic projections show that the current ferry service is reaching capacity during the morning (6:00 to 9:00 a.m.) and evening (5:00 to 7:00 p.m.) peak periods, primarily due to the presence of more working families on Anderson Island. With the current schedule, two direct sailings are provided to Anderson Island, and one direct sailing to Ketron Island is provided during each of the morning and evening peak periods. For Anderson Island, this provides an effective peak period capacity of 108 vehicles with the 54 car capacity M/V Christine Anderson (2 sailings x 54 vehicles).

The study projects moderate population growth for Anderson Island, and assesses the impacts of that growth on the current ferry service. With the current schedule, the ferry service is operating close to capacity for that run during the morning and evening peak periods. Traffic projections show that by as early as 2005, more vehicle overloads will occur on the Anderson Island run as traffic demands exceed available capacity.

To accommodate changes in demographics and projected future traffic growth, the study makes four key recommendations:

1. Replace the existing direct Ketron Island runs with triangle runs that serve Steilacoom, Ketron Island, and Anderson Island. This would add a third sailing to Anderson Island during each of the morning and evening peak periods, providing an effective peak period capacity of 162 vehicles (3 sailings x 54 vehicles) and meeting projected demands through 2025. It is also recommended that overlength vehicles be prohibited from peak period runs to maximize available vehicle capacity.
2. Add a 7:30 p.m. weekday Steilacoom-Anderson Island sailing (the last sailing is currently at 6:00 p.m.). This would provide greater convenience for commuters living on the Island, residents who are shopping or conducting other activities on the mainland, and students who wish to participate in after-school activities.
3. Replace the M/V Steilacoom with a new 54 car vessel similar to the M/V Christine Anderson. This would maintain route capacity when the M/V Christine Anderson is in dry-dock, extend periods between major overhauls by regularly alternating service between the two vessels, and keep both vessels in good running condition by using them regularly. In addition, there is the opportunity to

operate both vessels during very high demand periods (e.g., holiday weekends), doubling route capacity.

4. Update the current fare pricing structure so that all fare categories are based on algorithmic relationships between fare types, and update fares on a regular two year cycle. This provides the County with a consistent, structured approach for computing fare prices.

Costs associated with these improvements are estimated, and financial cost recovery profiles generated. A recommendation is made to move towards recovery of 80% of annual ferry system costs from fares (currently about 65% of costs are recovered from fares). Achieving an 80% recovery of costs from fares would allow the County to provide enhanced service and fund future vessel repair or replacement.

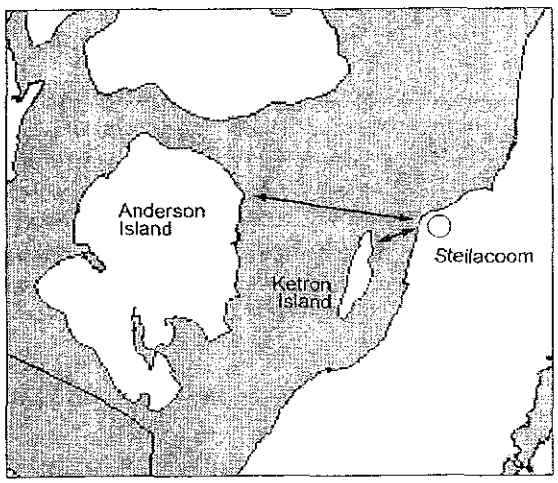
An example long term pricing table is presented that would gradually move the County to 80% cost recovery from fares by the year 2016.Cost recovery should be enhanced by retaining interest in the ferry fund to offset costs and fund future vessel and terminal improvements..

The study also identifies potential near term improvements in ferry facilities, ticketing and public information. For each potential improvement, costs are identified along with the potential impacts on fares.

1. INTRODUCTION

Pierce County Public Works & Utilities – Transportation Services, provides ferry service between the Town of Steilacoom, Anderson Island and Ketron Island as illustrated in Exhibit 1. Primary service is provided by the M/V Christine Anderson, a 54 car vessel. Back up service is provided by the M/V Steilacoom, a 30 car vessel that is now almost 70 years old.

Exhibit 1
Current Ferry System Routes



The ferry system is the lifeline for Island residents. Privately owned companies and private parties provided ferry services from the early 1900's until 1937 for Anderson Island, and until 1962 for Ketron Island. After that the County assumed responsibility for the service, contracting out the operations of the ferry system and Steilacoom dock.

The ferry system was last analyzed fourteen years ago by the 1989 Waterborne Transportation Study. Since that time, the population of Anderson Island has continued to grow and change, ferry demands have increased, and the M/V Steilacoom has reached the end of its serviceable life. Responding to these changes, Pierce County commissioned IBI Group, Jacobs Civil, and the Elliott Bay Design Group to conduct a new Waterborne Transportation Study.

Findings and recommendations from the Waterborne Transportation Study are summarized in this report and described in detail in a series of Technical Memoranda[1] that include:

- *System Demographics*: Analyzes current demographics, rider statistics, customer feedback and projections for future ferry usage.
- *Sensitivity Analysis*: Tests selected key findings in terms of sensitivity to future changes and uncertainty.
- *Propulsion System*: Analyzes the existing propulsion system of the ferry M/V Christine Anderson.
- *Fuel Configuration*: Explores the cost effectiveness, environmental benefits and technical feasibility of utilizing a diesel/natural gas fuel system.
- *System Security*: Provides a confidential assessment of current terminal and vessel security issues. This information will be used as input to the development of a ferry system security plan in early 2004.
- *Public Information*: Identifies potential improvements for dissemination of information to the public.

[1] *Waterborne Transportation Study Technical Memoranda*, October, 2003

2. PUBLIC CONSULTATION PROCESS

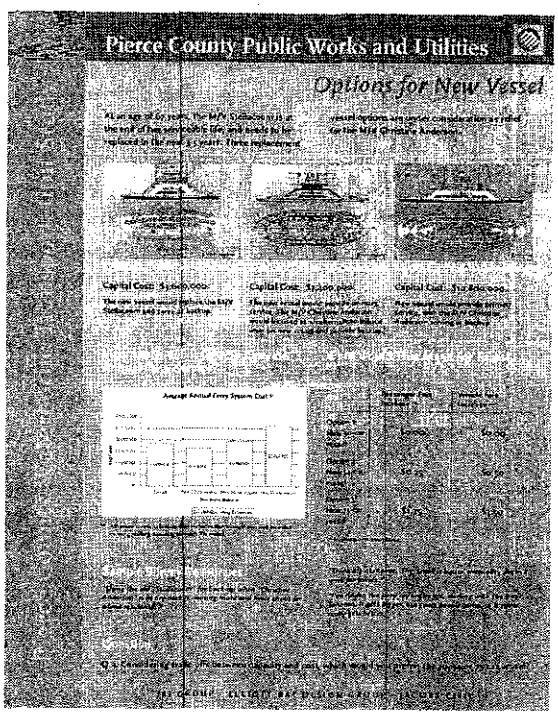
Integral to the study was a comprehensive public consultation process that included:

1. An on-board survey of ferry riders was conducted over four days in late August/early September 2002. The survey was designed to identify ferry rider needs and preferences, and included general demographic, trip behavior and service improvement questions, as well as general comments about the service. Eleven hundred and twenty-three surveys were completed by ferry riders.

2. The results of the on-board survey were supplemented with a property owners survey conducted in October, 2002. Approximately 3,000 surveys were mailed; about 950 completed surveys were returned.

3. A public open house conducted on Anderson Island in February, 2003, mid-way through the study. At the open house, initial options were presented for service and routing changes, ticketing improvements, new vessel procurement, and public information improvements as illustrated in the example presentation board in Exhibit 2. Approximately 250 Island residents and property owners attended the open house, and provided comments on the options presented.

Exhibit 2
Example Open House Presentation Board



Information from the surveys was used to help develop an initial set of proposed ferry system improvements and options. Information from the open house was used to help refine those options and develop a recommended list of improvements.

3. CURRENT ISLAND DEMOGRAPHICS

The demand for ferry service is driven by the demographic makeup of the Islands and associated travel needs. Comparison of US Census data showed that the Anderson Island population grew at a rate of about 5% per year over the period 1990 to 2000, rising from a population of 548 to 900 (an increase of about 64%) by 2000. Ketron Island currently only has a population of 18 people. The impacts of any changes in Ketron Island population on ferry service would be negligible.

As illustrated in Exhibits 3 and 4, the most significant demographic change from 1990 to 2000 was the relative increase in primary householders in the 45 to 64 year old range. Along with this has been a drop in the median age from 58 years old to 52. The number of households on Anderson Island also increased from 1990 to 2000, growing from 517 to 720 (total growth of about 39%). The most significant change was in the number of occupied (as opposed to vacant and seasonal homes) households. These grew from 245 in 1990 to 421 by 2000; an increase of 72%.

Exhibit 3
Age Classification of Primary Householder: 1990 Census (Anderson Island)

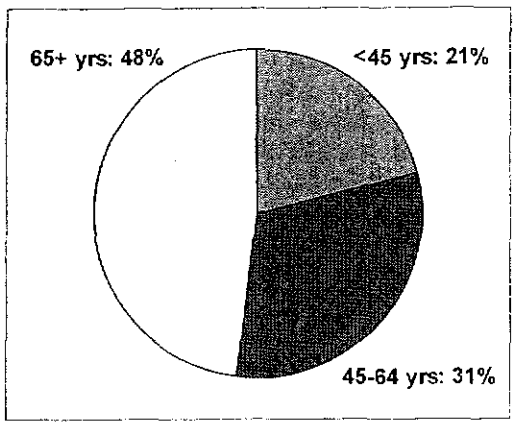
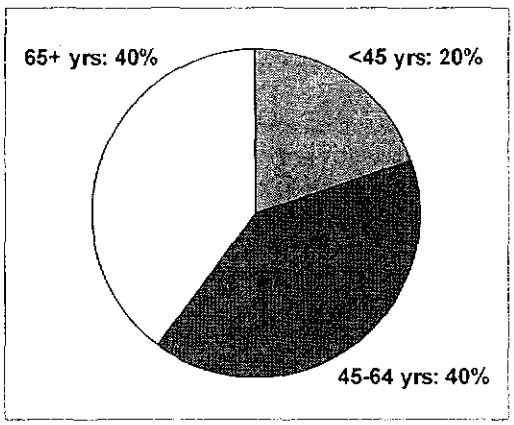


Exhibit 4
Age Classification of Primary Householder: 2000 Census (Anderson Island)



The change in number of occupied households, coupled with the increase in the 45-64 year old age demographic, signifies an increasing proportion of working families on the island. This further suggests that the primary impacts on ferry traffic are during the morning (6:00 – 9:00 a.m.) and evening (5:00 – 7:00 p.m.) peak periods as more residents are traveling to/from work and school.

4. PROJECTED POPULATION AND FERRY TRAFFIC GROWTH

Using historical information and current demographics, low, moderate and high population increase scenarios for Anderson Island through 2025 are:

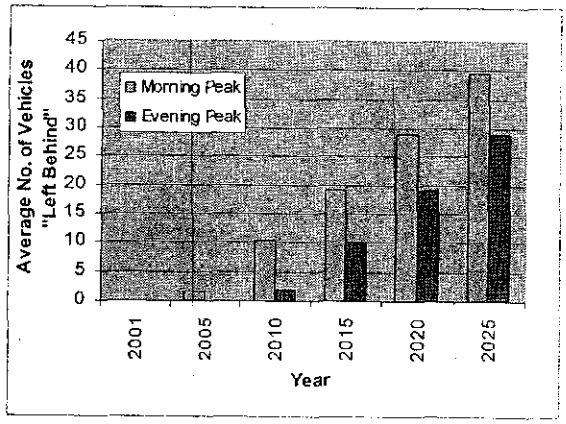
- *Low:* 2%/yr population increase through 2005, 1%/yr population increase from 2006-2015, and no growth thereafter.
- *Moderate*: 2.5%/yr population increase through 2005, 1.5%/yr population increase thereafter through 2025.
- *High*: 5%/yr population increase through 2010, dropping to 2%/yr increase thereafter.

A review of development constraints on Anderson Island[2], limitations of the current water and septic systems, and current economic conditions in the Puget Sound area, suggested that the most likely growth scenario would lie in between the low and high estimates. This scenario, classified as "moderate growth", projects a 2.5%/yr increase in Anderson Island population through 2005, transitioning to 1.5%/yr thereafter through 2025.

[2] Outside of the Riviera Community, R10 zoning requires a 10 acre minimum lot size. For septic and water purposes, the Pierce County Health Department recommends a minimum 1 acre lot size.

Using the moderate growth scenario, projections were made of future ferry system traffic demands through 2025, focusing in particular on impacts on ferry traffic during the morning and evening peak periods. During each of these periods, the M/V Christine Anderson provides a peak period route capacity of up to 108 vehicles (two sailings per peak period, 54 vehicles per sailing).

Exhibit 5
Projected Weekday Peak Period Overloads



An analysis of current traffic conditions showed that sailings during the morning and evening peak periods are now at or near vehicle capacity, particularly morning sailings from Anderson Island. Given the current schedule, overload conditions (where vehicles have to wait a sailing) during these periods are expected to occur with increasing frequency as illustrated in Exhibit 5. The number of vehicles that are "left behind" during the morning or evening peak periods are projected to grow from a few in 2005, to as many as 40 by 2025.

5. PROPOSED NEAR TERM SERVICE CHANGES

To accommodate projected vehicle demands, near term service changes were identified that would provide additional capacity during the weekday morning and evening peak periods. These include:

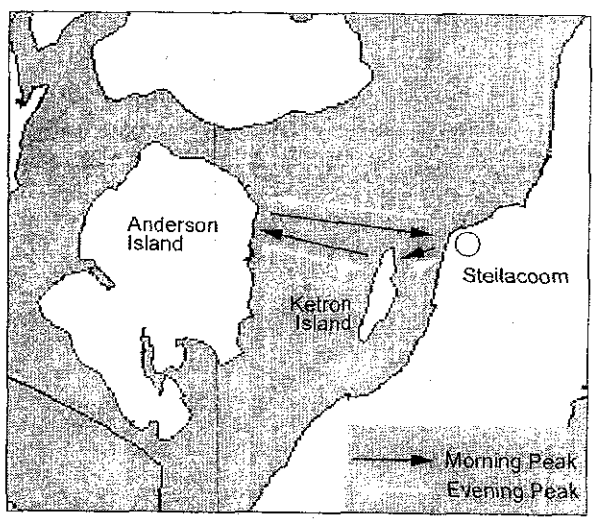
1. Replace existing direct Ketron Island runs with new triangle runs between Steilacoom, Anderson Island, and Ketron Island as illustrated in Exhibit 6. This adds a third sailing to Anderson Island during each of the morning and evening peak periods.

   The addition of a third sailing to Anderson Island increases the peak period capacity from the current 108 vehicles to 162 vehicles. Based on traffic projections, this provides sufficient capacity to meet peak period demands through 2025.

2. Add a 7:30 p.m. Monday-Thursday Anderson Island sailing (currently the last sailing departs at 6:00 p.m.). In the surveys and open house, customers indicated a strong preference for this run, noting that it better fits work schedules, allows additional time for students to participate in after school activities, and relieves concern over missing the last sailing.

3. Restrict overlength (over 40') vehicles to non-peak sailings. This increases the vehicle capacity of the vessel during peak periods, improves overall customer satisfaction, and reduces conflicts between overlength vehicle operators and other customers.

Exhibit 6
Proposed Triangle Runs
(Replacing Direct Ketron Island Runs)



An example near term revised sailing schedule is illustrated in Exhibit 7. The schedule replaces the existing 7:00 a.m., 11:00 a.m., and 4:20 p.m. direct sailings to Ketron Island with triangle runs. It also adds a 7:30 p.m. Monday-Thursday sailing to Anderson Island.

For Ketron Island, the last weekday and weekend sailings are shifted from 4:20 p.m. and 8:00 p.m., to 6:10 p.m. and 10:00 p.m. respectively. This will allow Ketron Island residents extra time to catch the ferry in the evening.

Exhibit 7
Example Near Term Sailing Schedule

	Leave Steilacoom	Leave Ketron	Leave Anderson
Mon-Fri Only	5:55 a.m.		6:30 a.m.
Every Day (1)	7:00 a.m.	7:20 a.m.	7:50 a.m.
Every Day	8:20 a.m.		8:50 a.m.
Every Day	9:20 a.m.		9:50 a.m.
	Break (20 min)		
Every Day (1)	10:40 a.m.	11:00 a.m.	11:30 a.m.
Every Day (2)	12:00 noon		12:30 p.m.
	Maintenance (70 min)		
Every Day	2:10 p.m.		2:40 p.m.
Every Day	3:10 p.m.		3:40 p.m.
Every Day	4:10 p.m.		4:40 p.m.
Every Day	5:10 p.m.		5:40 p.m.
Every Day (1)	6:10 p.m.	7:10 p.m.	6:40 p.m.
Every Day	7:30 p.m.		8:00 p.m.
	Break (15 min)		
Fri-Sat-Sun Only	8:45 p.m.		9:20 p.m.
Fri-Sat-Sun Only (1)	10:00 p.m.	11:00 p.m.	10:30 p.m.

(1) Triangle run
(2) Sailing canceled 1st and 3rd Wednesdays of the month to deliver fuel to the Islands

6. FUEL AND PROPULSION SYSTEM ANALYSIS

Three aspects of the M/V Christine Anderson were analyzed to determine if significant cost, operational or other benefits could be realized through upgrades or changes:

- *Fuel System:* The feasibility of converting the M/V Christine Anderson natural gas/diesel dual fuel was analyzed to determine if significant cost or other benefits could be realized. An economic analysis determined that it is not feasible at this time, primarily because of the costs to construct shore-side natural gas storage facilities at Steilacoom and the necessary ship modification.

- *Propulsion System:* The M/V Christine Anderson's propulsion system was reviewed to determine if benefits would be realized from retrofitting the vessel with a new controllable itch propeller system to improve vessel maneuverability and route speed. Although installation of controllable pitch propellers could improve the vessel's response in an emergency stop, overall travel time between Steilacoom and the Islands would remain unchanged due to the direct nature and short distance of the runs. The estimated cost to retrofit the M/V Christine Anderson is approximately $600,000.

- *Control System:* The existing pneumatic propulsion control system was reviewed to determine if installation of an electronic control system would increase the system reliability. Retrofitting the M/V Christine Anderson with electronic controls could increase the system reliability. The estimated cost is $115,000.

7. VESSEL REPLACEMENT OPTIONS

One of the primary objectives of the study was to identify options for replacement of the M/V Steilacoom which is at the end of its serviceable life. Five alternative options were considered, including:

1. Procure a new 30 car ferry to provide a direct replacement for the M/V Steilacoom.
2. Procure a new 54 car ferry to provide greater capacity than the M/V Steilacoom. This vessel would alternate with the M/V Christine Anderson to provide constant capacity all year.
3. Procure a new 75-car ferry to provide greater capacity than the M/V Steilacoom. This would serve as the primary vessel with the M/V Christine Anderson acting as backup.

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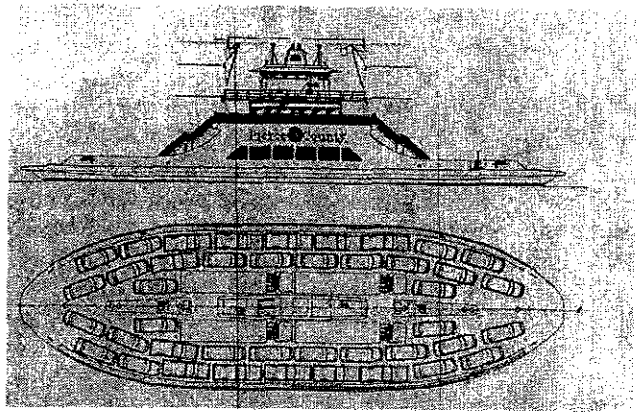
4. Provide a passenger-only ferry during maintenance of the M/V Christine Anderson. No vehicle service would be available for up to four weeks a year.
5. Provide a leased vehicle ferry during maintenance of the M/V Christine Anderson.

Exhibit 8
New 54 Car Vessel



A screening process was used to evaluate the different vessel replacement options and concluded that:

- Traffic levels have risen to the point where a 30 car vessel cannot provide sufficient back-up capacity.
- The availability of a leased vessel is uncertain, particularly during unplanned service disruptions.
- A passenger-only ferry would not be able to meet vehicle demands.
- A new 54 car vessel, operating under the service schedule identified in Exhibit 3, provides sufficient capacity to meet projected traffic demands through 2025. A 75 car vessel would provide excess capacity, would have higher operating costs, and would be significantly underutilized during low demand periods.
- A new 54 car vessel could alternate service with the M/V Christine Anderson, providing a constant level of capacity. This would extend the time period between major overhauls, provides more flexible dry-docking options, keeps both vessels in good running condition by having both used on a regular basis, and provides an option of operating both vessels in parallel during very high demand periods (e.g., holiday weekends).

Recommendations are to procure a new 54 car vessel as illustrated in Exhibit 8. This provides the most flexible service option and should accommodate projected demands through 2025.

8. FUTURE FARE CHANGES

In order to help finance proposed service changes, procure a new vessel to replace the M/V Steilacoom, and achieve fare recovery goals, a future fare pricing model was developed based on algorithms or relationships among fare attributes. Attributes include passenger/vehicle classification (e.g., vehicle type, single fare, commuter) and customer type (e.g., adult, senior/disabled, youth, child).

This model provides Pierce County with a consistent, structured approach for computing fare prices. It is based on implementing fare changes on a regular two year cycle, and adjusting fares over time to recover 80% of costs from fares (similar to State goals for the Washington State Ferry system). The model also includes pricing passenger fares in multiples of $0.10 and vehicle fares in multiples of $0.25.

Exhibit 9 summarizes the proposed fare structure for 2004-2005 based on the model. Attributes of this structure include:

- All prices are based on algorithmic relationships with two baseline fare categories: single adult fare and single vehicle-driver off-season fare (September-May).
- Summer peak season (June-August) vehicle fares are based on 120% of the off-season fare per current practice.
- Commuter fares are priced at 80% of the baseline fares.
- Senior/disabled, youth and motorcycle fares are priced as a percentage of corresponding peak season or off-season single fare adult fares.

Exhibit 9
Proposed 2004-2005 Fare Structure

	Current		2004-2005	
	Off Season	Peak Season	Off Season	Peak Season
Passengers				
Adults	$ 3.30	$ 3.30	$ 3.80	$ 3.80
Commuters (5 trips)	$ 2.10	$ 2.10	$ 3.00	$ 3.00
Child	$ -	$ -	$ -	$ -
Senior	$ 1.65	$ 1.65	$ 1.90	$ 1.90
Youth 5-18	$ 2.00	$ 2.00	$ 2.30	$ 2.30
Automobiles				
Auto w/driver	$ 11.50	$ 13.80	$ 12.50	$ 15.00
Auto w/Senior driver	$ 9.20	$ 11.00	$ 10.00	$ 12.00
Auto w/Comm. driver	$ 9.20	$ 9.20	$ 10.00	$ 10.00
Motorcycles				
Motorcycle Single	$ 6.00	$ 7.20	$ 7.50	$ 9.00
Motorcycle Commuter	$ 3.60	$ 3.60	$ 6.00	$ 6.00
Overlength Vehicles				
Under 20'	$ 11.50	$ 13.80	$ 12.50	$ 15.00
20'-30'	$ 20.50	$ 24.60	$ 22.50	$ 27.00
30'-40'	$ 30.25	$ 36.30	$ 33.25	$ 40.00
40'-50'	$ 40.00	$ 48.00	$ 45.00	$ 54.00
50'-60'	$ 50.00	$ 60.00	$ 57.75	$ 69.25
60'-70'	$ 60.00	$ 72.00	$ 71.50	$ 85.75
70'-80'	$ 70.00	$ 84.00	$ 86.25	$ 103.50
80' +	$ 80.00	$ 96.00	$ 102.00	$ 122.50

Overlength vehicle fares are computed on a per-foot basis for the mid-range of the category. To account for excess weight and deck utilization impacts of very large vehicles, pricing is based on a sliding scale of higher per foot prices for longer vehicles.

9. PROJECTED COSTS AND REVENUES

The study projected future ferry system costs and revenues through 2025 based on implementation of the proposed service changes and procurement of a new 54 car vessel.

Exhibit 10
Projected Costs and Revenues

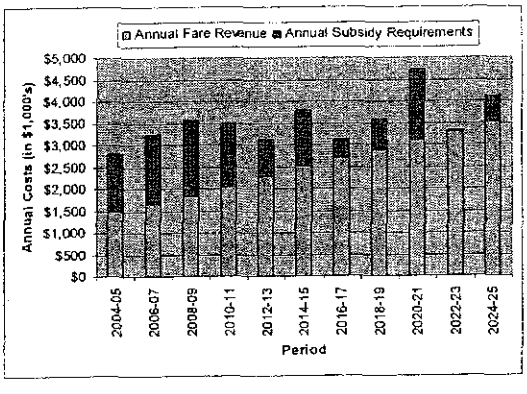


Exhibit 11
Projected Fare Recovery

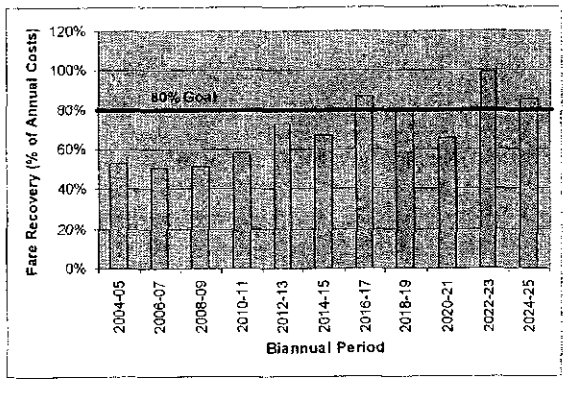


Exhibit 10 summarizes the projected fare revenue and the County or other subsidy requirements. Projections are based on implementing 8% fare increases every two year cycle through 2016, reducing to

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4% every two years thereafter. As illustrated in Exhibit 11, this would allow the County to gradually move towards recovery of 80% of annual ferry system costs by 2016.

The cost and revenue profile shown in Exhibit 10 includes vessel and terminal depreciation costs. They are used to fund future vessel procurements and terminal capital improvements. Interest from the fund assets is currently diverted for other purposes by the County. If interest were retained, it will be used for the County ferry system. Allocating depreciation costs for a new 54 car vessel alone would generate annual interest ranging from approximately $20,000/yr in 2005, to as much as $300,000/yr by 2025[3].

10. OTHER NEAR TERM IMPROVEMENTS

The study identified facility, ticketing, and public information improvements. Exhibit 12 summarizes potential near term improvements that should be considered. In each case, the potential impacts on fares are identified.

Exhibit 12
Potential Near Term Improvements

Improvement	Capital Cost	Amount to be Recovered through Fares[4]	Potential Impact on Fares	
			Passenger	Auto/Driver
Facility Improvements[5]				
Anderson Island pontoon replacement	$280k[6]	$12,000/yr	Negligible	$0.15
Anderson Island dolphin replacement	$0.6 Million	$25,300/yr	$0.05	$0.25
Second ferry slip – Steilacoom landing	$4.0 Million	$168,500/yr	$0.30	$1.50
Steilacoom waiting facility paint and re-roof	$30k	$1,300/yr	Negligible	Negligible
Ticketing Improvements				
Provide ticket sales at a retail location on Anderson Island	$40k+$13k/yr O&M	$14,000/yr	Negligible	$0.15
Provide online sales of tickets through the Internet	$12k/yr O&M	$10,000/yr	Negligible	$0.11
Participate in the Regional Smart Card Program	$40k+$4k/yr O&M	$11,000/yr	Negligible	$0.12

[3] $8.6 million vessel capital cost depreciated over 20 years. Interest retained in the fund and compounded.
[4] This reflects amortization of 80% of the identified capital costs over a 20-year period at 0.5% interest.
[5] Many of these are already funded and programmed by Pierce County.
[6] Total cost of the pontoon replacement is $1.4 million, however the County has secured grant funding such that only $280k needs to be funded locally.

Exhibit 12 Continued
Potential Near Term Improvements

Improvement	Capital Cost	Amount to be Recovered through Fares	Potential Impact on Fares	
			Passenger	Auto/Driver
Public Information Improvements				
Update and improve information pamphlets	$1k	Negligible	Negligible	Negligible
Add parking, transit and other information to ferry system website	$25k	$2,000/yr	Negligible	$0.02
Install a "web camera" providing images of the Steilacoom holding area over the Internet	$100k+$2k/yr O&M	$10,000/yr	Negligible	$0.11
Develop an information dissemination procedures manual	$15k	$1,000/yr	Negligible	$0.01
Provide automated email notification of service disruptions	$1k+$4k/yr O&M	$3,000/yr	Negligible	$0.03
Add parking and other information to the automated telephone system	$1k+$4k/yr O&M	$3,000/yr	Negligible	$0.03

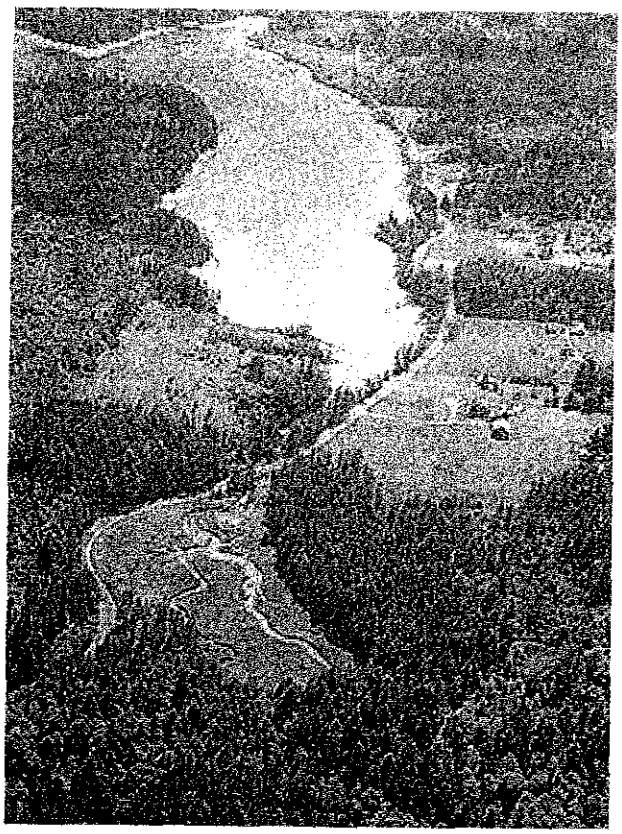
11. CONCLUSIONS AND RECOMMENDATIONS

Conclusions and recommendations from the Waterborne Transportation Study include:

1. Implement the proposed triangle runs, and add a later (7:30 p.m.) Monday-Thursday evening sailing to Anderson Island.
2. Implement proposed fare changes starting in 2004. Update thereafter in two-year cycles with a goal of moving towards 80% fare recovery by 2016.
3. Begin procurement of a new 54 car vessel to replace the M/V Steilacoom.
4. Implement overlength vehicle restrictions on morning and evening peak period sailings to provide additional auto capacity.
5. Retain the interest income generated by the ferry service.
6. Consider implementation of near term facility, ticketing and public information improvements, as they can be programmed into capital or other improvement projects and funding.
7. Consider retrofitting the M/V Christine Anderson with an electronic control system.

The Anderson Island Effect

In January 2004, Pierce County extended the operating hours of the ferry Christine Anderson *to Anderson Island. Liz Galentine {Anderson Island Citizens Advisory Committee} states: "There was one public meeting held, no vote, but a survey was conducted. What we have observed is many times issues/meetings have occurred and the island learns of them afterwards." Liz Galentine and Debbie Lowe describe how Anderson Island has been effected by the three additional runs per day.*



Oro Bay, Anderson Island

No one lives on an island by accident or happenstance. It is a deliberate choice. No one chooses to move to an Island for reasons such as proximity to workplace or access to entertainment options such as restaurants, theater, nightlife, etc. Although these reasons are often the basis for relocation to particular cities or communities, they are certainly not applicable to the decision to relocate to an island. The vast majority of islanders choose their island homes in an effort to leave behind the hectic lifestyle found in highly populated areas. They generally seek to escape traffic, air and noise pollution, people congestion in public places, and increasing crime. Once they have adopted the island lifestyle, they often mention the strong feeling of community and connectedness they have found on the island.

Having lived on Anderson Island for the past 7 years, I've never before witnessed such a dramatic change in the island as I have during the past year when Pierce County added a later ferry run on weekdays. Just three additional run per day has substantially affected our small island. I am not an opponent nor a proponent of additional ferry runs. It is important however, to recognize that any change in the accessibility to the island, will definitely bring change to the general flavor of the island. On the positive side, increased accessibility strongly impacts real estate values and sales, and brings a more diverse group of new residents to the community, some of whom might offer significant contributions to the welfare and development of the island.

On the other side of the coin, increased accessibility often

promotes increases in criminal activities, in particular property crimes and illegal drug operations. The inevitable increase in housing construction results in loss of green spaces and natural areas for enjoyment. On a more serious note, is the effect the increase in population has on the island's aquifer. We, as island residents, must realize that in most cases we do not possess an unlimited source of water, and should remain cognizant of the need to protect our supply.

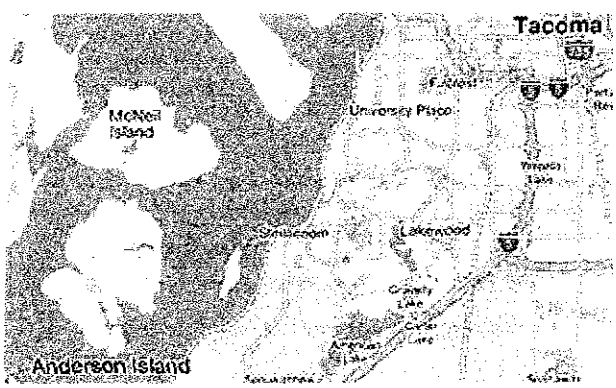
I've never before witnessed such a dramatic change in the island as I have during the past year when Pierce County added a later ferry run on weekdays.

200 Riviera Community Club lots purchased by a single California based land broker that markets via TV info-commercials in California and Arizona.

One of the most noticeable effects will be readily observed in the decreased accessibility to the ferry, due to the surge in the number of vehicles. Greater patience and planning will be primary requirements, and it will be just a matter of time before the need for a larger ferry will be too great to ignore. As with all matters on an island, there are always multiple opinions, usually strongly held and expressed. Regardless of which side of the issue you may find yourself, the most important factor is to maintain a realistic outlook. Denial will result in lack of adequate preparation and will promote a less than effective response to the inevitable changes to the community. It is very simple....increased accessibility to the island will most certainly generate radical change to your island. For better or worse, depending on your viewpoint.

- Debbie Lowe

Chair, Anderson Island Citizens' Advisory Board
Past-President, Anderson Island Association



Anderson Island

Southern most island in the Puget Sound, south of Tacoma. 800-900 year-round residents. More than 2,500 during the summer months with seasonal and weekenders.

Notable changes following extention of the ferry schedule:

Objective Changes:

Real estate boomlet:

Home sales have increased greater than 20 percent

Property values have increased

Many properties have changed owners in the past year

New Construction has risen

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Golf course, two marinas, two fresh water lakes (with bass and trout), tennis courts, parks, a two room schoolhouse (K - 5), five churches, and numerous bed and breakfasts.

Car and driver cash fare is $12.50/$15 peak season. Adult walk-on fare is $3.80.

Originally called Settlers' Island and to some, Wallace Island (after Leander Wallace, who was shot in a ruckus at Fort Steilacoom). Given a warm reception and assistance by Mr. Anderson and Captain McNeil at Fort Nisqually, Commander Wilkes of the U.S. Expedition renamed the two nearby islands. Anderson's first industry was the sale of cordwood to the wood-burning steamers.

and the cost per square foot has risen

200 Riviera Community Club lots purchased by a single California based land broker that markets via TV info-commercials in California and Arizona

Island is now suitable for close-in commuter (bedroom community)

Population has increased

Population shift - younger with families vs. retirees

More full-time residents as opposed to summer residents (snow birds)

More medical calls for the volunteer fire department

Subjective Changes:

More traffic

More noise

More visitors checking out the island

Increased traffic at the General Store

People wanting changes to make it more like the mainland. For example: the only island restaurant now has a "pizza night"

Easier access to island amenities by off islanders

Lakes and private campground

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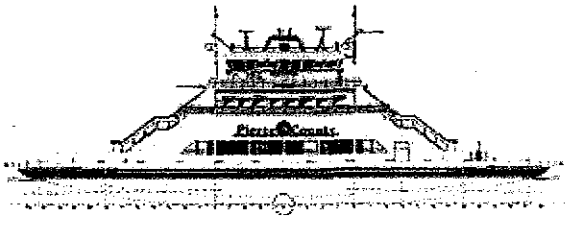
2003 Pierce County Ferry Study [792k PDF]

Anderson Island Ferry Web Site



Completion of a new Anderson Island ferry, Steilacoom II, is expected in September 2006.

The 54-car, 300-passenger ferry vessel will cost $11,200,000.

Public swimming area - increased traffic with alcoholic beverages which are not allowed, but no law available to enforce

Noise and safety issues on the lakes

More hunters on the island (all property is private)

A disregard for maintaining the "quiet" island life

The objective changes we can provide hard data to support, and the subjective are observations. The AICAB is appointed by the Pierce County Executive, and approved by the Pierce County Council. The AICAB was formed in September 2004 and meets quarterly. This board was formed so Anderson Island would have one voice to the County for issues affecting the island. According to our by-laws:

> "The purpose of the AICAB is to facilitate a structured two-way communication process between the County and Island residents, property owners, and business owners regarding significant issues affecting the community within Pierce County's jurisdiction. Issues include, but are not limited to, land use, environmental regulations, infrastructure, schools, ferry service, and public safety."

[6.26.5]

The AICAB is currently addressing the issue of safety on Lake Florence. We had a near fatality of 10 year old on a jet ski last summer. Since we have no available law enforcement, we are taking numerous steps to address safety and will make recommendations to the

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(DRAFT)

Washington Transportation Plan Update

Sharing What We've Learned

Charlie Howard
Director
Strategic Planning & Programming

Amy Arnis
Deputy Director
Strategic Planning & Programming

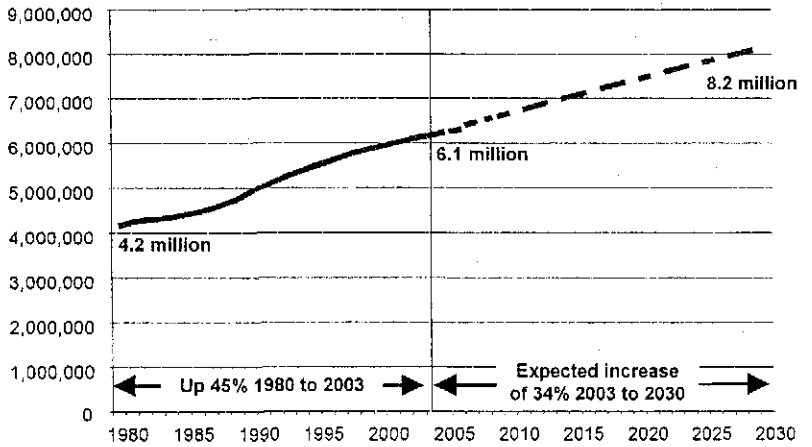
This presentation is a public record document. It is a draft and will be revised as needed. 3rd Edition last revised 10/21/2004.

October 19, 2004

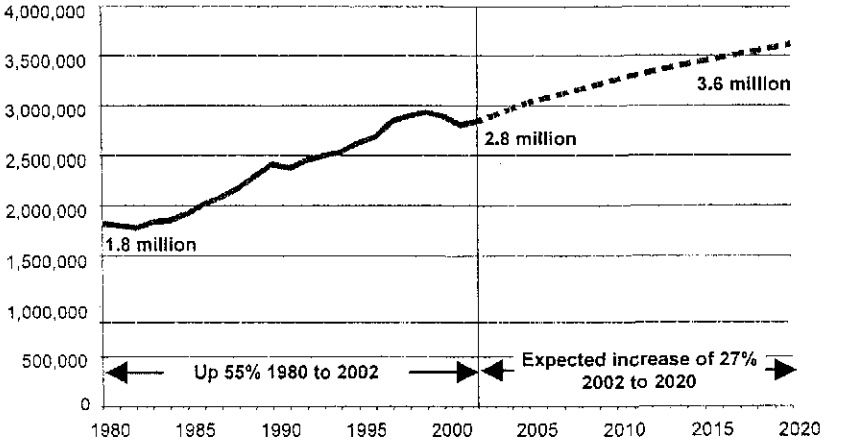
Washington State Department of Transportation

Demand is up…

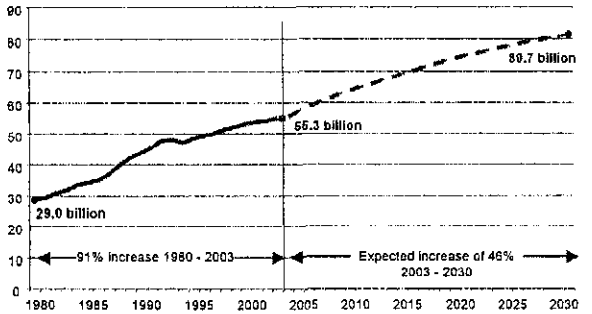
Population Will Continue to Grow



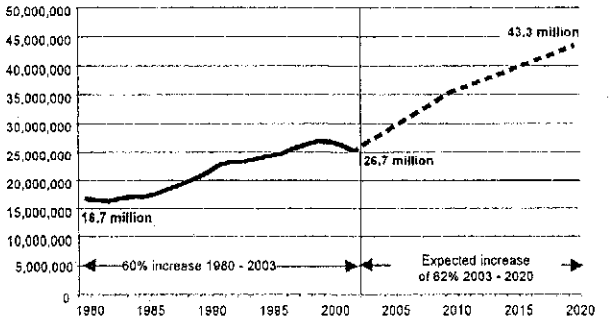
Employment Will Continue to Grow



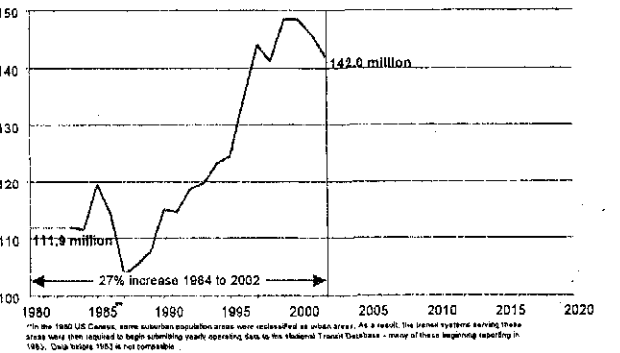
Vehicle Miles Traveled Will Continue to Grow (Miles in billions)



Ferry Ridership Will Continue to Grow



Transit Ridership Will Continue to Grow
(Fixed Urban Passenger Trips displayed)



Beauty, prosperity and growth

Most of us feel privileged to live in the Puget Sound region. Surrounded by soaring snow-capped peaks, defined by rich river valleys, and filled with islands, rocky beaches and picture-postcard bays and inlets, Puget Sound is a cornerstone of our regional identity, providing recreational, environmental and economic benefits.

The Puget Sound basin is home to a spectacular array of life—200 species of fish, 26 kinds of marine mammals, 100 species of sea birds and thousands of invertebrate species such as clams, oysters and shrimp.

Four million of us make our home here, relying on a healthy Puget Sound ecosystem to supply us with water, food and places to live.

Puget Sound is also at the heart of our state's prosperity. Together, the ports of Seattle and Tacoma are number two in the nation for container traffic. We are a world center for software development and information technology.

But the value of a beautiful, diverse and thriving Puget Sound cannot be measured solely in dollars and cents. This living landscape, with its beauty and bounty that sustain us, is a priceless legacy we inherited from our parents, and it is up to us to pass on this treasure to our children and grandchildren.

PHOTO: (opposite page) Sailboat rounding the south end of Vashon Island. | Rae A. McNally

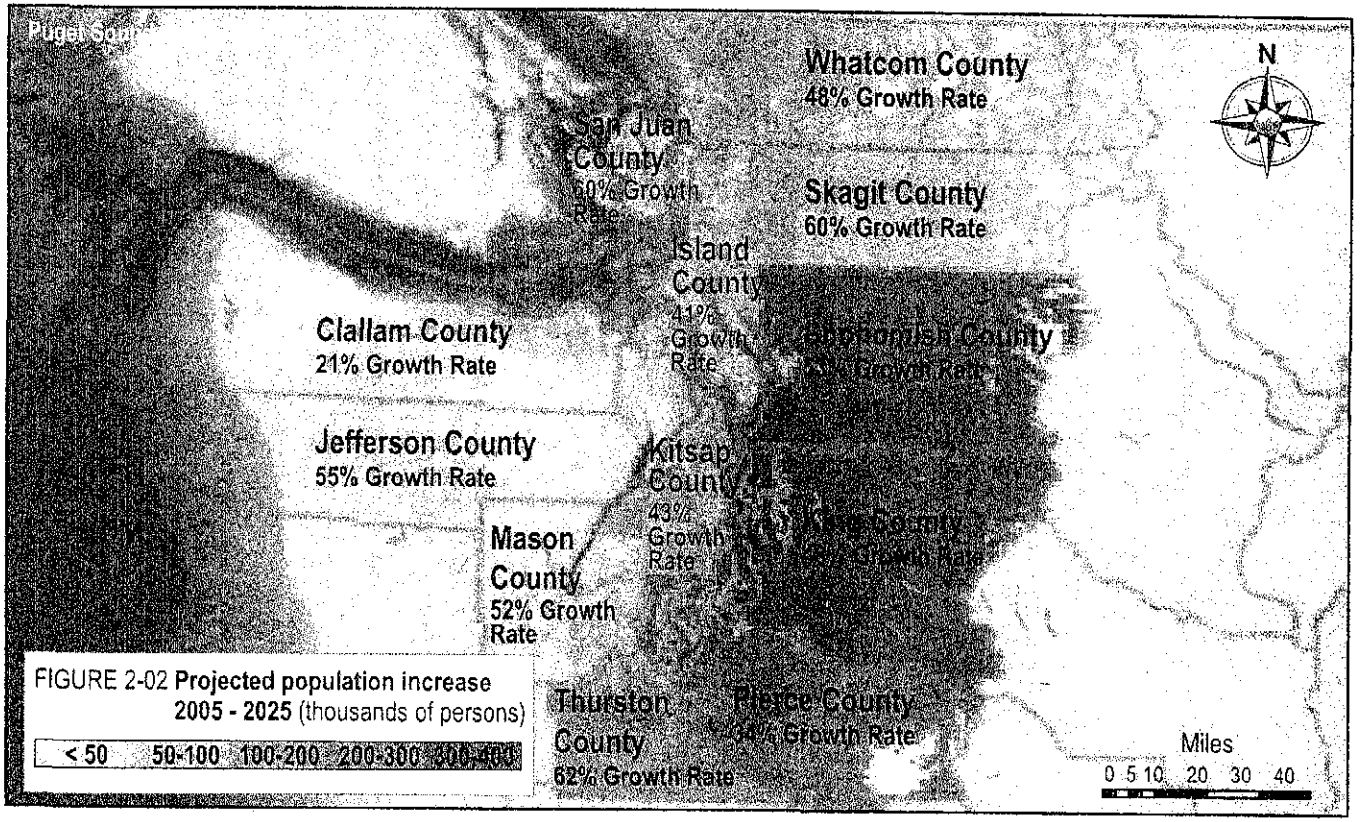


FIGURE 2-02 **Projected population increase 2005 - 2025** (thousands of persons)

Projected growth a continuing concern

The Puget Sound basin includes five of the top 10 fastest-growing counties in the state.

Between 2000 and 2006, Puget Sound counties added 315,965 people, a rate of more than 50,000 people per year.

This rapidly increasing population places significant stress on our natural environment, adding more pavement, more waste, more demands on resources such as fresh water and more destruction of critical habitats.

The projected growth in the region is a continuing concern (**Figure 2-02**). As many as 1.4 million new residents are expected to move into the region by 2025. Under the state's Growth Management Act, local cities and counties must plan for population growth over a projected 20-year period. *SOURCE: Action Team; State of Washington Office of Financial Management (OFM).*

PHOTO: Lime Kiln Lighthouse on San Juan Island. | Shutterstock.com/David Gaylor

Snohomish County Housing Sales Market

The *Growth Monitoring Report* typically includes Snohomish County housing sales price information and affordability analysis based on a database of housing sales from the past year. Creation of the annual sales database relies on access to County Assessor's information. Unfortunately, this information was not available to us in time for publication this year due to the recent implementation of a new Assessor's computer system and associated transition problems. The 1999 housing sales database will be compiled when the necessary information becomes available.

Instead this year, we are including housing sales statistics reported by the Northwest Multiple Listing Service (NWMLS) to provide an indication of housing market trends. NWMLS statistics are not comparable to figures derived from our housing sales database and contained in past *Growth Monitoring Reports.* The principal difference between the data sources is that NWMLS does not include owner sold homes. 1998 median single family home and condo sales price reported in the 1999 *Growth Monitoring Report* ($166,000) was 1.8% lower than 1998 median sales price reported by NWMLS ($168,950).

1999 Housing Sales Price Information

Table 22. 1999 Closed Housing Sales-Snohomish County[1]

Type of Property Sold	Median Sales Price	Average Sales Price	Total No. of Sales
Single family homes and condos	$178,950	$199,437	11,249
Single family homes only	$184,990	$208,495	9,688
Condominiums only	$135,000	$143,221	1,561

According to NWMLS data, 86% of 1999 housing sales in the County involved single family homes. The median price of a single family home sold in 1999 was 37% higher than the median price of a condominium.

Table 23. Snohomish County Median Sales Prices Over Time-Single Family Homes Only[2]

Year	Median Sales Price Reported in GMR	NWMLS Median Sales Price	Annual % Increase	No. of Sales
1999	NA	$184,950*	6.0%	9,649*
1998	$174,900	$174,500	7.7%	9,966
1997	$160,000	$162,000	8.0%	8,964
1996	$150,000	$150,000	1.0%	7,767
1995	$147,000	$148,500	NA	5,981

*Median single family sales price (based on NWMLS Area Market Survey) is slightly different from price reported in Table 22 above (based on NWMLS online search).

[1] Northwest Multiple Listing Service, *1999 Statistical Review and Highlights*, p. 9.
[2] Northwest Multiple Listing Service, *1999 Statistical Review and Highlights*, p. 19.

NWMLS single family home median sales prices increased by 8.0% from a year earlier in 1997. Annual price increase has been slowing since that time. Snohomish County median sales price of single family homes has increased 25% since 1995.

Table 24. Regional 1999 Median Sales Prices-Single Family Homes and Condos[3]

County	Median Sales Price	No. of Sales
Snohomish	$178,950	11,249
King	$217,000	30,805
Pierce	$144,450	11,044
Kitsap	$142,000	3,669
Skagit	$144,000	1,549

1999 median sales price in King County was 21% higher than in Snohomish County and almost 3 times as many sales took place in King County over the year.

Current Housing Sales Price Information

The most current NWMLS information available is for October 2000.

Table 25. October 2000 Closed Sales-Single Family Homes and Condos[4]

	No. of Sales	No. Sales 1 year earlier	Average Price	Median Price	Median Price 1 year earlier	Annual % Change in Median Price
Snohomish County	973	905	$211,814	$184,950	$179,950	2.8%

October 2000 median housing sales price increased by 2.8% from a year earlier. The number of closed sales was up 7.5% and the number of pending sales was up by 11.3% from a year earlier at 977.

[3] Northwest Multiple Listing Service, *1999 Statistical Review and Highlights*, p. 9.
[4] Northwest Multiple Listing Service, *Statistical Recap: Month of Oct. 2000*, November 9, 2000.

HOUSING MARKET SNAPSHOT

State of Washington and Counties

Fourth Quarter 2006

County	Home Resales #	Home Resales % change (year ago)	Building Permits (units) #	Building Permits (units) % change (year ago)	Median Price $	Median Price % change (year ago)	Affordability Index	First Time Affordability
ADAMS	150	-11.5%			$ 87,900	17.2%	193.9	130.0
ASOTIN	70	-23.5%			$ 153,600	24.1%	130.7	75.5
BENTON	710	-17.9%	152	-36.7%	$ 151,400	-4.1%	180.9	108.8
CHELAN	280	-40.5%	76	40.7%	$ 217,000	14.7%	102.8	59.7
CLALLAM	240	-10.4%	54	-43.8%	$ 239,800	11.5%	89.9	52.0
CLARK	1,410	-23.0%	572	-34.4%	$ 272,500	7.8%	98.0	59.7
COLUMBIA	20	-9.1%			$ 119,000	-23.2%	168.4	97.2
COWLITZ	680	-27.5%	114	5.6%	$ 179,800	14.5%	122.2	73.3
DOUGLAS	120	-40.5%	83	25.8%	$ 215,000	13.6%	97.7	60.9
FERRY	10	-27.1%			$ 150,700	13.8%	106.7	64.1
FRANKLIN	180	-17.9%	166	-58.1%	$ 151,400	-4.1%	135.5	89.6
GARFIELD	10	-23.5%			$ 153,600	24.1%	134.9	72.6
GRANT	670	-7.9%			$ 140,900	19.4%	136.7	86.0
GRAYS HARBOR	280	-19.0%			$ 147,500	6.5%	131.5	79.2
ISLAND	580	-18.6%	99	-19.5%	$ 309,500	8.2%	79.3	49.0
JEFFERSON	240	0.0%	49	-3.9%	$ 312,500	-5.6%	70.9	41.1
KING	9,620	-16.8%	2,531	-24.5%	$ 440,000	12.8%	69.6	39.0
KITSAP	860	-17.8%	224	-57.6%	$ 280,000	6.1%	96.7	58.2
KITTITAS	250	-20.3%	76	-16.5%	$ 256,500	20.9%	86.6	43.8
KLICKITAT	100	-16.0%			N/A	N/A	N/A	N/A
LEWIS	620	-21.6%	99	-14.7%	$ 180,000	13.4%	111.4	67.0
LINCOLN	50	-16.0%			N/A	N/A	N/A	N/A
MASON	880	-18.9%	101	-17.9%	$ 200,000	6.8%	110.5	67.7
OKANOGAN	260	-16.0%	37	8.8%	$ 150,000	16.3%	110.3	67.9
PACIFIC	120	-13.0%	0	-100.0%	$ 146,800	7.9%	128.1	73.8
PEND OREILLE	90	-27.1%	0	-100.0%	$ 150,700	13.8%	119.3	72.8
PIERCE	6,950	-20.2%	1,144	-30.9%	$ 276,500	8.4%	95.6	56.3
SAN JUAN	90	-17.5%	34	-10.5%	$ 620,000	34.1%	39.3	23.3
SKAGIT	590	-22.7%	117	-50.6%	$ 260,000	5.5%	92.6	56.6
SKAMANIA	50	-16.0%	18	-25.0%	N/A	N/A	N/A	N/A
SNOHOMISH	3,820	-15.4%	1,085	-27.7%	$ 355,000	12.7%	83.4	50.6
SPOKANE	2,840	-5.5%	340	-53.0%	$ 179,900	6.6%	126.4	70.6
STEVENS	230	-27.1%	2	0.0%	$ 150,700	13.8%	127.1	77.1
THURSTON	1,010	-0.8%	405	-25.7%	$ 254,000	3.7%	108.4	64.3
WAHKIAKUM	30	0.0%			$ 238,000	26.9%	88.8	55.9
WALLA WALLA	270	-9.1%			$ 165,000	2.2%	131.4	74.5
WHATCOM	760	-23.6%	151	-70.9%	$ 281,500	-2.9%	85.2	47.6
WHITMAN	100	18.9%	19	-48.6%	$ 173,300	-6.0%	123.8	55.8
YAKIMA	1,240	8.8%	49	-41.0%	$ 137,600	4.8%	140.7	86.3
Statewide	36,480	-16.6%	7,797	-32.9%	$ 301,400	9.3%	87.0	50.9

Notes:
1. Home Resales are WCRER estimates based on MLS reports or deed recording (RealEstats and Real Market Data LLC)
2. Building permits are from U.S. Department of Commerce. % changes on matched reports.
3. Median prices are WCRER estimates from MLS data or provided by firms monitoring deed recordings.
4. Affordability index measures ability of typical family to make payments on median price resale home assumes 20% down payment. First time buyer affordability assumes a less expensive home, lower downpayment and lower income.

Source: Washington Center for Real Estate Research/Washington State University

Table 1: Most Common County-to-County Commutes Involving Washington Counties, 2000

Rank	County of Residence	State of Residence	County of Work	State of Work	Worker Flow
1	Snohomish	WA	King	WA	103,334
2	Pierce	WA	King	WA	80,783
3	Clark	WA	Multnomah	OR	40,984
4	King	WA	Snohomish	WA	30,951
5	King	WA	Pierce	WA	18,564
6	Kitsap	WA	King	WA	14,960
7	Thurston	WA	Pierce	WA	14,352
8	Benton	WA	Franklin	WA	8,508
9	Kootenai	ID	Spokane	WA	8,190
10	Multnomah	OR	Clark	WA	7,095
11	Douglas	WA	Chelan	WA	6,801
12	Franklin	WA	Benton	WA	6,003
13	Clark	WA	Washington	OR	5,604
14	Thurston	WA	King	WA	5,350
15	Kitsap	WA	Pierce	WA	5,116
16	Island	WA	Snohomish	WA	5,022
17	Pierce	WA	Thurston	WA	4,953
18	Asotin	WA	Nez Perce	ID	4,540
19	Skagit	WA	Snohomish	WA	4,447
20	Clark	WA	Clackamas	OR	4,316
21	Stevens	WA	Spokane	WA	3,649
22	Pierce	WA	Kitsap	WA	3,456
23	Whatcom	WA	Skagit	WA	3,005
24	Thurston	WA	Lewis	WA	2,843
25	Mason	WA	Thurston	WA	2,841
26	Mason	WA	Kitsap	WA	2,744
27	Clark	WA	Cowlitz	WA	2,483
28	Lewis	WA	Thurston	WA	2,383
29	Latah	ID	Whitman	WA	2,300
30	Chelan	WA	Douglas	WA	2,287
31	Snohomish	WA	Skagit	WA	2,265
32	Island	WA	King	WA	2,152
33	Spokane	WA	Kootenai	ID	2,145
34	Yakima	WA	Benton	WA	2,141
35	Island	WA	Skagit	WA	2,094
36	Cowlitz	WA	Clark	WA	2,058
37	Clackamas	OR	Clark	WA	2,033
38	Washington	OR	Clark	WA	2,016
39	Umatilla	OR	Walla Walla	WA	1,866
40	Skagit	WA	Whatcom	WA	1,848
41	King	WA	Thurston	WA	1,792
42	Pierce	WA	Snohomish	WA	1,785
43	Skagit	WA	King	WA	1,689
44	Thurston	WA	Mason	WA	1,597
45	Grays Harbor	WA	Thurston	WA	1,595
46	Benton	WA	Yakima	WA	1,534
47	Columbia	OR	Cowlitz	WA	1,523
48	King	WA	Kitsap	WA	1,484
49	Nez Perce	ID	Asotin	WA	1,431
50	Cowlitz	WA	Multnomah	OR	1,307

Source: U.S. Census Bureau County-to-County Worker Flow Files, Census 2000

Table 2: County-to-County Worker Flow in Washington, 2000, Summary

County	Total Workers by Place of Work	County Resident Workforce	Resident Workers: Workers Who Worked in County of Residence	Resident Workers as a Percent of County Resident Workforce	County Resident Workforce as a Percent of Total Workers Employed in County	Resident Workers as a Percent of Total Workers in County	Residents Working in Other Counties	Workers Residing in Other Counties	Net Flow of Workers
	A	B	C	C/B	B/A	C/A	D	E	E-D
Adams	6,250	6,373	5,108	80.15%	101.97%	81.73%	1,265	1,142	-123
Asotin	5,755	9,067	3,954	43.61%	157.55%	68.71%	5,113	1,801	-3,312
Benton	62,694	65,348	52,231	79.93%	104.23%	83.31%	13,117	10,463	-2,654
Chelan	32,362	27,978	24,539	87.71%	86.45%	75.83%	3,439	7,823	4,384
Clallam	23,411	24,125	22,592	93.65%	103.05%	96.50%	1,533	819	-714
Clark	121,065	161,471	104,730	64.86%	133.38%	86.51%	56,741	16,335	-40,406
Columbia	1,640	1,699	1,264	74.40%	103.60%	77.07%	435	376	-59
Cowlitz	39,884	39,330	33,678	85.63%	98.61%	84.44%	5,652	6,206	554
Douglas	8,684	13,981	5,953	42.58%	161.00%	68.55%	8,028	2,731	-5,297
Ferry	2,420	2,572	2,022	78.62%	106.28%	83.55%	550	398	-152
Franklin	21,652	19,115	11,286	59.04%	88.28%	52.12%	7,829	10,366	2,537
Garfield	869	962	765	79.52%	110.70%	88.03%	197	104	-93
Grant	29,403	28,809	26,801	93.03%	97.98%	91.15%	2,008	2,602	594
Grays Harbor	26,262	27,036	23,616	87.35%	102.95%	89.92%	3,420	2,646	-774
Island	24,651	32,538	22,103	67.93%	131.99%	89.66%	10,435	2,548	-7,887
Jefferson	9,720	10,626	8,508	80.07%	109.32%	87.53%	2,118	1,212	-906
King	1,073,735	911,677	849,709	93.20%	84.91%	79.14%	61,968	224,026	162,058
Kitsap	92,526	106,877	82,265	76.97%	115.51%	88.91%	24,612	10,261	-14,351
Kittitas	13,518	15,209	12,758	83.88%	112.51%	94.38%	2,451	760	-1,691
Klickitat	6,644	7,664	5,632	73.49%	115.35%	84.77%	2,032	1,012	-1,020
Lewis	25,061	26,390	21,073	79.85%	105.30%	84.09%	5,317	3,988	-1,329
Lincoln	3,692	4,125	2,983	72.32%	111.73%	80.80%	1,142	709	-433
Mason	13,949	19,037	10,802	56.74%	136.48%	77.44%	8,235	3,147	-5,088
Okanogan	14,747	15,031	13,682	91.03%	101.93%	92.78%	1,349	1,065	-284
Pacific	7,348	7,887	6,511	82.55%	107.34%	88.61%	1,376	837	-539
Pend Oreille	3,114	3,965	2,460	62.04%	127.33%	79.00%	1,505	654	-851
Pierce	271,819	324,285	228,282	70.40%	119.30%	83.98%	96,003	43,537	-52,466
San Juan	6,353	6,350	5,951	93.72%	99.95%	93.67%	399	402	3
Skagit	44,481	45,453	35,590	78.30%	102.19%	80.01%	9,863	8,891	-972
Skamania	2,573	4,261	2,032	47.69%	165.60%	78.97%	2,229	541	-1,688
Snohomish	234,240	299,861	188,327	62.80%	128.01%	80.40%	111,534	45,913	-65,621
Spokane	201,433	191,195	184,768	96.64%	94.92%	91.73%	6,427	16,665	10,238
Stevens	12,089	15,273	10,813	70.80%	126.34%	89.44%	4,460	1,276	-3,184
Thurston	88,949	100,986	74,078	73.35%	113.53%	83.28%	26,908	14,871	-12,037
Wahkiakum	1,021	1,532	833	54.37%	150.05%	81.59%	699	188	-511
Walla Walla	24,537	23,240	20,064	86.33%	94.71%	81.77%	3,176	4,473	1,297
Whatcom	75,375	79,263	72,084	90.94%	105.16%	95.63%	7,179	3,291	-3,888
Whitman	19,617	18,305	16,206	88.53%	93.31%	82.61%	2,099	3,411	1,312
Yakima	86,249	86,583	82,588	95.39%	100.39%	95.76%	3,995	3,661	-334

Source: U.S. Census Bureau County-to-County Worker Flow Files, Census 2000

Seattle Area Puget Sound & Lake Waterfront Real Estate

Welcome to Scott Price's WaterHavens, the Seattle area Waterfront and Water View Real Estate information resource for both current and future WaterHaven homeowners. Here - and elsewhere on WaterHavens.com - I provide updated waterfront/water view real estate information, community descriptions, activities, resources, and more distilled from years of waterfront-specific real estate experience. Includes Puget Sound, Lake Washington, Lake Sammamish, and surrounding lakes and rivers.

JANUARY 11, 2007

2006 Waterfront Market In Review

2006 has come and gone, and it was yet another terrific year for WaterHavens everywhere. Waterfront real estate has risen with the general market throughout the year, and in many cases outperformed market averages. This is a normal occurrence: **waterfront is always more desirable and tends to be a better investment than non-waterfront real estate**. And if a down market ever occurs in the future, waterfront will still be the most desirable and first to sell if priced appropriately.

First, a review of the **general King County** real estate market: in December 2006, **house prices increased 12% for the year and arrived at a median price of $440,000, while condo prices rose an astounding 21% to a median $270,000**. For all combined residential properties, median was $399,900 and average was $477,845.

Now for the actual waterfront property sale price results of each local waterfront community for all of 2006. I have compiled all of this specific data for house and floating home properties (in west to east / north to south order), and at the end I have also provided general aggregate information for condominiums (since condo waterfront status is not as clearly tracked in the MLS as with houses) and vacant land.

To summarize all of the home sale price data below from all of the local waterfront communities:
Lowest: $158,500 (houseboat)
Highest: $15,000,000
Average: $1,806,860
Median: $1,187,000

Here's a key to reading data:
Number of houses from lowest to highest sale price, average list price / average actual sale price / average cost per square foot / average days on market.

NORTHWEST SEATTLE lakes: 6 from $350,000 - $994,000, list $625,408 / sale $634,667 / $285 sf / 113 days.
MAGNOLIA Sound: 2 from $899,000 - $1,500,000, list $1,224,500 / sale $1,199,500 / $1,087 sf / 261 days.
WEST SEATTLE Sound: 10 from $390,000 - $1,928,000, list $1,257,890 / sale $1,240,816 / $466 sf / 126 days.

BURIEN Sound and lakes: 11 from $250,000 to $1,300,000, list $914,350 / sale $840,277 / $339 sf / 160 days.
NORMANDY PARK Sound: 3 from $1,450,000 to $1,950,000, list $1,831,667 / sale $1,666,667 / $461 sf / 239 days.
DES MOINES Sound: 4 from $625,000 - $1,600,000, list $1,067,500 / sale $1,023,250 / $379 sf / 164 days.
FEDERAL WAY Sound & lakes: 11 from $302,500 - $1,770,000, list $719,400 / sale $698,209 / $268 sf / 134 days.
SEATTLE Lake Union houseboats: 17 from $158,500 to $1,385,000, list $514,135 / sale $484,300 / $466 sf / 108 days.
NE SEATTLE Lake Washington: 13 from $940,000 - $4,250,000, list $2,761,531 / sale $2,619,692 / $642 sf / 80 days.
SE SEATTLE Lake Washington: 5 from $985,000 - $1,775,000, list $1,437,331 / sale $1,395,333 / $480 sf / 56 days.
MERCER ISLAND, Lake Wash: 22 from $1,100,000 - $6,200,000, list $3,524,136 / sale $3,304,955 / $774 sf / 317 days.
KENMORE Lake Wash: 3 from $1,410,000 - $1,605,000, list $1,606,667 / sale $1,530,000 / $464 sf / 52 days.
KIRKLAND Lake Wash: 3 from $2,400,000 - $6,175,000, list $5,087,667 / sale $4,525,000 / $816 sf / 397 days.
HUNTS PT Lake Wash: 10 from $2,100,000 - $8,700,000, list $5,362,600 / sale $5,113,834 / $1,179 sf / 353 days.
MEDINA Lake Wash: 9 from $2,570,000 - $15,000,000, list $6,309,889 / sale $6,093,889 / $1,191 sf / 308 days.
BELLEVUE Lake Wash: 13 from $1,300,000 - $4,300,000, list $2,906,077 / sale $2,709,064 / $649 sf / 166 days.
WEST LAKE SAMMAMISH: 18 from $930,000 - $7,600,000, list $2,220,417 / sale $2,192,483 / $516 sf / 98 days.
EAST LAKE SAMMAMISH: 9 from $1,199,000 - $2,100,000, list $1,722,444 / sale $1,683,000 / $600 sf / 91 days.
RENTON lakes: 18 from $495,950 - $2,645,000, list $894,461 / sale $881,775 / $292 sf / 98 days.
KENT lakes: 10 from $325,000 - $825,000, list $642,980 / sale $635,965 / $211 sf / 90 days.
AUBURN lakes: 4 from $349,950 - $690,000, list $496,975 / sale $494,738 / $258 sf / 59 days.
CONDOMINIUMS all local areas: list $506,773 / sale $496,207 / $371 sf / 61 days.
VACANT LAND all local areas: list $773,734 / sale $751,496 / 215 days.

Quite a year! Enjoy a WaterHaven. Our waterfront and waterview is the best in the world.

Realty Times
News & Advice > MCR City Report

Seattle Ferry Towns Offer Long Commutes But Spectacular Views

by Blanche Evans

Several small towns about an hour and a half away from Seattle are finding themselves in popular seller's markets because of their mountain and water views and serene lifestyles, says a local Realtor.

Seabeck

"Seabeck is located on the Hood Canal with dramatic Olympic Mountain views," says Realtor Jim P. Harris. "Some say it reminds them of Switzerland. An area once full of sawmills and now known for its state park on the pristine Hood Canal, the town is a marina and a couple of shops with Silverdale being the closest town of significance."

Silverdale

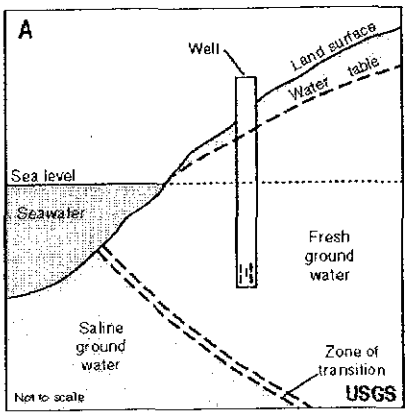
"Silverdale is located close to Bangor Subbase and is a result of the base being located close by on Hood Canal," explains Harris. "The growth originally from the base has now taken on its own flavor and the area is now home to a new branch of Harrison Hospital. With prices lower than Seattle, located some 1 to 1 1/2 hours away, many people have chosen to commute. The homes are generally located on larger lots and many have views of the Olympics or one of the local inlets from Hood Canal or Puget Sound. Kitsap County has the most waterfront of any county in the state."

Poulsbo

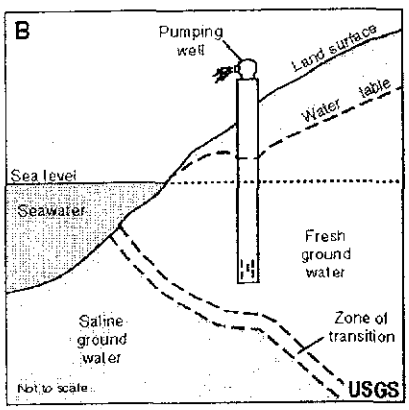
"A small town on Liberty Bay with a population of less than 6000," says Harris, "Poulsbo was originally populated with Norwegian families whose many cultural traits are evident in the downtown area and in festivals held throughout the year. Poulsbo is a delightful area known for its water activities and bakery, yet it is within an hour of Seattle by ferry."

Of the three communities, Harris says, "With prices about half of what you would pay in Seattle, located just about an hour and a half away, homes are appreciating. Average sales price 7/03 was $232,146 and in 7/02, it was $119,275. That's over a $110,000 increase in those homes sold. Twice as many homes sold this month compared to last year. The number of homes available is dwindling, so the market is becoming a seller's market. County-wide average price 'solds' were up 12 percent."

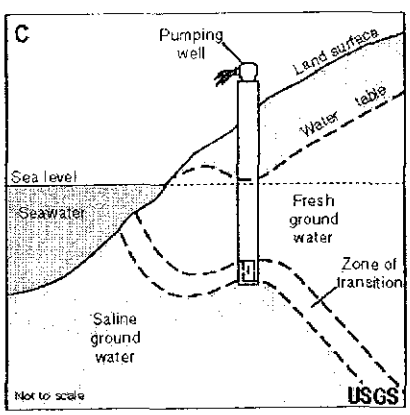
Published: August 15, 2003



Nonpumping well in an unconfined (water-table) aquifer under conditions of equilibrium--no intrusion has occurred.



Well pumping from an unconfined (water-table) aquifer--seawater intrusion not affecting salinity of pumped water.



Well pumping from an unconfined aquifer--seawater intrusion affecting salinity of pumped water.

Figure 13. Conceptual diagram showing how seawater intrusion can occur due to pumping of wells (from Orr, 2000).

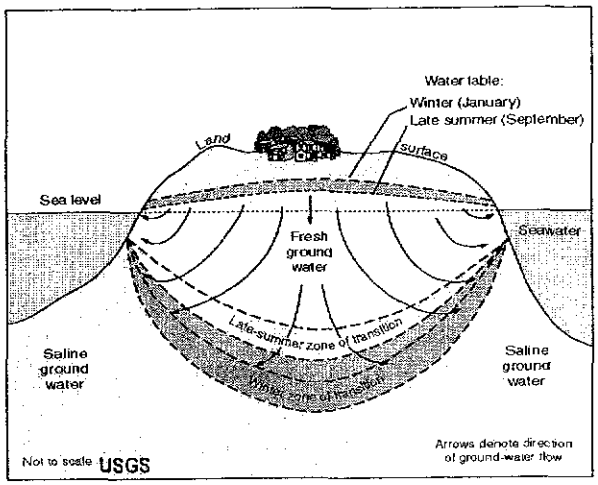


Figure 14. Conceptual diagram showing the relationship between fresh and saline ground water in a homogenous unconfined island aquifer. Fresh ground water flows both outward and upward while the zone of diffusion shifts seasonally (from Orr, 2000).

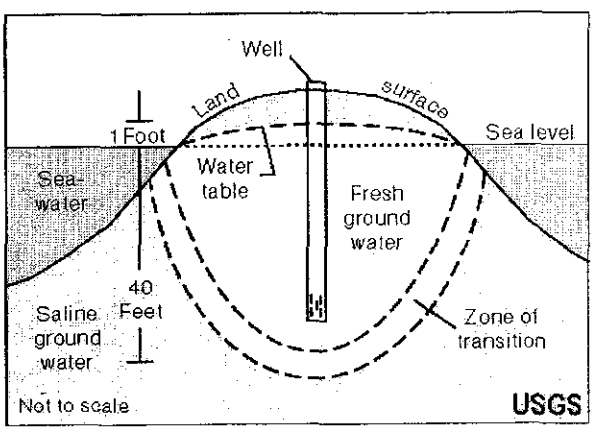


Figure 15. Conceptual diagram showing the Ghyben-Herzberg relation – that fresh ground water theoretically extends 40 feet below sea level for every foot it extends above sea level (from Orr, 2000).

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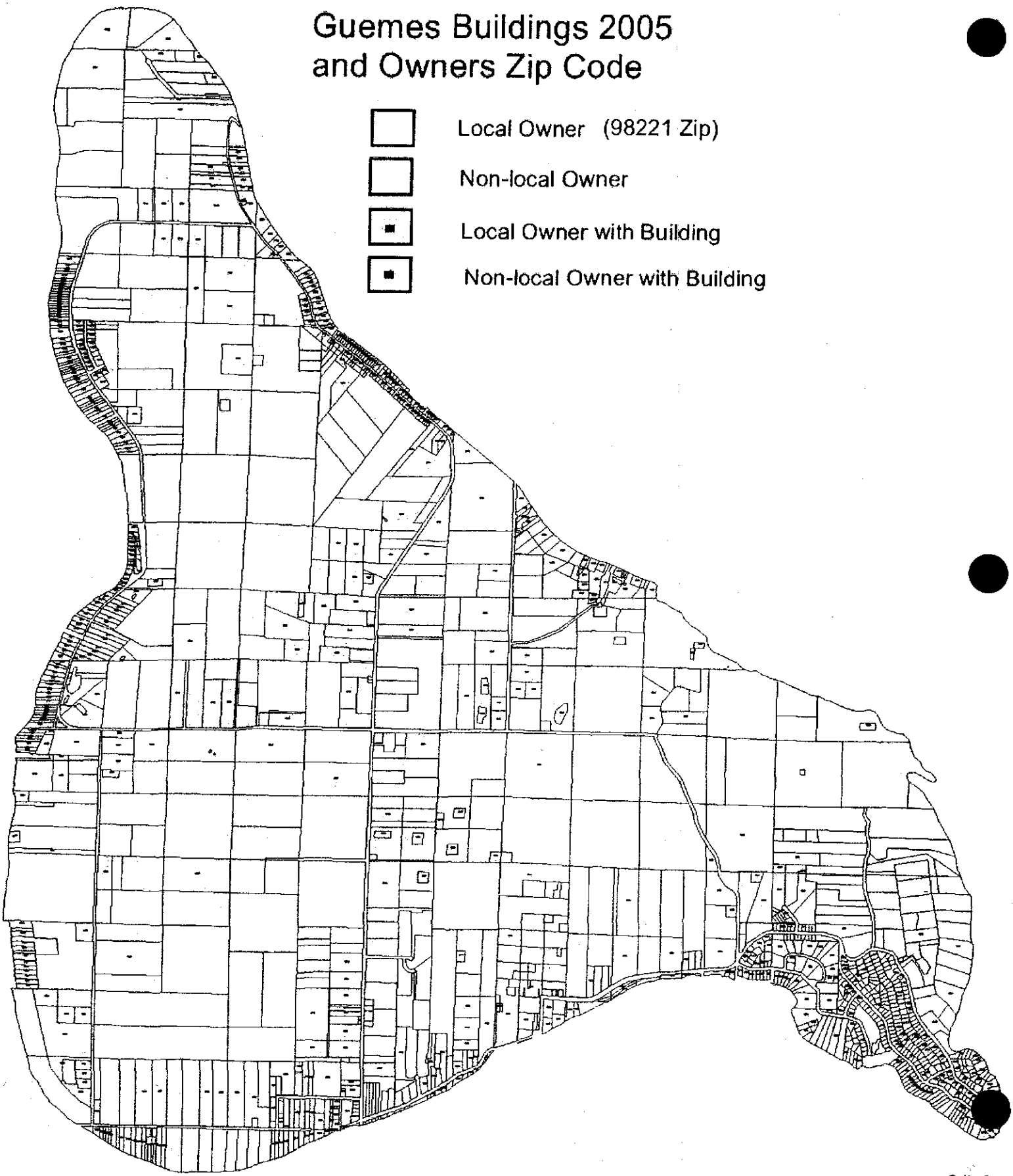
Guemes Buildings 2005 and Owners Zip Code



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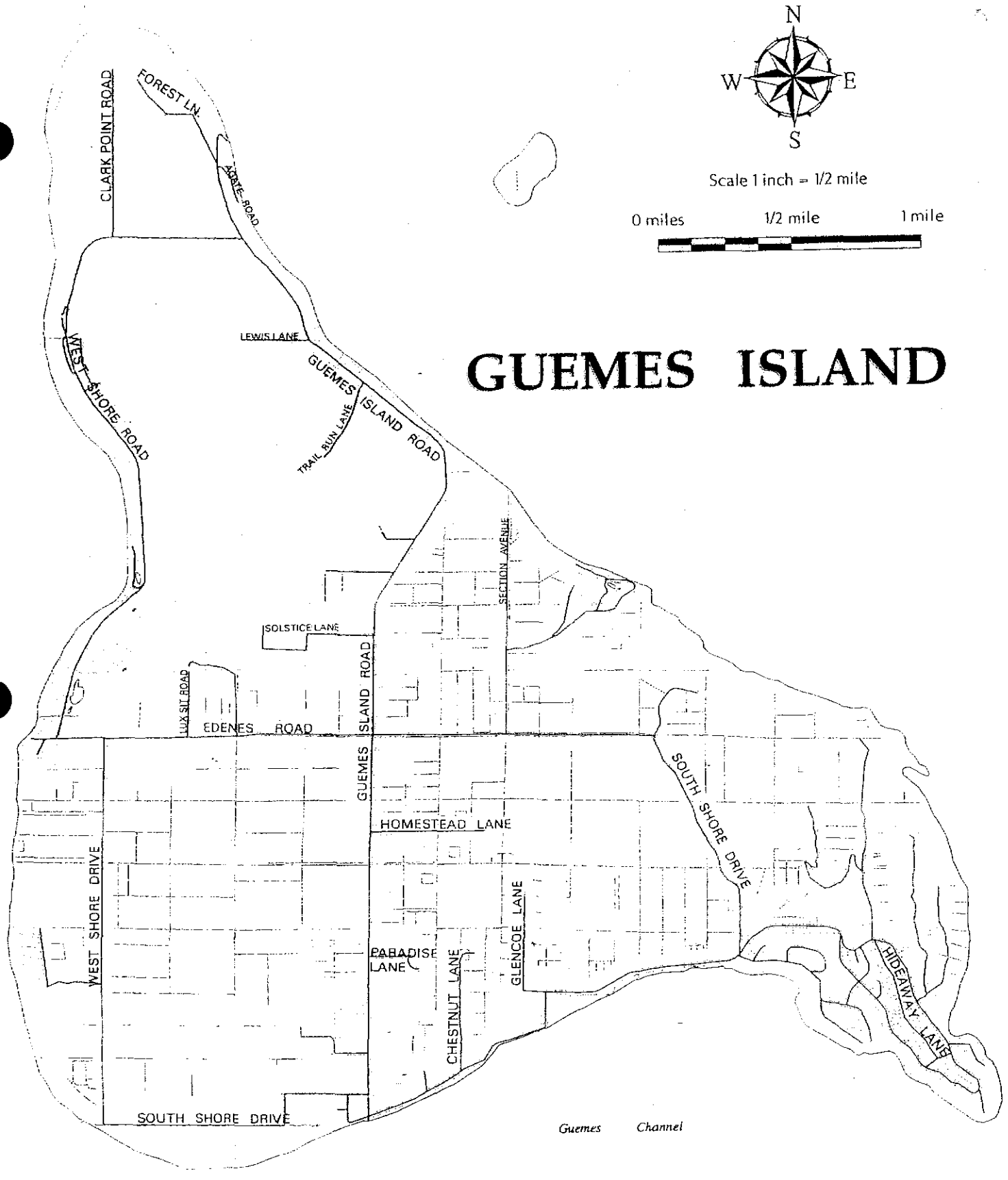

Areas Where Well Drillers Apply To The Health Dept. Before Drilling

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California Coastal Commission

Seawater Desalination in California

CHAPTER THREE: *POTENTIAL ENVIRONMENTAL IMPACTS / COASTAL ACT ISSUES*

Development in the coastal zone must conform to the policies and standards of the California Coastal Act and, if applicable, the Commission-certified Local Coastal Program (LCP) of the government with jurisdiction in the area of the proposed development. The Coastal Commission reviews projects on a case-by-case basis and considers the environmental benefits and coastal zone impacts of all projects. The following types of potential coastal zone impacts should be considered and addressed for desalination plants:

- Construction
- Energy Use
- Air Quality
- Marine Environment
- Increased Development
- Other Coastal Zone Issues (geologic hazards, navigation, cumulative effects, etc.)

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- Preference for desalination technologies and plant designs that reduce energy consumption;

- Use of renewable energy resources, when feasible; and

- Siting of the proposed plants near to power plants capable of cogeneration.

Air Quality

- **Impacts/Related Policies**

Section 30253(3) of the Coastal Act requires that new development be consistent with requirements imposed by an air pollution control district or the State Air Resources Control Board as to each particular development. In general, desalination plant air emissions consist only of discharges of nitrogen and oxygen from distillation plants that use deaeration processes to reduce corrosion, discharge of the air ejector system (thermal plants), or discharge of the degassifier (RO plants).

The production of energy for use in desalination plants, however, will increase air emissions. In addition, substantial increases in air emissions could occur if a new power plant or cogeneration facility is built for a desalination project. Some of the proposed plants would be built in areas where air quality violations already exist; consequently, the plant designs should include consideration of measures to offset air emissions from energy production.

- **Potential Mitigation Measures**

- Compliance with local Air Pollution Control District and State Air Resources Board standards;

- Preference for reduced energy use, as discussed above; and

- Use of alternative energy sources to minimize air emissions.

Marine Environment

- **Related Policies**

Marine resources in the vicinity of a desalination plant can be affected by the constituents present in the waste discharges, by the waste discharge method used, and by the process of feedwater intake. Coastal Act Sections 30230 and 30231 provide for the maintenance, enhancement, and restoration of marine resources and biological productivity. Specifically, Section 30230 provides:

> "Marine Resources shall be maintained, enhanced, and where feasible restored. Special protection shall be given to areas of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes."

Section 30231 states in part:

> "The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment...."

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In addition to these Coastal Act policies, Section 307(f) of the Federal Coastal Zone Management Act (CZMA) provides that for purposes of the Commission's exercise of its consistency review authority under CZMA Section 307(c), federal, state, and local provisions established pursuant to the Clean Water Act (CWA) shall be incorporated into state coastal management programs and shall be the water pollution control requirements applicable to such program. Consequently, a number of the general policies and objectives of the California Ocean Plan are incorporated directly into the California Coastal Management Plan (CCMP). In addition, Coastal Act Section 30412(a) specifies that the provisions set forth in

Section 13124.5 of the State Water Code shall apply to the Commission, while Coastal Act Section 30412(b) states that the SWRCB and the RWQCBs are the state agencies with primary responsibility for the coordination and control of water quality.

- **Constituents of Waste Discharges from Desalination Plants**

The constituents of water discharged from desalination plants depend in part on: the desalination technology used; the quality of the intake water; the quality of water produced; and the pretreatment, cleaning, and RO membrane storage methods used.

All desalination plants use chlorine or other biocides, which are hazardous to marine resources, to clean pipes and other equipment and sometimes to pretreat the feedwater. The State RWQCBs do not permit chlorine or other biocides to be discharged directly into the ocean. Consequently, these chemicals would have to be neutralized before discharge.

Alternative treatment processes and technologies that eliminate the need for biocides can also be used. For example, ultraviolet light may be used instead of biocides to remove biological organisms. Ultraviolet light is more expensive than biocides but is an effective method. Similarly, the disc tube RO technology, which has been used primarily in Europe, does not require use of pretreatment chemicals to remove particles and organisms. This technology, unlike the more common spiral wound RO technology, does not have a mesh net between layers of the RO membranes (the net catches particles and biological organisms and can clog the membranes). The disc tube technology, however, is more expensive than the spiral wound technology and, according to one source, is unproven on seawater desalination. (Source: Dick Sudak, Separation Processes, 1992.) The need for pretreatment chemicals and processes can also be eliminated or reduced substantially if feedwater is taken in from beach wells or infiltration galleries, which serve as natural filters. (An infiltration gallery has perforated pipes arranged in a radial pattern in the saturated sand onshore, and water in the sand seeps into the perforated pipes.)

Some RO plants use a coagulant (usually ferric chloride), as part of the pretreatment process to cause particles in feedwater to form larger masses that can be more easily removed with filters before the water passes through to the RO membranes. The pretreatment filters are backwashed with filtered seawater every few days, producing a sludge that contains filter coagulant chemicals. Options for disposal of coagulants, particles and sludge removed from the filters include discharge with the brine, transport to a landfill, or a combination thereof. A desalination plant would have to include a process for removal of the particles if they are to be discharged with the sludge. Ferric chloride is not toxic but may cause a discoloration of the receiving water if discharged.

Desalination plants often use anti-scalants to remove scales that form on the plant's interior. Most plants use a polyacrylic acid as an anti-scalant, which is not hazardous to marine resources. MSF distillation plants may use a small quantity, about 0.1 milligrams for each liter of water, of an antifoaming agent (similar to cooking oil) to reduce the foam produced when the water boils.

In RO plants, cleaning and storage of the membranes can produce potentially hazardous wastes. The membranes must be cleaned at intervals from three to six months depending on feedwater quality and plant operation. The membrane cleaning formulations are usually dilute alkaline or acid aqueous solutions. In addition, a chemical preservation solution (usually sodium bisulfite) must be used if the membranes are stored while a plant is shut down. These chemicals should be treated before discharge to the ocean to remove any potential toxicity.

In general, discharges from desalination plants may have the following types of potentially adverse constituents and qualities:

- Salt concentrations above those of receiving waters (seawater salt concentration is about 35,000 ppm; desalination plants discharge brine with 46,000 to 80,000 ppm). Salt concentrations may be reduced by mixing desalination plant discharges with other discharges, such as wastewater;

- Temperatures above those of receiving waters (about 5° F increase at the point of discharge) for discharges from distillation plants; (Source: Baum, 1991.)

- Turbidity levels above those of receiving waters;

- Oxygen levels below those of receiving waters from deaeration to reduce corrosion (distillation plants only);

- Chemicals from pretreatment of the feedwater (these may include biocides, sulfur dioxide, coagulants (e.g., ferric chloride), carbon dioxide, polyelectrolytes, anti-scalants (e.g., polyacrylic acid), sodium bisulfite, antifoam agents, and

polymers);

- Chemicals used in flushing the pipelines and cleaning the membranes in RO plants (these may include sodium compounds, hydrochloric acid, citric acid, alkalines, polyphosphate, biocides, copper sulfate, and acrolein);

- Chemicals used to preserve the RO membranes (e.g., propylene glycol, glycerine, or sodium bisulfite);

- Organics and metals that are contained in the feedwater and concentrated in the desalination process; and

- Metals that are picked up by the brine in contact with plant components and pipelines.

- **Marine Resource Impacts from Desalination Waste Discharges**

Concern over the potential adverse effects to marine resources of desalination plant discharges is tempered by the following factors: the total volume of brine being released; the constituents of the brine discharge; and the amount of dilution prior to release. For example, the potential for environmental damage from small amounts of brine discharge (less than 1 MGD) may differ considerably from the potential impacts associated with discharges greater than this amount. Discharge of concentrated brine in large amounts requires more careful consideration of potential environmental impacts than do smaller brine discharge volumes. (Source: Dr. Phillip McGillivary, NOAA, 1992.)

The constituents of discharges of particular concern for marine organisms include biocides, high metal concentrations, and low oxygen levels. Not all desalination plant discharges contain these constituents; however, where detected, these constituents should be removed or neutralized to acceptable levels before discharge or else adequately diluted in the ocean in accordance with RWQCB NPDES permit requirements for compliance with the California Ocean Plan and Regional Basin Plans.

The high salt concentration of the discharge water and fluctuations in salinity levels may kill organisms near the outfall that can not tolerate either high salinity levels or fluctuations in the levels (similarly, if a temporary desalination plant is shut down, the organisms that have become accustomed to high salinity levels and/or salinity fluctuations may be killed). In addition, discharges from desalination plants will be more dense than seawater and could sink to the bottom, potentially causing adverse impacts to benthic communities. These effects may be significantly reduced if desalination plant discharges are combined with sewage treatment plant discharges (which are less dense than seawater) or are diluted by mixing with power plant cooling water discharges. At this time, there is considerable uncertainty about how well desalination plant discharges, either alone or combined with other discharges, will be diluted in seawater. The metals may become concentrated in the upper few micrometers of the ocean (the microlayer), which would be toxic to fish eggs, plankton, and larvae that are located there. Toxic constituents of the plume could be driven by wind or currents to become concentrated in the intertidal zone. (Source: pers. comm. with Dr. Phillip McGillivary, NOAA, 1991.)

Discharge of brine water with high salt concentration, particularly if combined with sewage effluent, may also cause sewage contaminants and other particulates to aggregate in particles of different sizes than they would otherwise. This effect influences rates of sedimentation, and is highly important for determining the well-being of benthic organisms that may be buried or burdened by an increase in deposition of unstable and/or finely suspended materials. If the particles are smaller and stay in suspension, they could interfere with transference of light in the ocean, which would diminish the productivity of kelp beds and phytoplankton. In addition, redistribution of trace metals (e.g., iron, nitrogen, and phosphorus) could change the phytoplankton community to one that is unappetizing to fish and may also be toxic (for example, by increasing the possibility or prolonging the occurrence of a "red tide" condition). Larval fish that feed on the phytoplankton could be forced beyond nearshore waters, where they may not survive. (Source: pers. comm. with Dr. Phillip McGillivary, NOAA, 1991.)

Changes in salinity and/or temperature from the brine discharges may also affect migration patterns of fish along the coast. If some fish species sense a change in salinity or temperature, they may avoid the area of the plume and move further offshore. As a result, the fish would be forced to swim a longer distance, they would leave the areas of highest food concentrations, and they would have increased exposure to predators. The potential impacts of this nature are uncertain because of limited knowledge about fish migration along the coast and uncertainty about how large the plume would have to be to cause this effect.

- **Waste Discharge Methods**

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The brine from desalination plants can be discharged directly into the ocean or combined with power plant cooling water or post-treatment sewage plant discharges. Mixing the discharges with power plant cooling water would most likely be desirable, because the brine solution discharged would be considerably less concentrated. Mixing with sewage treatment

discharges may also be preferable to direct discharge to the ocean. Brine discharge from desalination plants is more dense than seawater and could remain or fall to the ocean bottom, depending on the outfall location. Treated sewage effluent has a relatively low level of total dissolved solids, and blended brine/wastewater effluent has the potential to be closer to ambient ocean concentrations, so dispersion may be enhanced beyond a brine-only discharge. The addition of brine discharge to wastewater effluent reduces the biological oxygen demand (BOD) of the sewage effluent and has the potential to reduce the temperature of the sewage effluent. (For more information, see Woodward-Clyde Consultants, EIR for the City of Santa Barbara and Ionics, Inc.'s Temporary Emergency Desalination Project, March 1991.) On the other hand, blending the brine discharge with sewage discharges may have some undesirable side-effects, which are discussed below under Marine Resource Impacts.

Difficulties in enforcement may arise if desalination wastes are mixed with other waste streams. If the recipient of the desalination waste stream is the only party responsible for compliance with the regulatory requirements, this discharger would have to request the desalination plant operator to make changes if problems with compliance develop. If a proposed desalination plant incorporates combined discharges, the project description must identify the party or parties responsible for meeting the discharge requirements in order to avoid enforcement problems.

- **Marine Resource Impacts from Desalination Plant Intake**

Intake of water directly from the ocean usually results in loss of marine species as a result of impingement and entrainment. Impingement is when species collide with screens at the intake; entrainment occurs when species are taken into the plant with the feedwater and killed during plant processes. The intake of feedwater can also affect marine resources by altering natural currents in the area of the intake structure.

The use of beach wells or infiltration galleries eliminates these impacts; however, these intake methods have not been used extensively in California, and the maximum capacity of a plant that could draw feedwater effectively from these sources is unknown. Beach wells should only be used in areas where the impact on aquifers has been studied and saltwater intrusion of freshwater aquifers will not occur. Infiltration galleries are constructed by digging into sand on the beach, which could result in the disturbance of sand dunes.

- **More Information is Needed on Marine Resource Impacts**

Very little information is available on the impacts of desalination plants on the marine environment. For example, few if any monitoring studies have been conducted on the marine resource impacts of discharges from plants operating in the Middle East, Saipan, the Virgin Islands, and Cuba. Although a number of brackish water desalination plants are operating in Florida, these plants are not permitted to discharge directly to the ocean because the ocean waters are shallow out to about 10 to 15 miles from shore and do not dilute the discharges adequately. The brine is discharged either into deep, confined aquifers or to saline streams or lakes that discharge to estuaries.

An extensive analysis was conducted of the impacts of ocean discharges from a MSF desalination plant that operated in Key West, Florida during the 1960s and mid-1970s. The following studies were done to characterize dispersion of the effluent: 1) measurements of the concentration of metals in marine sediments; 2) dye observations and in situ diver observations; 3) temperature inversion analysis; and 4) semiweekly analysis of water conditions, including temperature, salinity, copper, alkalinity, pH, and oxygen. In addition, the following studies were conducted to determine impacts on the biological community:

1) analysis of foraminifera, small shelled protozoans;

2) wooden settlement panels that collected organisms over known exposure times and on substrates that were uniform in size and material;

3) surveys of organisms within transects;

4) laboratory bioassays;

5) surveys of organisms within one-meter square quadrats at twenty monitoring stations;

6) transplants of selected species into particular effluent regimes to study their survival and growth;

7) analysis of biomass samples;

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8) collection of benthic diatoms and protozoans in glass microscopic slides in special racks (diatometers);

9) analysis of plankton tows; and

10) Carbon 14 measurements of photosynthesis.

The studies found that the effluent mixed turbulently with ambient water at the point of discharge. The density of this mixture was greater than that of the ambient water in the harbor where the effluent was discharged, so the mixture sank to the harbor bottom, filled up the harbor basin which was deeper than the surrounding waters, and then flowed into more shallow water. The temperature of the effluent averaged about 0.5 to 0.9°F above ambient temperatures and the effluent salinity was 0.2 to 0.5% above ambient salinity. The analyses found that the changes in temperature and salinity did not by themselves cause damage to marine organisms, but did result in lower mixing rates for copper in the effluent. Copper concentrations, which were often 5 to 10 times ambient levels, were found to be toxic to marine organisms. The studies also found that effluent discharged following startup of the plant after maintenance procedures had higher copper concentrations and caused more biological damage than effluent discharged during normal operations. (The high levels of copper detected may have due to a copper grating that was later replaced, not to the desalination process itself. The internal components of many modern desalination plants are composed of titanium rather than copper.) A variety of organisms were adversely affected by the effluent. For example, sea squirts, various species of algae, bryozoans, and sabellid worms were excluded from the harbor during at least a portion of the study; no live lamellibranchs were found by the end of the study; many dead shells of various clams and oysters were found; and echinoids were killed in the shallower waters near the harbor. Two or three of the species that survived well in the area near the effluent did so because they were able to avoid the peaks associated with start-up and were able to tolerate the steady-state effluent conditions. (Source: Chesher, 1975.)

In California, discharges from the desalination unit at the Chevron Gaviota Oil and Gas Processing Plant have been monitored in accordance with the plant's NPDES permit since January 1987. The discharges have been relatively small, because the unit has been operating at reduced capacity. Discharge constituents monitored include: dissolved oxygen, copper, iron, nickel, pH, temperature, total chlorine residual, toxicity concentration in marine organisms (bioassays), arsenic, cadmium, lead, hexavalient chromium, mercury, silver, zinc, cyanide, suspended solids, particulates, grease and oil, settleable solids, flow rate, and turbidity. A plume trajectory study was not conducted, because the computer models used by the RWQCB at the time could not be applied to plumes with salinity levels greater than that of the ocean. (New computer models have since been developed.) The monitoring results to date show no violations of the permit except for high levels of zinc. (The high levels may have been a result of high levels at the intake.) Recent monitoring has shown zinc levels within permitted standards.

The Marin Municipal Water District built a pilot plant and conducted some studies of the impacts of discharges from this plant on San Francisco Bay. Bioassay studies were conducted on two waste streams - the concentrate discharged directly to San Francisco Bay, and the concentrate mixed with effluent from the Central Marin Sanitation Agency (CMSA). The studies performed for each waste stream were the 7-day chronic *Menidia beryllina* test, the 96-hour *Skeletonema costatum* growth test, the 48-hour bivalve larvae test, and the 96-hour acute *Citharichthys stigmaeus* test. The studies found that to achieve the No Observable Effect Concentration (NOEC) for these organisms, the dilution ratio for Bay water to effluent would have to be 23:1 for unmixed concentrate and 20:1 for concentrate mixed with the CMSA effluent. The study also found that the quality of the CMSA effluent was improved by mixing it with the pilot plant discharges, because the salinity increased and the buoyancy was reduced. (Source: Boyle Engineering Corp. for the Marin Municipal Water District, 1991.)

The Southern California Coastal Water Research Project (SCCWRP) Toxicology Laboratory recently completed a study of potential effects resulting from the discharge of effluent from the City of Santa Barbara desalination plant. The research was conducted for use in an EIR for the City's Long-Term Water Supply Program. The SCCWRP conducted experiments to measure the effect of elevated salinity on sensitive marine species likely to be found in the vicinity of the Santa Barbara discharge to determine if salinity stress affected an organism's sensitivity to sewage toxicity, and to document the level of toxicity in brine resulting from chemicals added during the desalination process. According to the SCCWRP, the experiments indicated that a salinity of 36.5 g/kg (the maximum expected to occur at the Santa Barbara discharge site) did not produce measurable effects on amphipod survival or giant kelp growth; however, an inhibition of sea urchin embryo development at this salinity was measured. Additional studies are needed to confirm the data and determine their applicability to other discharge situations. (Source: SCCWRP, *Coastal Currents*, Vol. 2, No. 1, Summer 1993.)

Other existing desalination plants in California have been operating only for only a short time or are very small, so the impacts of discharges from these plants cannot be compared with potential impacts from larger plants. The Santa Catalina Plant, which began operating in June 1991, is located near Areas of Special Biological Significance (ASBS), as designated by the SWRCB. The results of monitoring studies for this plant should be reviewed closely by the Commission staff to determine whether any adverse impacts have occurred and whether the staff should recommend that any changes be made to mitigation and monitoring requirements in the plant's NPDES permit.

- Siting of plants near existing fresh water distribution mains to distribute the product water;

- Sizing of plant capacity to be commensurate with the planned level of development authorized by the certified LCP for the area;

- Assessment of the long-term growth-inducing impacts of proposals for long-term projects and for projects that are intended to be temporary, but may become permanent in the future; and

- Coordination of project approval with regional growth management goals.

Other Coastal Zone Issues

- **Impacts**

The following potential coastal zone impacts should be considered in evaluating proposals for desalination plants:

- Impacts to the marine environment from accidental discharges of hazardous materials;

- Impacts to commercial fishing and navigation during construction of intakes and outfalls and during operation;

- Interference with public access and recreation from pipelines, wells or other structures;

- Visual impacts - towers for most distillation plants will be 30 to 46 feet high; RO plants are usually not more than 15 to 20 feet high;

- Impacts resulting from geologic hazards and seismic activity;

- Noise from pumps during operation;

- Impacts on the desalination process from pollution near the intake pipes (e.g., discharges from other sources, oil spills, etc.);

- Use of landfill disposal space for solid waste disposal;

- Impacts from increased chloride concentration - RO product water may have higher levels of chlorides than other water sources (using product water with high levels of chloride for irrigation may result in more water use and adverse impacts on soils; chloride levels can be reduced by employing more passes [RO plants] or by using a different process [e.g., MSF, MED, VC]); and

- Cumulative impacts of the desalination plants in the coastal zone.

- **Potential Mitigation Measures to Minimize the Impacts Listed Above**

- Quality control procedures and personnel training to avoid accidents;
Secondary containment for chemical feed lines and provisions for leak detection;

- Notification of commercial fishing interests and the U.S. Coast Guard prior to construction;
Placement of navigational buoys on any new intakes and outfalls;

- Provisions for public access and timing of construction to avoid peak recreational periods;

- Architectural design and natural buffers to reduce visual impacts;

- Preliminary siting studies of potential geologic hazards conducted by geologists or engineering geologists licensed in the state of California;

- Equipment enclosures to reduce noise levels;

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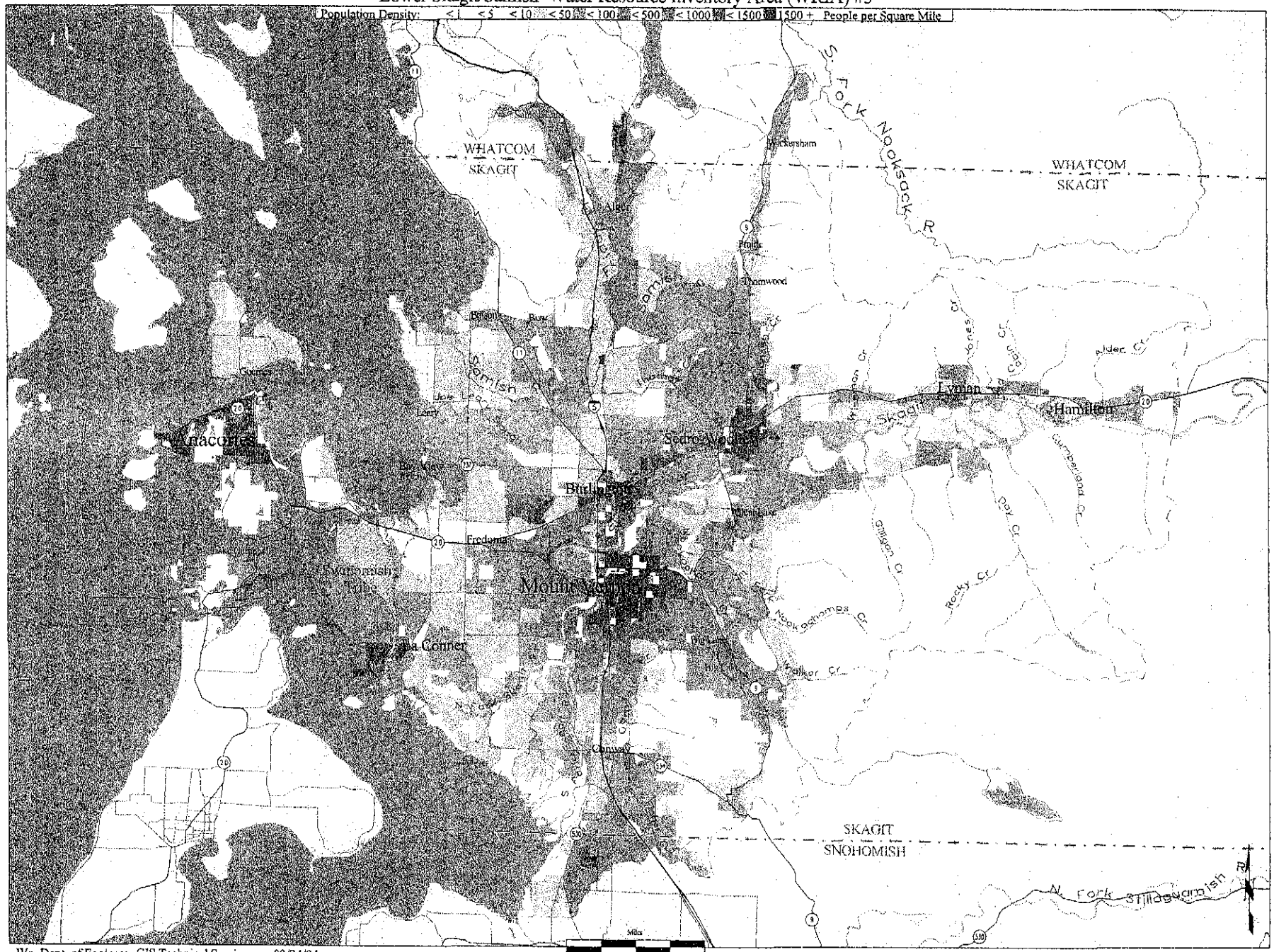
Lower Skagit/Samish Water Resource Inventory Area (WRIA) #3



Wa. Dept. of Ecology, GIS Technical Services 03/24/04

2000 Census Block Population

popden3

Land Use Impacts of Transportation: A Guidebook

Prepared for
National Cooperative Highway Research Program
Transportation Research Board
National Research Council

Project 8-32(3)
Integration of Land Use Planning with Multimodal Transportation Planning

Prepared by:
Parsons Brinckerhoff Quade & Douglas, Inc.

October 1998

EXECUTIVE SUMMARY

This Guidebook has two basic objectives:
1. To improve the practice of land use forecasts.
2. To identify tools and procedures for realistically evaluating the land use impacts of transportation investments and policies.

These improvements in best practices are needed because of the transportation planning requirements of ISTEA, the need to evaluate the land use impacts of transportation investments in MIS/EIS processes, and the many policy questions about the interrelationships of transportation and land use that MPOs and DOTs have been asked.

The Guidebook meets these objectives in a series of steps. In Chapter 1, we reviewed what is known about the relationship between land use and transportation. In Chapter 2, we evaluated the analytical tools that are currently available for these tasks. In Chapter 3, we outlined a behavioral framework for understanding the process of urban growth and development. In Chapter 4, we described processes for doing base case forecasts and land use impact assessments using familiar tools but drawing upon the behavioral framework. This chapter summarizes each of these steps and identifies the key lessons learned.

The Guidebook is not the last word on how to evaluate transportation-land use interactions. Because every region and every transportation project has its unique characteristics, the guidebook cannot provide a definitive set of steps that will answer all questions. Rather the guidebook is a "guide" to a variety of strategies that can be used. The particular choice of approaches will depend upon the scope and scale of the required analysis, the available data, the budget, and the skills of the personnel doing the analysis. We hope that the guidebook will provide MPOs and DOTs with improved ways to think through land use analysis and this will produce better results.

In addition to producing this Guidebook, this NCHRP project is documenting and making available UrbanSim, an integrated land use model for metropolitan areas. This will add another tool to those described in the Guidebook. This model is based on the same behavioral framework presented in this guidebook. There are components reflecting the behavior of households, businesses, developers, and government. This model draws on random utility theory for its theoretical foundation and builds on the well-developed basis of disaggregate choice modeling now widely employed in models of mode choice. In extending the discrete choice modeling framework to households and businesses, we have developed a model framework that is intuitive and transparent to the user, as well as theoretically sound and computationally tractable.

WHAT DO WE KNOW ABOUT TRANSPORTATION AND LAND USE?

The review of the literature in Chapter 1 pointed out that accessibility is the key to understanding the link between transportation and land use. When a transportation project

or policymakes it easier to access certain locations, these places become attractive to more or different types of development. However, improving accessibility does not guarantee that land use changes will follow. The type, amount, and timing of land use changes will also depend upon the state of the regional economy, the current levels of accessibility, the types of development permitted by land use regulations, the availability of services such as sewer and water, the desirability of the area for development, and other factors. Land use changes can also vary because travelers have many options about the ways they can change their behavior in response to a change in the transportation network or the cost of travel. They can adjust the timing, route, or mode of trips as well as change the locations where they live, work, or shop.

We do know that the type and scope of the transportation project or policy change can affect the range of potential outcomes. Larger scale transportation projects, like adding capacity to freeways, are more likely to produce measurable land use changes than small scale projects, like changing signalization on arterials. Similarly, policies that make large changes in the cost or ease of travel are likely to have greater land use impacts than policies that make minor adjustments. Highway improvements tend to produce more spatially diffuse impacts than transit improvements because more types of travelers are affected and the benefits are dispersed by the street systems connected to the highway.

WHAT ANALYTICAL TOOLS DO MPOS AND DOTS CURRENTLY USE?

MPOs and DOTs currently use a variety of tools for land use forecasts and land use impact assessment depending upon their size, the questions they have been asked to answer, and their interests in advancing the practice. In Chapter 2, we identified eight basic types of analytical procedures or tools currently available and in use. These are described below along with their strengths and weaknesses.

Use Of Comprehensive Plans and Other Land Use Regulations

It is important to understand the land use regulations that influence where and what type of development can occur. However, current practice tends to rely too heavily on public policy as the primary shaper of urban form. For political reasons, many regions produce "plancasts" that assume that development will occur where land use policies and regulations direct that growth. When using comprehensive plans in forecasting and impact assessment, it is important to evaluate realistically the effectiveness of these tools at shaping growth and to consider how the land market might produce different outcomes from those described in policy.

Qualitative Methods that Tap Expert Knowledge

MPOs and DOTs use a variety of qualitative methods to understand the complexity of urban development. These tools can be used as the primary method of analysis or in conjunction with other tools. Panels of experts, Delphi's, interviews, surveys, and case studies are qualitative techniques that rely on the knowledge and skills of one or more experts to determine where growth is likely to occur. These methods can combine understanding of

DOING LAND USE ANALYSIS

Chapter 4 describes similar processes for doing base case forecasts and land use impact or policy impact assessments. The steps are outlined in Table E-1. Both processes require understanding the existing transportation and land development patterns, making assumptions about the policy framework that will guide the process, estimating the amount of growth expected during the planning period in the study area, inventorying land that might be developed and any physical and regulatory constraints on that development, and assigning the expected growth in households and jobs to specific locations. The key difference between the processes is that an impact or policy assessment requires estimates of the ways that accessibility and travel behavior will change because of the investments or policy changes. In addition, an impact or policy assessment requires a comparison not only with existing conditions, but with the quantity, type, and location of future growth that would occur without the projects or policies.

Table E-1
Comparison of Steps in Base Case Forecasts and Impact or Policy Assessments

Base Case Forecast	Impact or Policy Assessment
1. Understand existing conditions and trends	1. Understand existing conditions and trends
2. Establish policy assumptions	2. Establish policy assumptions
	3. Measure the transportation outcomes with and without the projects or policy changes
3. Estimate regional population and employment growth	4. Estimate total study area population and employment growth with and without project
4. Inventory land with development potential	5. Inventory land with development potential
5. Assign population and employment to specific locations	6. Estimate how the project will change the location and type development within the study area from what would occur anyway.

The behavioral framework can be incorporated into these steps using a variety of land use analysis tools as summarized in Table E-2. Impact or policy assessments also require the use of travel demand models in Step 3 to provide estimates of the changes in transportation demand that transportation investments or policies will produce.

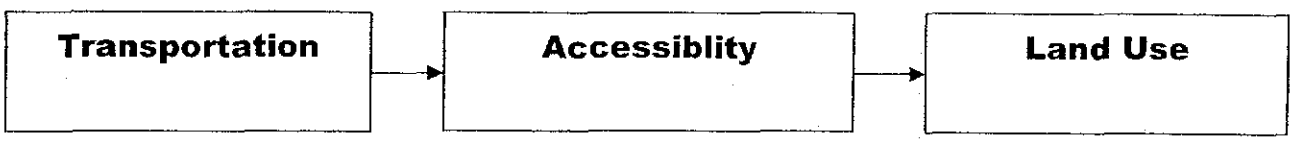
Similarly, among the factors required for consideration in State Transportation Planning, Section 135(c) requires States to undertake a transportation planning process which considers...

> 14. "The effect of transportation decisions on land use and land development, including the need for consistency between transportation decision making and the provision of all applicable short-range and longrange land use and development plans."

1.2 OVERVIEW OF THE RELATIONSHIP BETWEEN TRANSPORTATION AND LAND USE

The concept of accessibility is the key to understanding how transportation and land use relate to one another. Transportation promotes spatial interaction between activities or land uses. This interaction is measured by accessibility, which reflects both the attractiveness of potential destinations and ease of reaching them (Handy, 1993). Accessibility includes the attractiveness of a place as an origin (what opportunities there are to reach other destinations) and as a destination (how easy it is to get there from all other origins). The pattern of land uses is important because it determines the opportunities or activities that are within range of a given place. The potential for interaction between any two places increases as the cost of movement between them--either in terms of money or time--decreases. Consequently, the structure and capacity of the transportation network affect the level of accessibility. Figure 1 illustrates this relationship between transportation and land use.

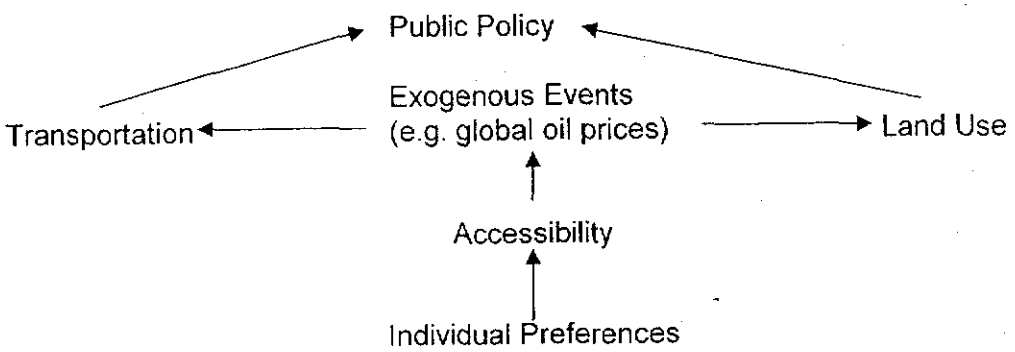
Figure 1: Accessibility Links Tran sportation and Land Use



The simple diagram in Figure 1 assumes that transportation and land use adjust to each other without the influence of other factors. However, in the real world, that is seldom the case. In the case of freeway construction, for example, land use policies must allow new development within the freeway corridor if the benefits of increased accessibility are to be realized. In addition, public policy makers must approve the project and allocate public funds for it to be built. Furthermore, the supply of both land uses and transportation can be affected by exogenous factors, such as the world price of oil or the cost of construction. A more detailed diagram adding these factors is shown in Figure 2.

The relationship between transportation and land use can thus be conceptualized as an interaction of the supply of and demand for accessibility that is further affected by public policies. The supply side considers the physical aspects of land use and transportation, while the demand side considers the preferences of individuals and firms. It should be noted from Figure 2 that preferences are not independent of public policies. In the given context of transportation-land use interaction, however, preferences are affected by public policies only through the effect of policies on accessibility.

Figure 2: Supply and Demand for Accessibility



A Critical Consideration: Travel Behavior

In order for a change in transportation to generate a significant shift in land use, the transportation change must affect accessibility enough to generate a change in land use. Consider the construction of a new freeway interchange. Locations in the vicinity of the interchange are made more accessible, and some shift in travel patterns occurs. As travelers make more trips to this location, development pressures intensify which leads to increased land values as competition for the sites rises, provided land use policies allow changes in land uses near the interchange. As new development occurs, this will cause additional shift in travel patterns. The magnitude of changes in land use depend upon a) how much accessibility is improved, b) the relative attractiveness of the locations near the transportation improvement, and c) the real estate market in the region.

Likewise, a land use change must also change accessibility significantly in order for there to be changes in travel behavior. For example, the opening of a new shopping center will shift shopping trip patterns. Customers who had previously shopped at other locations now frequent the new center. The degree to which customers shift (and therefore travel choices shift) depends upon a) the shopping center's location (how accessible it is to the shopping population) and b) its attractiveness relative to the other centers in the area. Will the opening of the center generate more travel? It is possible that some people will make more shopping trips, because the new center makes shopping more convenient, but it is also possible that some people will make fewer shopping trips, because the new center provides a larger number of shopping opportunities.

Note that the same principle can be applied to land use or transportation policies that do not deal with changes in capital structures. Raising parking prices can induce shifts from driving alone to ridesharing and transit use and, thereby, reduce the demand for parking. As parking demand declines, more intensive development can be accommodated. Given

sufficient demand, higher density development will follow. On the other hand, if there are competing locations where the price of parking is lower, some development may shift to those locations, since travelers will prefer them.

The changes in these examples will be mediated by the marketplace for housing and commercial expansion. In a robust fast-growing economy, demand for new housing and commercial activities will be high. Under these conditions, the effects of accessibility changes will be much stronger than they are in a weak market.

Factors that Affect Transportation — Land Use Relationships

Relationships between transportation and land use exist within the larger context of metropolitan growth and urban structure. It is, therefore, useful to review the major historical trends in urban development patterns and regional growth.

Urban Development Trends

It is well known that metropolitan areas within the U.S. have been decentralizing throughout this century, in concert with transportation technology improvements. The streetcar systems and commuter rail lines of the turn of the century made it possible for population to spread out from the central city core and to live at increasing distances from the workplace (Warner, 1962; Fogelson, 1993; Mohl, 1985; Goldfield and Brownell, 1990). Decentralization accelerated with the adoption of the automobile and truck in the 1920's and 1930's, and has continued to this day (Muller, 1981, 1995; Lowry, 1988). With population and employment decentralizing, metropolitan development densities have declined.

A comprehensive discussion of the causes of decentralization is beyond the scope of this review, but it is useful to identify the major factors involved. Decentralization is not simply the result of the adoption of the automobile and truck, but rather of a convergence of economic trends and policy decisions. Rising incomes have allowed more households to own automobiles and to move to the suburbs. In addition, widespread use of the automobile was promoted by a massive public highway building program and regulatory policies that kept auto ownership and fuel prices low. Decentralization was promoted by federal tax and mortgage policies that made suburban residential development more economically attractive. Decentralization was further promoted by changing industrial technology that favored horizontal manufacturing structures and shifts to service-sector activities less reliant on central location. Political and cultural factors also played a role: political fragmentation of local government that enabled escape from urban social and fiscal problems; ethnic and racial segmentation; historical preferences for single family home ownership; and the tradition of private property rights.[1] Decentralization is also not unique to the U.S.. Metropolitan areas throughout the developed world are decentralizing as a result of rising household incomes, rising auto ownership rates, and structural economic shifts. These trends are expected to continue and perhaps even intensify as the shift to an information-based economy and globalization continue.

3.3 THE ROLE OF GOVERNMENT IN THE LAND MARKET

Local governments shape the land use market by managing growth to maximize the longrun fiscal returns to their communities or to achieve a long-run vision for their community. Strategies can vary widely, even within a single metropolitan area, because of differing community characteristics. For instance, some communities zone abundantly for industrial development because they believe industry provides good jobs for their residents and pays more in property taxes than it costs in local governmental services. Other communities provide little or no land for industrial development because they want to avoid the pollution, traffic, and other costs of that type of growth. Communities will bid for the nonpolluting
light industries that are most desirable. The losers in the bidding process end up taking the less desirable industries (McHone, 1986; DiPasquale and Wheaton, 1996). Local government plans and policies can affect the supply of land available for development or the cost of development, as shown in Table 5. Some actions may have both affects, but are listed in the table under their primary area of impact.

Table 5
Summary of How Governmental Agencies Directly Affect the Land Use Market

Change the Supply of Land Available for Development	**Change the Cost of Development**
Land Use Regulations Comprehensive land use plans Subdivision ordinances Zoning Growth limits Urban growth boundaries Transfer/purchase of development rights Property tax reductions for certain uses, like agriculture Environmental regulations like wetlands protection and flood plain restrictions Public ownership--parks and open space Special assessments Land acquisition (right-of-way, etc.) Impact fees and exactions Infrastructure Provision Water and sewer expansions and extensions Transportation improvements Urban service areas and phasing of improvements Adequate public facilities ordinances	Economic Development Programs Tax incentives Density bonuses Public-private partnerships Land assembly Infrastructure provision Charges or Requirements for Development Development permit fees Ease and length of time required to obtain permits. Required on- or off-site improvements Real estate transfer taxes Design standards Parking requirements Inclusionary zoning

Changing the Supply of Land Available for Development

Local governments affect the supply of developable land through land use regulations that specify where and under what conditions development can occur and through the provision of infrastructure, such as water, sewer, and transportation systems, which are essential for urban levels of development. These policies influence the market mainly by restricting the supply of land available for development. They can not force development to occur in locations where the market does not support development.

Local governments regulate land uses in order to avoid incompatible land uses, efficiently provide public services, conserve natural resources and environmental qualities, improve economic opportunities, preserve quality of life, and avoid burdening current residents with the costs of growth. Most communities have long-range or comprehensive land use plans that set out their goals, objectives, and policies. Policies are implemented through subdivision, zoning, and other ordinances that identify where particular types of development are allowed, the process for obtaining approvals, and the conditions that may be placed on development (Porter, 1997; Nelson and Duncan, 1995).

These regulations can limit the amount and location of land available for certain uses. Traditional zoning ordinances regulate the types, intensities, and bulk of uses allowed within each zone (Kelly, 1988). Recently many communities have adopted additional growth management tools to more effectively manage where and when growth occurs. Urban growth boundaries specify where urban and rural land uses are allowed. Urban service areas have the same effect, but may also include a timing element that specifies the order in which areas will receive urban services. Growth limits regulate the timing of growth by setting limits on the rate of development. Agricultural preservation programs, such as exclusive agricultural zoning, lower property tax rates for lands actively farmed, and programs to buy or transfer development rights, keep land out of the urban development market. Land purchased for parks, open spaces, or rights-of-way is not available for development (Kelly, 1993; Nelson and Duncan, 1995; Porter, 1997).

Policies regarding the provision of urban infrastructure constrain the supply of developable land since urban development cannot occur without access to water, sewer, stormwater, and transportation systems. Development requires capacity in central facilities, like water and sewer treatment plants, and extensions of services to the areas where development is occurring. Developments which generate high levels of traffic such as large manufacturing plants, shopping centers, and multi-family housing requires access to roads with the capacity to handle these traffic volumes. Because it is expensive to add central facility capacity and extend infrastructure, developers prefer locations where these facilities are available, provided these areas are otherwise attractive to development. The supply of developable land is, therefore, constrained by the public and private resources available to extend roads and other infrastructure systems (Kelly, 1993; Nelson and Duncan, 1995, Miles et al., 1996).

Local governments develop capital improvement plans to identify the construction schedule for improvements to water, sewer, roads, and other infrastructure. Some areas have developed detailed plans specifying a phasing of service expansions over a number of years. These plans aim to most cost-effectively extend services, but they may not

4.4 DETERMINING LAND USE IMPACTS OF A TRANSPORTATION PROJECT

An impact assessment for a transportation project estimates the size and nature of any land use changes caused by the project within a defined study area. These changes in land use could occur for several reasons.

- The growth that would have occurred anyway could be arranged in a different pattern, with changes in the types, densities, or locations of new development. New commercial activities might choose sites that the project makes more accessible rather than other sites in the study area. For example, additional highway capacity could cause a shift of some residential development from urban to rural areas because of the improved access to jobs and other destinations from the rural area.

- The transportation project could cause some households or business to locate in the study area instead of in other places in the region or other regions. If access is improved to land on the urban fringe that is otherwise ready for development, developers may capitalize on the improved access and build homes in these areas instead of elsewhere in the region. The expansion of an airport might attract businesses dependent upon air service to locate in the study area instead of near another airport.

- The transportation project could stimulate changes in existing land uses and intensities in already developed areas. For example, residential properties near a new interchange might be redeveloped into commercial buildings, because the changes in accessibility will make the land more attractive to commercial users who will offer higher prices for the land.

None of these changes will automatically follow from changes in accessibility. There must also be demand for new development, locations within the study area must be attractive to development, and land use regulations must allow the development. All of these factors must be systematically evaluated in an impact assessment.

It is appropriate here to review information presented in previous chapters that relates to the role of accessibility and its influence on locational decisions. As previously stated, accessibility is a complex notion. Further, it is only one of many factors that influence the locations of households and firms.

Households, for example, have many accessibility needs. Access to employment is most conventionally recognized, but in today's world of multi-worker households, in which employment changes occur more frequently than was the case a generation ago, accessibility to employment location has taken on a more generalized form and plays a corresponding diminished role in household decisions about where to live. Accessibility to activities such as shopping, recreation and social life also are important and have different meanings to individuals of different ages and incomes.

In addition to all these ways in which accessibility still matters to households, other factors also clearly influence their locational choice. The most important are the price of housing and where housing is available within household budgets, given their base needs and

preferences. If price constraints do not significantly narrow a households choice set, other factors such as preferences or prejudices regarding race, ethnicity, life style, and amenities also contribute to the locational decisions.

In a similar way, accessibility takes on different meanings to different types of businesses. Businesses vary in the extent to which they value accessibility to customers, suppliers, labor markets and competitors. Nevertheless, as for households, accessibility is only one of many factors influencing business costs and business location decision making. Furthermore, the transportation costs play a smaller role today in the overall costs of doing business than they did a generation ago. One evidence of this is the declining proportion of national and metropolitan economic activity accounted for by the wholesale and distribution sectors of the economy. In less than a generation, wholesale and distribution activity's proportion of all economic activity has shrunk by a factor of 50 percent. This is not merely the result of businesses internalizing their transportation costs; if anything, the trend has been in the other direction.

Thus, both for households and businesses, transportation accessibility has become both more complex and more generalized a notion; thus, it is more difficult to define and apply in the context of location choice models. This trend is likely to continue.

Some Differences from the Base Case Forecasting Process

An impact assessment uses a process similar to that used in a base case forecast. The process includes understanding existing conditions, establishing policy assumptions, estimating study area population and job growth, and assigning that growth to locations and types of development with the study area. But there are some critical differences because an impact assessment considers whether a transportation project will result in changes in the location of households and firms.

As discussed in Chapter 1, land use changes are the result of changes in travel behavior generated by the project. Thus, one difference between impact assessments and base case forecasts is the additional step of evaluating how the transportation project changes accessibility and travel behavior. Another difference is that an impact assessment measures differences in land use patterns between a future with the transportation project and one without it. This comparison distinguishes between land use changes that would have occurred anyway and those related to the transportation project. Two forecasts of future land uses--one with and one without the project--are needed to make this comparison.

Basic Steps in Impact Assessments

With these differences in mind, the steps in an impact assessment process are:

1. Understand existing conditions and trends.
2. Establish policy assumptions.
3. Measure the transportation outcomes with and without the project.
4. Estimate total study area population and employment growth with and without project.
5. Inventory land with development potential.
6. Estimate how the project will change the location and types of residential and business development within the study area.

Table 17
Recommended Tools for Understanding Existing Conditions for an Impact Assessment

Tools	Primary Tools	Secondary Tools
Qualitative Methods		
Delphi/Panel		
Interviews/Survey/Case Studies	◆	
Allocation Rules		
Decision Rules		
GIS	◆	
Statistical Methods		◆
Regional Economic and Demographic Models		
Formal Land Use Models		

Step 2: Establish the Policy Assumptions

Policy assumptions establish a framework for the impact assessment. Decisions must be made about the policies that are assumed to affect land uses. These include zoning, sewer and water extensions, and transportation projects. As in base case forecasts, impact assessments generally assume that development will continue as it has in the past, except for the introduction of the new transportation project being studied. The assumptions must list specific transportation projects that are assumed to be built within the study period. One option is to adopt the same policy assumptions used in the base case forecast for the regional or state-wide transportation plan. This facilitates use of data and results from the earlier study.

Sometimes, impact assessments explicitly include different policies than a base case. For example, the assumptions may include a change in zoning near transit stations or interchanges. If this is done, it is important to distinguish the role of the project with and without the added policies.

Product

The product for this step is a list of the policy assumption being used in the analysis.

Step 3: Measure the Transportation Outcomes With and Without the Project

Transportation projects change travel behavior and this in turn produces changes in land use. Thus, an important step in an impact assessment is an understanding of how travel behavior would change because of the project. The project might affect the movement of people (e.g. a transit project), goods (an intermodal freight facility), or both (highway projects). This has implications for the size of the impact area and the types of movement to analyze. Transit projects, for example, tend to have localized impacts while highway

projects tend to have more diffuse impacts because of the number and nature of travelers who use the facilities.

Travel models predict how many trips are made, where (and in some models, what time) the trips occur, the modes of travel used, and specific routes used. The models can estimate the number of trips and their location, length, and mode with and without the project. Travel models can also identify overall congestion and specific points of congestion. The models can also produce estimates of zonal impedance which can be used to measure accessibility to employment and population from the study area.

Product

The step produces forecasts about where and to what degree travel behaviors and accessibility will change because of the project.

Basic Questions

How will study area travel behavior change without the project? What differences will the project make in travel behavior?

- How will the number of trips in the study area change?
- Will the modes of travel change?
- How much will travel speeds and times change?
- How much and more will the distribution of trips by time of day change?
- How much and where will be congestion levels be changed?
- Will the movement of freight change?

How will accessibility to, from, and within the study area change with and without the project?

- How much and where will access to jobs change?
- How much and where will firms access to workers change?
- How much will access to other major destinations change?

How will the cost of travel change for study area residents or businesses with and without the project?

- Where, how much, and for which people will the cost of travel change?
- Where, how much, and for which firms will the cost of freight movement change?

Appropriate Analytical Tools

The key tools are travel demand models and freight models. These models consider a series of decisions that the traveler or shipper must make. The following discussion briefly describes the steps in a typical travel demand model.

The first step determines how many trips will be generated by the land uses in each zone. Trips are typically divided into categories such as home-based work, home-based shopping, home-based other, non-home-based trips, and truck trips. Trip generation rates can vary household characteristics, such as the number of people in the household and the number of automobiles owned.

The second step links trips producers, such as households, to destinations, such as stores. These estimates are based on the number of origins and destinations in a zone and some measure of the cost or distance of travel between the zones.

The third step determines the modes of travel used. Mode choices are based on travelers personal characteristics, the costs of travel, and time involved in travel.
The fourth step assigns trips to paths in the transportation network. Trips are first assigned to the shortest link, but if this route becomes congested because of the number of trips assigned to it, some may be reassigned to less congested routes.
A variety of commercial and agency developed models are available to estimate travel demand. These models have been criticized for their focus on motor vehicle trips, inability to analyze the linking of trips into multiple purpose chains, insensitivity to many socioeconomic characteristics, insensitivity to factors affecting pedestrian and bicycle trips, lack of feedback between choices, and absence of time-of-day analysis (Beimborn et al., 1996; Harvey and Deakin, 1993). There are a number of efforts underway to improve travel demand models. To learn more about the models and their strengths and limitations, consult one of the following:

Travel Demand Model Development and Application Guidelines, prepared for the Oregon Department of Transportation by Parsons Brinckerhoff, June 30, 1995.

A Manual Of Regional Transportation Modeling Practice for Air Quality Analysis, prepared for the National Association of Regional Councils, by Deakin, Harvey, and Skabardonis, July, 1993.

Issues

One of the inputs into a travel demand model is a land use forecast. Thus, the outputs from the models are based on constant assumptions about land uses. The analysis assumes the same pattern of land uses is generating trips even as it handles different transportation networks. The lack of integration between transportation and land use modeling processes means that the cumulative impacts of land use changes resulting from transportation system changes are not considered.

Step 4: Estimate Total Study Area Population and Employment Growth With and Without the Project

Estimates of the amount of population and employment growth expected in the study area put some boundaries on the size and nature of the land use impacts. If the study area is in a growing region or a growing part of a region, a transportation project has the potential to cause significant changes in land uses. In contrast, if the study area is expected to have a low growth rate, even with the project, there is much less potential for land use change. Another objective of this step is to determine whether the transportation project causes any shift in population or jobs to the study area from other parts of the region or state. The

analysis of shifts in population and jobs is most important for projects at the local and intermetropolitan scales. At the local level, a transportation project may induce households or jobs to move from other parts of the region to the study area. For example, a highway project that improves accessibility to vacant land on the urban fringe could make that area more attractive to residential developers and cause a shift in development from another part of the region. At the metropolitan and intermetropolitan levels, the analysis can consider both whether the entire study area might grow faster as a result of the project, and whether growth is shuffled around among counties within the study area. For instance, improvements in an intermetropolitan highway corridor may induce growth only at the points along the corridor that are most attractive to development, causing some counties to grow more rapidly than they would without the improvements.

Product

This step will produce an estimate of the number of people and jobs expected in the study area at the end of the planning period with and without the transportation project. This will indicate the magnitude of growth expected and also whether the study area (and perhaps individual counties) will have more or less population and job growth because of the transportation project.

Additional Basic Questions for an Impact Assessment

In addition to needing to know how much population and employment growth is expected in the study area, an impact assessment must consider the following question:
Will the transportation project induce any increases (or decreases) in population or jobs in the study area over what would occur anyway?

Appropriate Analytical Tools

The appropriate tools for this analysis vary with the scale of the study area and whether there are existing employment and population forecasts that can be utilized.
There may be requirements that official state forecasts be used. It is important to check the policy assumptions of any forecasts to determine if they are the same as those of the project and also to determine whether the forecast includes the transportation project being studied. If the forecasts are based on different assumptions, then adjustments will be needed to reflect the policy assumptions of the analysis.
The following methods can be used to estimate the control totals with and without the project.

Qualitative Methods. A Delphi or panel can be used for estimating total population and job growth for any size of geographic area. This is a useful technique for evaluating the suitability of an existing forecast and considering how the project (or its deletion, if it is assumed in the forecast) would affect these forecasts. A variation on this approach is for the analyst to interview experts and use this information to help produce the forecast. In addition, case studies of other places with similar projects can be used to estimate the

amount of population and job growth, provided similarities and differences between the study area and the case study locations are carefully assessed.

Qualitative methods may be the only method available for local impact assessments. As in a base case forecast, they can also be used as a secondary tool providing insights on newly emerging businesses or population groups, especially if the changes in accessibility could influence their location. Quantitative methods tend to miss these changes because they rely on historical data which does not capture the behavior of new groups.

Statistical Methods. Regression analysis of recent growth trends is useful for predicting underlying patterns of growth, especially for larger areas. This tool can predict how growth would occur if transportation investments follow past patterns. However, if the transportation project being evaluated deviates from past investment, trend analysis will not pick up the ways the accessibility improvements of the project could change the forecasts. In these cases, the analysis of total expected growth with the project will need to be done by another method, such as one of the qualitative approaches.

Regional Economic and Demographic Models. Regional economic and demographic models that consider the impacts of transportation on the economy are well suited for estimating population and employment growth with and without a transportation project for metropolitan and intermetropolitan impact assessments. Since they typically use counties as the unit of analysis, they are not as useful for predicting study area total growth for local impact assessments when the study area is smaller than a county. For these smaller studies, the county estimates would need to be further broken down into study area and non-study area estimates of growth using another method, such as one of the qualitative approaches.

Formal Land Use Models. Formal land use models can be used to predict total population and employment growth for study areas that are smaller than the area covered by the model. A metropolitan land use model could produce estimate of growth with and without the project for a local impact assessment within the metropolitan area. Likewise a statewide model could estimate total growth for an intermetropolitan corridor. The accuracy of these forecasts improves when the study area encompasses a number of zones within the model, as there is more uncertainty in the estimates for a single zone than in a collection of zones.

These recommendations are summarized in Table 18.

Table 18
Recommended Tools for the Estimating Total Study Area Population and Employment Growth for an Impact Assessment

Tools	Primary Tools	Secondary Tools
Qualitative Methods		
Delphi/Panel	◆	◆
Interviews/Survey/Case Studies	◆	◆
Allocation Rules		
Decision Rules		
GIS		
Statistical Methods		◆
Regional Economic and Demographic Models	◆	
Formal Land Use Models	◆	

Step 5: Inventory Land With Development Potential
The inventory of land with development potential is similar to that for a base case forecast. The process identifies vacant land or land that could redevelop or infill, subject to the assumed policy constraints and the need for lands for public facilities.
Product
The product of this step is an inventory of the land available for development in the study area, including an assessment of regulatory constraints on the types and densities of uses.

Analytical Tools
As in other steps, a more detailed analysis may be needed for local impact assessments. In particular, more emphasis may be needed on the potential for redevelopment and infill in already developed areas near the project, because highly accessible places can develop higher value, higher intensity uses.

The effects of policy constraints must also be carefully considered, because they may prevent changes in land uses from taking place despite improvements in accessibility. If one of the policy assumptions is that current zoning will remain in effect, then the impact assessment should evaluate whether there would be pressure to change that zoning because of the changes in accessibility. The process should also consider any reduction in the amount of developable land because of land required for the project.

The appropriate tools for carrying out this analysis are the same as in a base case forecast, as shown in Table 19. GIS is the primary tool for analyzing and displaying the data, although manual methods may suffice for some local impact assessments. Interviews and decision rules can provide information or rules for identifying developable land, when the criteria for doing so is not obvious, such as which lands are ready for redevelopment. More emphasis may be placed on interviews in a local impact assessment because of the heightened need to understand the local actors in the land market.

Table 19
Recommended Tools for the Inventory of Developable Land for an Impact Assessment

Tools	Primary Tools	Secondary Tools
Qualitative Methods		
Delphi/Panel		
Interviews/Survey/Case Studies		◆
Allocation Rules		
Decision Rules		◆
GIS	◆	
Statistical Methods		
Regional Economic and Demographic Models		
Formal Land Use Models		

Step 6: Estimate How the Project Will Change the Location and Types of Population and Employment Growth in the Study Area

This final step in the process estimates where and what type of development will occur with and without the transportation project. The objective is to understand how land use patterns would be different with the project. This step assigns the estimated change in jobs and households to specific areas with developable land. The expected growth may be rearranged because of the project, additional growth may be attracted and must be located, and existing uses may change.

This analysis takes into consideration both present and future travel conditions in the study area. It may be that accessibility is not an impediment to growth in the study area at the present time, but increased travel demand could lead to levels of congestion during the study period that discourage households or firms from locating in the area. Thus, some time during the study period, the level of accessibility without the project could limit growth.

Product
The product of this step is forecast of the types, quantities, and location of new development in the study area with and without the project. This report shows how the project would change development from what would have occurred anyway during the study period.

Basic Questions
In addition to the questions of a base case forecast, an impact assessment must consider how households, firms, or developers will react to the changes in accessibility or transportation costs that the project produces.

- Which locations, if any, will become more (or less) attractive to households?
- Which locations, if any, will become more (or less) attractive to firms?
- Where will the profitability of development change?

Appropriate Analytical Tools

The tools for carrying out this analysis are similar to those in a base case forecast, where they are discussed in more detail. The primary tools are Delphis or panels, allocation rules, and statistical methods. A panel of experts can analyze the information on developable land, growth trends, and changes in accessibility and make forecasts of whether the growth patterns will change because of the project. Allocation rules that consider levels of accessibility, such as simple gravity models, can assign people and jobs to specific zones. Statistical methods that combine information on the factors affecting people's and firm's choices, including changes in accessibility, can project where people and firms will locate within the region.

The primary assignment process can be supported by information gathered in interviews, from case studies of places with similar projects, with decision rules developed from local or national data, and by spatial analysis using GIS, as summarized in Table 20.

Table 20
Recommended Tools for Assigning Households and Firms in an Impact Assessment

Tools	Primary Tools	Secondary Tools
Qualitative Methods		
Delphi/Panel	◆	
Interviews/Survey/Case Studies		◆
Allocation Rules	◆	
Decision Rules		◆
GIS		◆
Statistical Methods	◆	
Regional Economic and Demographic Models		
Formal Land Use Models		

2000 US Census Statistics

Census Tract 9501, Block 1, Guemes Island (Blocks 1002-1024 & 1038-1042)

Resident Population		
		percent
Total	563	100%
Median Age	53 years	-
Persons 20 -39 years	36	6%
Person over 55 years	239	42%
Persons over 65 years	140	24%
Resident Children		
Persons under 18 years	69	12%
School age children	54	5%
High School	23	4%
Housing		
Total Housing Units	592	100%
Occupied units	287	48%
Vacant units	305	52%
Seasonal, recreational, or occasional use	295	49%
Total households	287	100%
Households with Children 18 years and under	44	15%
Households Headed by person over 55 years	167	58%
Employment (1in 6 sample)		
Households with no wage or salary income	151	52%
Households receiving Social Security income	142	50%
Households with Self employment income	57	19%
Commute Time		percent of total
residents		
Persons who commute to work	187	33%
Commute less than 15 minutes	48	
Commute between 15 and 34 minutes	99	
Commute from 40 minutes to 90 minutes or more	40	

Persons per occupied housing unit	1.96

ADDENDUM TO ENVIRONMENTAL CHECKLIST

A. **Overview.**

The Guemes Island ferry is operated and maintained by Skagit County as a part of the county's road system. See *State ex rel. King County v. Murrow*, 199 Wash. 685, 93 P.2d 304 (1939). The extension of ferry operating hours on Monday through Thursday evenings is a non-project action (WAC 197-11-774.) It is authorized under RCW 36.54.010. The extension was implemented for a trial period, ending June 30, 2008, to allow the county to evaluate operational and financial information gathered during the trial period.

The extension of ferry operating hours will have no impact on the county's Comprehensive Plan, development regulations, zoning, shoreline planning, or land use plans. It will not require any changes to the existing ferry facilities, parking, or lighting. Although the Guemes Island ferry is a part of the county's road system, the change in ferry schedule primarily concerns a specific geographic area – Anacortes and Guemes Island – and a site specific analysis is not required. WAC 197-11-442(3).

B. **History of increasingly restrictive zoning on Guemes Island.**

1. On July 24, 1961, in resolution No. 3678, Skagit County established a planning department and created a planning commission of nine members as a component of that department.

2. In May 1963, M. G. Poole and Associates, a firm of professional planners and consultants, delivered a 51-page report in booklet form entitled "Regional Planning in Skagit County" to the county commissioners. M. G. Poole and Associates identified all of Guemes Island as "livable area." Map: Skagit County, page 2; Map: Distribution of Population in Lowland Area, page 5. Guemes Island was not identified as an area incompatible with residential development, i.e., floodplain, agricultural area, septic tank problem area, port district or airport (Map: Skagit Lowland Area, page 9), and M. G. Poole and Associates recommended a minimum lot area of 10,000 square feet for residential lots. Page 8.

3. On April 12, 1966, the Skagit County Board of County Commissioners adopted an Interim Zoning Ordinance, including a zoning map. At that time, all of Guemes Island was zoned Residential-single and two family. Other than requiring a minimum lot size of 10,000 square feet, water availability, and septic needs, land division and development were unrestricted. See Interim Land Use Plan-map adopted 4-5-1966

4. On September 10, 1968, Skagit County adopted a Comprehensive Plan. Under the plan, Guemes Island was zoned (1) Residential-single and two family and (2) Heavy Industrial. The Heavy Industrial mapping change was reversed on appeal. See *Smith v. Skagit County*, 75 Wn.2d 715, 748, 453 P.2d 832 (1969).

5. Skagit County revised its Comprehensive Plan in July 1972. The 1972 Comprehensive Plan provided for five zoning districts on Guemes Island:

Rural (RU)
Residential (R)
Rural Intermediate (RI) (estimated 30 acres)
Public Use (P) (estimated < 5 acres)
Commercial-Limited Industrial (C-LI) (estimated < 5 acres)

6. Under the Skagit County Zoning Ordinance adopted June 11, 1979 (Resolution no. 8003), the following development regulations applied to the zoning districts on Guemes Island:

Zoning District	Minimum Lot Size	Former SCC Section
Commercial-Limited Industrial (C-LI)[1]	10,000 square feet	14.04.070
Residential (R)	varies[2]	14.04.090
Rural Intermediate (RI)	2.5 ac.	14.04.098
Rural (RU)	5 ac.	14.04.100
Public Use District (P)	n/a	14.04.130

Most of Guemes Island was zoned RU on this 1979 pre-GMA zoning map. Only thin strips of the outer shoreline area on some parts of the island were zoned R, or in one very small case, RI.

7. In 2000, the county rezoned much of the 5 acre Rural zoned land on Guemes Island to Rural Reserve, with a minimum 10 acre lot size, and placed 502.2 acres in the Rural Resource zone, which has a 40 acre minimum lot size. The Comprehensive Plan adopted July 24, 2000, provides for the following zoning districts on Guemes Island:

Zoning District	Minimum Lot Size	SCC Section	Total area
Rural Reserve (RRv)	10 ac.	14.16.320	3,984.6 ac.
Rural Intermediate (RI)	2.5 ac.	14.16.300	801.4 ac.
Rural Resource-NRL (RRc-NRL)	40 ac.	14.16.430	502.2 ac.
Rural Business (RB)	n/a	14.16.320	9.3 ac.
Small Scale Recreation and Tourism (SRT)	n/a	14.16.130	15.8 ac.
Rural Center (RC)	n/a	14.16.110	1.6 ac.

[1] The C-LI zone was deleted following its challenge in Smith v. Skagit County, 75 Wn.2d 715, 435 P.2d 832 (1969).

[2] A single-family residence served by public sewer could be built on an 8,400 sq. ft. lot. With Health Department approval, a single-family residence on a septic system could be built on a 12,500 sq. ft. lot, and a duplex on a septic system could be built on a 13,000 sq. ft. lot.

C. **Island geography restrains development on Guemes Island.**

1. On February 12, 1991, the Skagit Valley Herald reported that DOE "has identified six pockets of saltwater intrusion along the south, west and northwest coasts of the island." Funding sought for USGS study.

2. The 1994 Hydrogeology and Quality of Ground Water on Guemes Island report, which was considered during the adoption of zoning amendments for Guemes Island, addresses regional and local geologic history; area distribution and physical properties of significant hydrogeologic units; basic principles of the hydrologic cycle and ground-water occurrence; precipitation; recharge and discharge of ground water on the island; water-level fluctuations and trends; water budget of the island; seawater intrusion; general chemistry of ground water; and the need for monitoring and additional studies. (Comprehensive Plan, Appendix C at 13-14.)

3. In June 1994, Skagit County adopted a Final Environmental Impact Statement (EIS) for adoption of the Land Use Element in the Comprehensive Plan

a. The Final EIS provides that "[t]he Proposed Action [adoption of the Skagit County Comprehensive Plan Land Use Element] analyzes how growth will occur in unincorporated Skagit County during the next 20 years." (at page 5)

b. The Final EIS identified significant unavoidable adverse impacts that would occur (at page 6):
The following are unavoidable adverse impacts that are common, to a greater or lesser degree, to each of the alternatives:
•The population will increase over the next twenty years. With this growth will come increased development, noise, light and glare, potential for traffic congestion and demand for public services.
•With new development, the loss of environmentally critical areas and wildlife habitat areas may occur.
•Changes to the drainage pattern, soils, geology and topography will occur with new development.

c. The final EIS provides that "[b]ecause of existing low light levels in rural County areas, rural development could have a significant light and glare impact on adjacent land uses." (page 90).

d. The final EIS provides that "Skagit County operates the Guemes Island Ferry, a 22 vehicle vessel, which provides frequent daily service between Guemes Island and Anacortes." (page 95)

e. The Final EIS adopted the following projections for population and housing:

Total Population (page 20)

1990	1994	2000	2010
79,555	93,647	111,567	113,885

Rural Population and Housing Distribution (population/housing) (page 21/24)

	1990	1994	2000	2014
rural:	38,186/16,038	44,951/18,879	48,535/20,385	53,741/22,628
total:	79,555/33,413	93,647/39,331	111,567/46,859	137,597/57,934

f. The Final EIS provides that the "development forecast for the "Rural" designated area of the county would likely be evenly distributed as the alternative does not incorporate any goals to manage this growth in any fashion." (page 21)

g. The Final EIS provides that "Skagit County intends to adopt the proposed Comprehensive Plan prior to initiating final development guidelines and regulations to implement the Plan." (page 37)

h. The Final EIS recommends that Guemes be zoned rural. Figure 1, Appendix C.

4. Resolution 15570 Adopting an Interim Seawater Intrusion Policy (December 12, 1994) restricted development on Guemes Island by providing, in part:

> The Washington State Department of Ecology identified coastal seawater intrusion areas on Guemes Island in the late 1980s. A U.S. Geological Survey (U.S.G.S.) groundwater study began in October, 1991. More than forty individual wells have been drilled on Guemes Island since the beginning of the U.S.G.S. study. Additional hydrogeological investigative work by Dr. John Oldow will begin in late 1994 and continue through 1998 on Guemes Island. A Sole Source Aquifer application has been filed with the U.S. Environmental Protection Agency for Guemes Island.
>
> . . .
>
> This Interim Policy is based on the hypothesis that low pumping rates, lowered water use, and judicious location of well sites will eliminate or reduce seawater intrusion in newly developed wells and surrounding wells. However, the cumulative effect of additional wells on seawater intrusion into the aquifer is not yet known. The observation of significant increases in aquifer chloride levels may result in a modification of this policy.
>
> . . .
>
> Limits placed on building permits.
> Land divisions with chloride test results < 199 ppm may be approved with conditions.
> Land divisions with chloride test results > 200 ppm will be denied.

5. The Guemes Island Planning Advisory Committee commented during the SEPA process:

> a. County islands generally have less groundwater supply because of the prominence of bedrock located near the surface, lower levels of precipitation and salt water intrusion." (DEIS at 43)
>
> b. On Guemes Island, the bedrock indeed limits the amount of water which may be stored in the lower aquifer. Moreover, an unknown portion of the so-called recharge seeps out along the coastal bluffs as highly impermeable layers prevent it from reaching the deeper water-bearing layers.
>
> Much of the problem concerning salt water intrusion has to do with the residential development along the shores of these islands and the fact that many wells are thus located close to the fresh water/seawater interface.
>
> [Guemes Island is a sole source aquifer.] The ground water of such areas must be protected from depletion and contamination. Growth and development shall not be directed to them by any means. Rezones, variances, and special use permits shall only be issued after careful consideration of possible impacts to the ground water.

6. Gerald Steel commented and proposed that rural density be changed from an average 1 dwelling unit per 5 acres to 1 dwelling unit per 10 acres:

> The DEIS shows that there are an excess of building sites in the unincorporated county under all plans considered. To better meet the goal of the cities and the county to have an 80% - 20% growth allowance, I suggest that the rural recommendation of an average density in the rural area be reduced from 1 unit per 5 acres proposed by committee to 1 unit per 10 acres.

7. The Final Supplemental Environmental Impact Statement (SEIS) for the Skagit County Comprehensive Plan, May 1997, recognized that development of existing lots was restricted by poor soils (for septic systems) and water resources.

8. Holiday Hideaway contains minimum size lots (6,000 to 9,000 square feet) with extremely poor soils and a water system of questionable capacity for full development. (Skagit County memo Re: UGAs and Land Capacity Analysis, and Clustering dated January 13, 1997.)

9. On December 1, 1997, the U.S. EPA designated Guemes Island as a sole source aquifer (62 FR 230 at 63545-48, December 1, 1997.) This designation requires that "all Federal financially-assisted projects proposed in the designated area will be subject to EPA review to ensure that they do not create a significant hazard to public health."

10. The Skagit County Coordinated Water System Plan Regional Supplement (July 2000) estimated the Guemes Island recharge area at 5.75 square miles with the remainder of island

being bedrock. It also provided that Guemes Island contained indications of saline water intrusion on wells on southwest, southeast and north coasts and some inland wells.

11. The Square Harbor area of Guemes Island was undeveloped in 1990 and remains substantially undeveloped forest. The area is a poor choice for intensive construction because it is largely underlain by rock and has little water available to support development, it contains critical areas: several eagle nest sites, wetlands, stream, steep and unstable slopes; and it is zoned for 5 and 10 acre lots. (Roz Glasser comment on Comprehensive Plan Update, April 18, 2006.) "devastating impacts to the sole source aquifer and rural character of the island would be likely."

D. Litigation has imposed limits on development on Guemes Island.

1. The Western Washington Growth Management Hearings Board has ruled that any density increases on Guemes Islands be preceded by detailed studies. The Western Washington Growth Management Hearings Board held:

> Evergreen Islands did an intricate study of Fidalgo and Guemes Islands showing the number of new lots that theoretically could be created after aggregation was rescinded. It claimed that dropping the aggregation requirement would significantly increase the density potentials for those Islands and would contribute to a new pattern of low-density sprawl.

Evergreen Islands, et al. v. Skagit County, WWGMHB No. 00-2-0046c, Final Decision and Order at 3 (February 6, 2001)

2. The county dropped the challenged lot aggregation ordinance and earned an accolade:

> [Friends of Skagit County] complimented the County on not allowing development on substandard lots one acre or less within the Fidalgo Island Subarea Plan boundary and on Guemes Island until those subarea plans are adopted.

Evergreen Islands, et al. v. Skagit County, WWGMHB No. 00-2-0046c, Compliance Order at 3 (June 23, 2004).

3. One Hearings Board member reiterated the kudo:

Also, the County has responsibly disallowed the development of substandard lots of less than an acre on Fidalgo Island and Guemes Island until subarea plans for those areas are completed.

Evergreen Islands, et al. v. Skagit County, WWGMHB No. 00-2-0046c, Compliance Order at 9 (June 23, 2004) Gadbaw (concurrence).

4. To settle another GMA issue, the County disallowed the development of substandard lots of less than an acre on Guemes Island until subarea plans for those areas are completed. (Evergreen Islands, et al. v. Skagit County, WWGMHB No. 00-2-0046c, Compliance Order Lot Aggregation at 15 (May 19, 2005).)

E. Growth has created a need for additional ferry service.

1. In 2001, Skagit County commissioned a comprehensive review of ferry operations, planning, management, and policies. Adequacy of the schedule and its impacts on Ferry operations were included in the issues the review was commissioned to address.

2. The Final Report Guemes Island Ferry Operations Management Analysis (March 4, 2003, provides:

a. The report recognizes that growth on the island creates a need for additional ferry service:

> The Guemes Island Ferry Capital Facilities Plan 2001-2015, documented that in the previous two decades the Guemes Island population has grown and Ferry System ridership has increased significantly.

b. The report provides the following information about ridership composition and growth between 1980 and 2000:

Ridership composition	Vehicle/ Driver	Walk-ons	Non-paying	Total
1980	43,429	49,778	12,785	105,992
1990	71,874	59,729	11,527	143,130
2000	106,410	86,862	8,604	201,876

Change Since 1980	Vehicle/ Driver	Walk-ons	Non-paying	Total
1980	----	----	----	----
1990	65.5%	20.0%	-9.8%	35.0%
2000	145.0%	74.5%	-32.7%	90.5%

c. The 1991 Guemes Island Ferry Capital Facilities Plan projected "total ridership on the system in the year 2005 to range from 182,000 to 196,500 representing an increase of 28% to 38%." (The 1991 projections were low. Actual ridership in 2000 exceeded the estimates for 2005.)

d. The Guemes Island Ferry Capital Facilities Plan (2006-2020) estimated a 29.0% growth in total ridership over the next 15 years. (Chart 4.15, page 34).

Year	Estimated total ridership
2010	250,000
2016	285,000
2020	300,000+

e. The county estimates that current total vehicle carrying capacity will be exceeded in 2014 and that "the data suggests that in about 10 years, without the addition of runs or a bigger vessel, the ferry system will not be able to accommodate more growth." Level of Service (page 35)

f. Ferry employees assessed the adequacy of the Ferry schedule and its impact on Ferry operations, in part, as follows:

•It provides good service to the customer; however, the number of additional trips is increasing. The best that can occur are two trips within the 30-minute schedule. Since the vessel is making more trips, the crews need to go to 8-hour days, 13.5 and 14 hour days are too long.
•An increase in unscheduled trips and changes in the Purser's reconciliation activities require crews to work more than the Certificate of Inspection (COI) limited 12 hours. Due to the increased activity, crews are getting tired and should not be working beyond 12 hours.

. . .

•The number of extra runs is increasing. The 12.5-hour day ends up being 13.5 hours. Two trips can be delivered, however, a third trip can only be accomplished when a person is left on the dock to collect money and sell tickets to drivers and passengers.
•The current schedule does not meet demand. Trips are needed before 6:00 a.m. and after 6:00 p.m. in the summer.
•There is demand for additional service in the evening; other runs are not full.

. . .

•Increased demand has resulted in additional unscheduled trips and is increasing the need to work more than 12 hours per day. A 12.5-hour day is too long when making additional trips. At a minimum, shorter work shifts need to be created for the summer schedule.

. . .

•Very busy, demand is greater than the available service. Difficult to consistently stay with scheduled sailings during the half scheduled service.
•Create 8-hour day schedules for crews, expand the operating day to accommodate the increase in demand, . . .

g. Ferry customer responses to a survey question about service expansion were summarized as follows:

> Ridership is divided regarding service expansion. Almost 53% of respondents (251) people) did not want the schedule to be extended and 45% (215 people) did. Those against extending the schedule favor using it as a growth management or land use tool. Those who want service expanded also added comments, including "reluctantly," "seasonally," "for holidays, specifically," "between the hours of 11:00 a.m. and 1:00 p.m.", or cite their interest in being able to access school activities or services off-island. Full-time residents/property owners were less likely to favor (38.4% yes) extending the schedule than part-time

residents/property owners (49.1%), full-time residents/renters (57.9%), and non-resident Ferry customers (66.7%).

h. The report concluded, from survey responses, that:

•The most popular time to extend service to was 10 p.m. – almost one quarter of those selecting a preferred hour to extend service (a total of 226 or 46% of respondents) selected this hour.
•Regarding continued double trips (on-demand, unscheduled trips), almost 90% of respondents felt that the current on-demand schedule should "remain as is." Written comments included:

-The System should return to running three trips per hour'
-Provide more trips when "backed up" at the beginning, middle and end of the day;
-"Until all cars are gone;"
-Adding a 12:30 p.m. Ferry run during summer weekdays;
-Reducing the break in the middle of the day; or
-Running service on the half hour for the majority of the day until 6:00 p.m.

i. Survey respondents ranked the following as the top five management and operating priorities:

Vessel safety	73%
Continuation of Ferry service available on demand	42%
Planning for future Ferry traffic growth	36%
Maintaining current weekday hours of operation	33%
Expanding weekday hours of operation	31%

j. The report assessed the impact of ridership growth on ferry scheduling as follows:

Growth in Ferry Passengers impacts schedule requirements and reliability in three aspects:

1. There is increased vehicle demand at both trip ends, and therefore, increased frequency of sailing operating at capacity on both legs of the round-trip. In the past, the Ferry was more likely to be operating at capacity on one side of the Guemes Channel, but not on the other. As the population of the Island grows and demand increases, so has and will the frequency of trips operating at capacity on both sides of the crossing. Concomitant with this growth comes other impacts, i.e. an increase in passengers not traveling on frequent user (punch) cards, and therefore an increase in full fare ticket sale requirements.

2. There has been an increase in the number of oversize and large vehicles that require additional loading and unloading time. This includes construction-related vehicles such as lumber and concrete trucks.

3. There is an increase in the number of walk-on passengers. This increase has two separate impacts: offloading time increases as vehicles wait for passengers to clear the ramp; and time is required for passenger ticket sales. In the September 27 videotape, the volume of additional walk-on passengers was a significant determinant of ticketing time: because there is only on ticket seller for both vehicles and walk-on passengers, the seller must interrupt his/her processing of vehicles, turn and sell tickets to the walk-ons, then return to vehicle ticking – all of which adds time to the process.

k. The report addressed the popularity of unscheduled weekday runs after 6 p.m.:

A defining feature of Guemes Island Ferry service is the practice of providing additional Ferry runs when the vessel overloads, i.e. when vehicle demand exceeds capacity for a given sailing. Historically, the Ferry has provided double and triple runs beyond the regularly scheduled sailing. This has the effect of providing continuous, on-demand Ferry service during and extending beyond the scheduled hours of operation. Such on-demand service is extremely popular with Ferry riders. . .

l. The report addressed the significance of the county's practice of providing unscheduled weekday runs after 6 p.m.:

Impact of Level of Service Standards on Current Practices. Although the County does not have a Ferry System level of service in place, it does have a practice in effect: all vehicles in line at Anacortes at 6:00 p.m. are provided with passage to the island. As previously noted, . . . it is not possible to determine how many of the unscheduled sailings are related to the 6 p.m. mid-week termination time, versus those that occur at other times in the schedule. This is important since there is a material difference between demand that can be met by having the passenger wait for the next sailing, versus a passenger who needs to go home for the evening.

. . .

There is a real question as to whether vehicle demand – at least in the summer months – has now grown to the point where the system is bumping up against capacity constraints: there is or very shortly will be insufficient capacity available to respond to demand. . . . What is clear, even without the reports, is that demand is exceeding scheduled sailing capacity during some periods, and the County is providing this service.

. . .

. . . The community is split on the schedule extension, with a significant degree of passion and emotion on all sides of the issue. However, what has emerged from

this analysis is – in the aggregate – a disconnect between people's stated preferences and their behavior. (There is also a disconnect within the state preferences – i.e. "leave the schedule as it is" and "continue double trips.") While both the Management Analysis and GIPOA survey found that the Guemes community, by a small percentage, prefers the schedule to remain as it is, down at the docks actual demand for services is extending beyond the regular sailing schedule.

4. The 2001 Capital Facilities Plan notes that "[a]ctual total ridership on the Guemes Island Ferry system in the year 2000 has exceeded the highest 2005 growth projections in the 1991 Capital Facilities Plan. . ." and "if growth trends continue, it may create capacity issues for the ferry." (Page 6)

5. The Guemes Island Ferry Capital Facilities Plan (2006-2020) provides the following chronology of ferry service:

-Guemes Island settlement began in late 1800s and a private ferry, which could carry 6ix cars, served settlers
-1958: private ferry service expanded with M/V Almar, capacity of 9-11 vehicles
-mid-1960s: Skagit County purchased the ferry service
-1978: planning began for larger ferry and services
-1979: county purchases M/V Guemes, capacity of 22 vehicles and 99 passengers
-1983: Guemes parking area for 60 vehicles constructed
-2004: two additional lots purchased to double Guemes parking purchased
-2005: extra lanes for auto staging added to I Avenue in Anacortes
-2005: parking lot for additional 70 ferry passengers constructed in Anacortes, increasing available parking near Anacortes terminal from 45 to 115 parking spaces.
-2005 schedule call for 6,760 runs per year
-additional runs provided as needed
$315 for special run + $325/hour standby charge
$1,000 special run during normal operating hours
runs to isolate vehicles carrying flammable materials provided
runs for emergencies provided

6. The Capital Facilities Plan provides the following information about development on Guemes Island:

a. Total assessed value of land/property on Guemes Island

1980:	$19,967,213
2004	$178,246,172

b. Historical development of single-family residences (SFR) on Guemes Island:

	New SFRs	Avg/Year	Total SFRs	% Increase	Avg. %/year
1951-60	+67	6.79	101	197.1	19.7

1961-70	+74	7.4	178	76.2	4.4
1971-80	+146	14.6	329	84.8	4.5
1981-90	+136	13.6	472	43.5	3.1
1991-00	+178	17.8	666	41.1	2.9
2001-04	+28	7.0	695	4.4	1.1

c. Identified constraints on development excluded ferry service as a controlling factor:

-saltwater intrusion
-steep slopes
-water and septic concerns
-environmental regulations
-market conditions ($ property values)

d. Existing potential for future development:

"It is impossible to know how many lots will ultimately be affected by development constraints, but it is clear that there is great potential for additional residential development on Guemes Island" (page 22)

"At this point in time, there are no indications that residential growth on Guemes Island will slow down." (page 23)

An estimated that 228 new single-family residences will be built from 2005-2020 resulting in a grand total of 891 homes on Guemes Island in the year 2020. (page 23.)[3]

F. <u>The Skagit County Comprehensive Plan includes a Transportation Element which details transportation goals, objectives, and policies for the county.</u>

1. Objective 6 requires the county "[t]o assist in promoting a coordinated and integrated public transportation system available to all people in the county."

2. Policy 9A-6.9 provides that "[t]he County shall support public or private transit service links to the Guemes Ferry and the State Ferry in Anacortes."

3. Objective 8, provides: "To encourage adequate and cost effective ferry service." Seven policies are listed under Objective 8:

9A-8. The County encourages the provision of adequate street, highway, and road facilities to accommodate traffic to the ferry terminals in Anacortes.

[3] 2000 Assessor's data provides that there are 1,589 parcels on Guemes Island, 681 are developed (43%) and 908 are undeveloped (57%).

Skagit County Comprehensive Plan

October 10, 2007

Skagit County
Planning and Development Services
Skagit County, Washington

CHAPTER 10

CAPITAL FACILITIES AND ESSENTIAL PUBLIC FACILITIES

INTRODUCTION

This Chapter, and the six-year Capital Facilities Plan (CFP), constitute the Capital Facilities Element of the Comprehensive Plan. The CFP is a technical extension of this Chapter and includes: an inventory of County capital facilities; a forecast of future needs; and a six-year financing plan. These policies are designed to ensure that the public facilities necessary to support the County's current and future population and economy are planned for and fully funded. This chapter guides and implements the provision of adequate public facilities as required by the Growth Management Act. Level-of-service (LOS) standards are included for certain public facilities, along with policies to ensure that these facilities are planned for and available to serve growth. Finally, the element includes goals and policies for the establishment of regional, or difficult-to-site facilities referred to under state law as essential public facilities.

Planning for major capital facilities enables Skagit County to:

- Demonstrate facility needs through adopted level of service standards.
- Anticipate capital improvement needs and plan for their costs.
- Integrate community capital facility wants/needs into the annual budget process.
- Monitor growth and manage development.
- Qualify for revenue sources such as federal and state grants and loans, real estate excise taxes and impact fees. This level of planning also enables the county to receive a better rating on bond issues.

Skagit County is responsible for capital facilities and service levels related to:

- Public works – County roads/ferry (transportation), surface water management and solid waste disposal

California Coastal Commission

Seawater Desalination in California

CHAPTER THREE: *POTENTIAL ENVIRONMENTAL IMPACTS / COASTAL ACT ISSUES*

Development in the coastal zone must conform to the policies and standards of the California Coastal Act and, if applicable, the Commission-certified Local Coastal Program (LCP) of the government with jurisdiction in the area of the proposed development. The Coastal Commission reviews projects on a case-by-case basis and considers the environmental benefits and coastal zone impacts of all projects. The following types of potential coastal zone impacts should be considered and addressed for desalination plants:

- Construction
- Energy Use
- Air Quality
- Marine Environment
- Increased Development
- Other Coastal Zone Issues (geologic hazards, navigation, cumulative effects, etc.)

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These impacts, related Coastal Act policies, and potential mitigation measures are discussed below.

Construction

- **Impacts/Related Policies**

Construction activities could result in the following types of coastal zone impacts: air emissions; disturbance of dune, surf zone, and seafloor ecology; disturbance to seabirds, marine mammals, other land and marine species, and their habitats; disturbance to archaeological and paleontological resources; erosion; interference with public access and recreation; noise; nonpoint source pollution; and obstruction of views by machinery, piping, or tall structures.

Significant construction impacts may also occur away from the desalination plant site if long pipelines are needed for seawater intake or for distribution of the product water, or if power transmission lines or distribution facilities must be built. Pipeline routes may have adverse impacts on benthic habitats such as surfgrass and rocky tidepools. Streambed or lagoon ecosystems along proposed power transmission line routes would be of particular concern. Any proposed diking, filling, or dredging activities in open coastal waters, wetlands, or estuaries must be in compliance with Section 30233 and other sections of the Coastal Act.

- **Potential Mitigation Measures**

- Minimize the numbers and lengths of pipelines and power transmission lines;

- Site pipeline routes to minimize impacts to sensitive areas;

- Site plants in locations where existing intake or outfall structures may be used or minimize the size of new seawater intake and outfall structures; and

- Incorporate mitigation measures commonly required for construction activities (e.g., construction schedules that minimize impacts on public access and recreation, visual screening, noise buffers, siting away from high resource are limited construction zones and corridors, etc.).

Energy Use

- **Impacts/Related Policies**

Desalination plants require significant amounts of energy for their operation. For example, the Santa Barbara RO desalination plant was using about 6,600 kWh of electricity per acre-foot of water produced before the plant shut down operations. In most cases, RO plants are less energy intensive than distillation plants.

Section 30253(4) of the Coastal Act requires that new development minimize energy consumption. Consequently, the Commission will review desalination plant proposals to determine if a project incorporates means to conserve energy or reduce energy use. The Commission should also consider the secondary impacts resulting from the increase in power production needed for the desalination plants. These impacts include higher levels of air emissions, increased entrainment and impingement of fish from intake of cooling water, higher levels of cooling water discharges to the ocean, and effects from additional transportation of oil and gas.

- **Cogeneration**

Cogeneration is a process in which exhaust steam from electricity generating plants is used for another purpose. If a desalination plant uses cogeneration to supply part of its energy needs, the plant could reduce both its demand for power and the associated environmental impacts of power generation.

For example, a distillation plant can use the heat in a power plant's exhaust steam to evaporate feedwater. A cogeneration power plant that operates with a distillation plant, however, must be specially designed for that purpose. distillation plant that is dependent on a power plant's exhaust steam for its operation would not be able to operate wh the power plant is not operating. (The capacity factor for most thermal power plants is not more than 75%.)

An RO plant may also use exhaust steam from a power plant to heat feedwater slightly (too high temperatures can damage the RO membranes). In this application, the RO plant depends on electricity to power its high pressure pumps;

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the thermal heat from the power plant improves the production of the desalination process but does not power the plant. Therefore, RO plants can operate with or without the heat from the power plant, and the power plant does not have to be specially designed to fit with the desalination plant. Cogeneration can also be used in RO plants by using exhaust steam in a steam turbine to power the pressure pumps. (Figure 3.)

A third option for cogeneration is in a hybrid plant that uses both RO and distillation (e.g., MSF) technologies. Existing power stations can and have been "retrofitted" in the evaporators and RO units to achieve a hybrid plant, thus eliminating the need to construct a new desalination facility. The MSF plant draws waste steam from a thermal power station and uses the energy in the steam to preheat seawater which is then distilled in the MSF unit. The RO unit uses electricity from the power station and operates during periods of reduced power demand, thus optimizing the overall efficiency of the entire operation. Advantages of the hybrid design include: reduced energy costs (the distillation portion would have energy savings from cogeneration, while the RO portion could use electricity from the grid to produce water when the power plant is not in operation) and reduced capital and operating costs from reuse of cooling water, feedwater or steam.

Although distillation plants usually have higher overall energy requirements than RO plants, the potential energy savings from cogeneration are greater for distillation plants. According to one estimate, use of cogeneration at an RO plant that produces 15,000 AF/yr could reduce electricity consumption by about 7%. (Source: Southern California Gas Company, 1991.) According to another estimate, for an RO plant that produces 50,000 to 60,000 AF/yr of water and that uses the exhaust steam from a power plant to heat the feedwater 20°F, the electricity demand could be reduced 10 to 15%; for a distillation plant of the same capacity that uses cogeneration, the reduction in demand for additional energy sources could be 20 to 25%. (Source: pers. comm. with Mark Skowronski, SCE, 1991.)

One option being considered is to design and build a new power plant to operate in conjunction with a desalination facility. A power plant designed specifically for cogeneration with a desalination plant could produce lower air emissions than existing power plants if the new plant is fired with natural gas and uses the latest air emission control technologies. However, construction and operation of a new power plant could have a number of adverse impacts including air emissions, impacts on marine resources, degradation of visual and recreational opportunities, disturbance of sensitive habitat areas, and increased growth in coastal communities.

- **Other Options for Saving Energy**

One method for reducing energy use in all types of desalination plants is by employing energy recovery. In the case of distillation, heat in the brine and fresh water leaving the plant is used to preheat the feedwater. In RO, energy is recovered by converting hydraulic pressure in the brine to electricity or by transferring this energy to the feedwater.

Solar energy could also be used to heat the water for a small distillation plant. Solar energy is expensive compared to other desalination technologies and may require a larger area for the solar energy gathering and conversion devices; however, this technology would not produce toxic air emissions and would not consume exhaustible resources.

Ocean Thermal Energy Conversion (OTEC) is an offshore technology for producing electricity where the difference in the temperatures of deep ocean water and warm surface water is used to vaporize liquid ammonia for turning a turbine. The turbine drives a generator that provides power for the water pumping system. Warm surface water is evaporated in a partial vacuum and the condensed fresh water is shipped back to land in a tanker from the offshore location (e.g., a floating production platform). OTEC was evaluated by various federal agencies in the 1960s and 1970s and was found to be commercially viable, though expensive. One company has recently developed a proposal to use OTEC, but so far none of the municipalities or companies that are planning desalination plants have decided to use this technology. OTEC would not produce toxic air emissions and would not consume exhaustible resources, other than from the tankers used to ship the water.

Figure 3. Cogeneration options.

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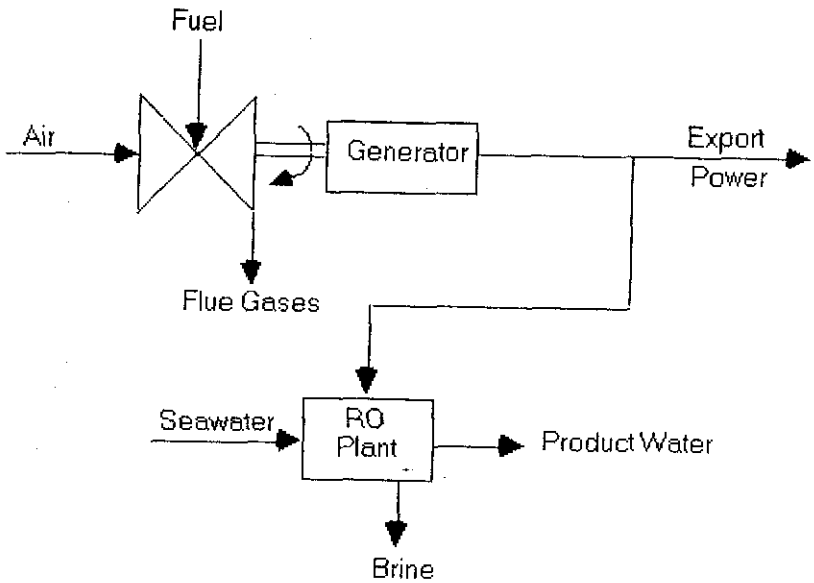
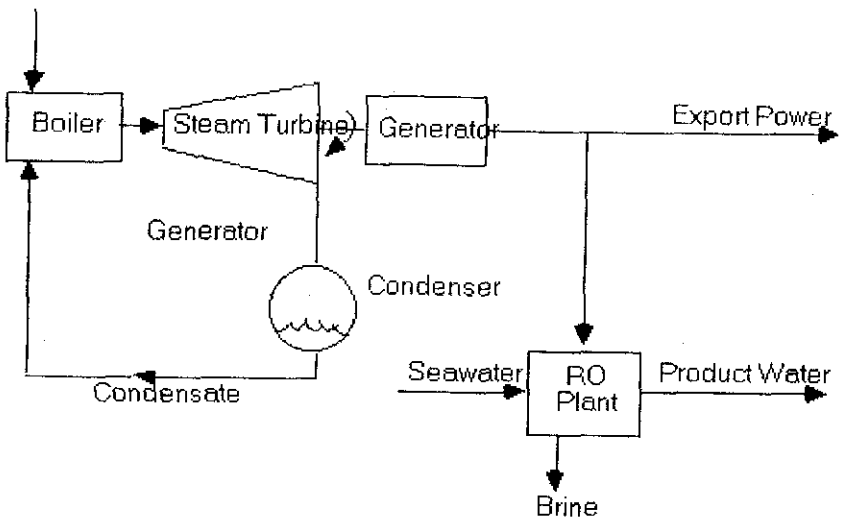
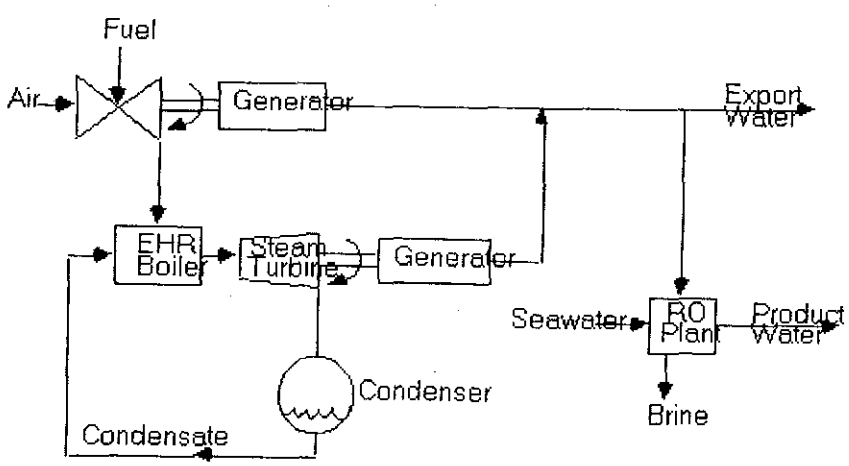


Reverse Osmosis and Gas Turbine Cogeneration



Reverse Osmosis and Steam Turbine Cogeneration



Reverse Osmosis and Combined Cycle Cogeneration

- **Potential Mitigation Measures**

- Preference for desalination technologies and plant designs that reduce energy consumption;

- Use of renewable energy resources, when feasible; and

- Siting of the proposed plants near to power plants capable of cogeneration.

Air Quality

- **Impacts/Related Policies**

Section 30253(3) of the Coastal Act requires that new development be consistent with requirements imposed by an air pollution control district or the State Air Resources Control Board as to each particular development. In general, desalination plant air emissions consist only of discharges of nitrogen and oxygen from distillation plants that use deaeration processes to reduce corrosion, discharge of the air ejector system (thermal plants), or discharge of the degassifier (RO plants).

The production of energy for use in desalination plants, however, will increase air emissions. In addition, substantial increases in air emissions could occur if a new power plant or cogeneration facility is built for a desalination project. Some of the proposed plants would be built in areas where air quality violations already exist; consequently, the plant designs should include consideration of measures to offset air emissions from energy production.

- **Potential Mitigation Measures**

- Compliance with local Air Pollution Control District and State Air Resources Board standards;

- Preference for reduced energy use, as discussed above; and

- Use of alternative energy sources to minimize air emissions.

Marine Environment

- **Related Policies**

Marine resources in the vicinity of a desalination plant can be affected by the constituents present in the waste discharges, by the waste discharge method used, and by the process of feedwater intake. Coastal Act Sections 30230 and 30231 provide for the maintenance, enhancement, and restoration of marine resources and biological productivity. Specifically, Section 30230 provides:

> "Marine Resources shall be maintained, enhanced, and where feasible restored. Special protection shall be given to areas of special biological or economic significance. Uses of the marine environment shall be carried out in a manner that will sustain the biological productivity of coastal waters and that will maintain healthy populations of all species of marine organisms adequate for long-term commercial, recreational, scientific, and educational purposes."

Section 30231 states in part:

> "The biological productivity and the quality of coastal waters, streams, wetlands, estuaries, and lakes appropriate to maintain optimum populations of marine organisms and for the protection of human health shall be maintained and, where feasible, restored through, among other means, minimizing adverse effects of waste water discharges and entrainment...."

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In addition to these Coastal Act policies, Section 307(f) of the Federal Coastal Zone Management Act (CZMA) provides that for purposes of the Commission's exercise of its consistency review authority under CZMA Section 307(c), federal, state, and local provisions established pursuant to the Clean Water Act (CWA) shall be incorporated into state coastal management programs and shall be the water pollution control requirements applicable to such program. Consequently, a number of the general policies and objectives of the California Ocean Plan are incorporated directly into the California Coastal Management Plan (CCMP). In addition, Coastal Act Section 30412(a) specifies that the provisions set forth in

Section 13124.5 of the State Water Code shall apply to the Commission, while Coastal Act Section 30412(b) states that the SWRCB and the RWQCBs are the state agencies with primary responsibility for the coordination and control of water quality.

- **Constituents of Waste Discharges from Desalination Plants**

The constituents of water discharged from desalination plants depend in part on: the desalination technology used; the quality of the intake water; the quality of water produced; and the pretreatment, cleaning, and RO membrane storage methods used.

All desalination plants use chlorine or other biocides, which are hazardous to marine resources, to clean pipes and other equipment and sometimes to pretreat the feedwater. The State RWQCBs do not permit chlorine or other biocides to be discharged directly into the ocean. Consequently, these chemicals would have to be neutralized before discharge.

Alternative treatment processes and technologies that eliminate the need for biocides can also be used. For example, ultraviolet light may be used instead of biocides to remove biological organisms. Ultraviolet light is more expensive than biocides but is an effective method. Similarly, the disc tube RO technology, which has been used primarily in Europe, does not require use of pretreatment chemicals to remove particles and organisms. This technology, unlike the more common spiral wound RO technology, does not have a mesh net between layers of the RO membranes (the net catches particles and biological organisms and can clog the membranes). The disc tube technology, however, is more expensive than the spiral wound technology and, according to one source, is unproven on seawater desalination. (Source: Dick Sudak, Separation Processes, 1992.) The need for pretreatment chemicals and processes can also be eliminated or reduced substantially if feedwater is taken in from beach wells or infiltration galleries, which serve as natural filters. (An infiltration gallery has perforated pipes arranged in a radial pattern in the saturated sand onshore, and water in the sand seeps into the perforated pipes.)

Some RO plants use a coagulant (usually ferric chloride), as part of the pretreatment process to cause particles in feedwater to form larger masses that can be more easily removed with filters before the water passes through to the RO membranes. The pretreatment filters are backwashed with filtered seawater every few days, producing a sludge that contains filter coagulant chemicals. Options for disposal of coagulants, particles and sludge removed from the filters include discharge with the brine, transport to a landfill, or a combination thereof. A desalination plant would have to include a process for removal of the particles if they are to be discharged with the sludge. Ferric chloride is not toxic but may cause a discoloration of the receiving water if discharged.

Desalination plants often use anti-scalants to remove scales that form on the plant's interior. Most plants use a polyacrylic acid as an anti-scalant, which is not hazardous to marine resources. MSF distillation plants may use a small quantity, about 0.1 milligrams for each liter of water, of an antifoaming agent (similar to cooking oil) to reduce the foam produced when the water boils.

In RO plants, cleaning and storage of the membranes can produce potentially hazardous wastes. The membranes must be cleaned at intervals from three to six months depending on feedwater quality and plant operation. The membrane cleaning formulations are usually dilute alkaline or acid aqueous solutions. In addition, a chemical preservation solution (usually sodium bisulfite) must be used if the membranes are stored while a plant is shut down. These chemicals should be treated before discharge to the ocean to remove any potential toxicity.

In general, discharges from desalination plants may have the following types of potentially adverse constituents and qualities:

- Salt concentrations above those of receiving waters (seawater salt concentration is about 35,000 ppm; desalination plants discharge brine with 46,000 to 80,000 ppm). Salt concentrations may be reduced by mixing desalination plant discharges with other discharges, such as wastewater;

- Temperatures above those of receiving waters (about 5° F increase at the point of discharge) for discharges from distillation plants; (Source: Baum, 1991.)

- Turbidity levels above those of receiving waters;

- Oxygen levels below those of receiving waters from deaeration to reduce corrosion (distillation plants only);

- Chemicals from pretreatment of the feedwater (these may include biocides, sulfur dioxide, coagulants (e.g., ferric chloride), carbon dioxide, polyelectrolytes, anti-scalants (e.g., polyacrylic acid), sodium bisulfite, antifoam agents, and

polymers);

- Chemicals used in flushing the pipelines and cleaning the membranes in RO plants (these may include sodium compounds, hydrochloric acid, citric acid, alkalines, polyphosphate, biocides, copper sulfate, and acrolein);

- Chemicals used to preserve the RO membranes (e.g., propylene glycol, glycerine, or sodium bisulfite);

- Organics and metals that are contained in the feedwater and concentrated in the desalination process; and

- Metals that are picked up by the brine in contact with plant components and pipelines.

- **Marine Resource Impacts from Desalination Waste Discharges**

Concern over the potential adverse effects to marine resources of desalination plant discharges is tempered by the following factors: the total volume of brine being released; the constituents of the brine discharge; and the amount of dilution prior to release. For example, the potential for environmental damage from small amounts of brine discharge (less than 1 MGD) may differ considerably from the potential impacts associated with discharges greater than this amount. Discharge of concentrated brine in large amounts requires more careful consideration of potential environmental impacts than do smaller brine discharge volumes. (Source: Dr. Phillip McGillivary, NOAA, 1992.)

The constituents of discharges of particular concern for marine organisms include biocides, high metal concentrations, and low oxygen levels. Not all desalination plant discharges contain these constituents; however, where detected, these constituents should be removed or neutralized to acceptable levels before discharge or else adequately diluted in the ocean in accordance with RWQCB NPDES permit requirements for compliance with the California Ocean Plan and Regional Basin Plans.

The high salt concentration of the discharge water and fluctuations in salinity levels may kill organisms near the outfall that can not tolerate either high salinity levels or fluctuations in the levels (similarly, if a temporary desalination plant is shut down, the organisms that have become accustomed to high salinity levels and/or salinity fluctuations may be killed). In addition, discharges from desalination plants will be more dense than seawater and could sink to the bottom, potentially causing adverse impacts to benthic communities. These effects may be significantly reduced if desalination plant discharges are combined with sewage treatment plant discharges (which are less dense than seawater) or are diluted by mixing with power plant cooling water discharges. At this time, there is considerable uncertainty about how well desalination plant discharges, either alone or combined with other discharges, will be diluted in seawater. The metals may become concentrated in the upper few micrometers of the ocean (the microlayer), which would be toxic to fish eggs, plankton, and larvae that are located there. Toxic constituents of the plume could be driven by wind or currents to become concentrated in the intertidal zone. (Source: pers. comm. with Dr. Phillip McGillivary, NOAA, 1991.)

Discharge of brine water with high salt concentration, particularly if combined with sewage effluent, may also cause sewage contaminants and other particulates to aggregate in particles of different sizes than they would otherwise. This effect influences rates of sedimentation, and is highly important for determining the well-being of benthic organisms that may be buried or burdened by an increase in deposition of unstable and/or finely suspended materials. If the particles are smaller and stay in suspension, they could interfere with transference of light in the ocean, which would diminish the productivity of kelp beds and phytoplankton. In addition, redistribution of trace metals (e.g., iron, nitrogen, and phosphorus) could change the phytoplankton community to one that is unappetizing to fish and may also be toxic (for example, by increasing the possibility or prolonging the occurrence of a "red tide" condition). Larval fish that feed on the phytoplankton could be forced beyond nearshore waters, where they may not survive. (Source: pers. comm. with Dr. Phillip McGillivary, NOAA, 1991.)

Changes in salinity and/or temperature from the brine discharges may also affect migration patterns of fish along the coast. If some fish species sense a change in salinity or temperature, they may avoid the area of the plume and move further offshore. As a result, the fish would be forced to swim a longer distance, they would leave the areas of highest food concentrations, and they would have increased exposure to predators. The potential impacts of this nature are uncertain because of limited knowledge about fish migration along the coast and uncertainty about how large the plume would have to be to cause this effect.

- **Waste Discharge Methods**

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The brine from desalination plants can be discharged directly into the ocean or combined with power plant cooling water or post-treatment sewage plant discharges. Mixing the discharges with power plant cooling water would most likely be desirable, because the brine solution discharged would be considerably less concentrated. Mixing with sewage treatment

discharges may also be preferable to direct discharge to the ocean. Brine discharge from desalination plants is more dense than seawater and could remain or fall to the ocean bottom, depending on the outfall location. Treated sewage effluent has a relatively low level of total dissolved solids, and blended brine/wastewater effluent has the potential to be closer to ambient ocean concentrations, so dispersion may be enhanced beyond a brine-only discharge. The addition of brine discharge to wastewater effluent reduces the biological oxygen demand (BOD) of the sewage effluent and has the potential to reduce the temperature of the sewage effluent. (For more information, see Woodward-Clyde Consultants, EIR for the City of Santa Barbara and Ionics, Inc.'s Temporary Emergency Desalination Project, March 1991.) On the other hand, blending the brine discharge with sewage discharges may have some undesirable side-effects, which are discussed below under Marine Resource Impacts.

Difficulties in enforcement may arise if desalination wastes are mixed with other waste streams. If the recipient of the desalination waste stream is the only party responsible for compliance with the regulatory requirements, this discharger would have to request the desalination plant operator to make changes if problems with compliance develop. If a proposed desalination plant incorporates combined discharges, the project description must identify the party or parties responsible for meeting the discharge requirements in order to avoid enforcement problems.

- **Marine Resource Impacts from Desalination Plant Intake**

Intake of water directly from the ocean usually results in loss of marine species as a result of impingement and entrainment. Impingement is when species collide with screens at the intake; entrainment occurs when species are taken into the plant with the feedwater and killed during plant processes. The intake of feedwater can also affect marine resources by altering natural currents in the area of the intake structure.

The use of beach wells or infiltration galleries eliminates these impacts; however, these intake methods have not been used extensively in California, and the maximum capacity of a plant that could draw feedwater effectively from these sources is unknown. Beach wells should only be used in areas where the impact on aquifers has been studied and saltwater intrusion of freshwater aquifers will not occur. Infiltration galleries are constructed by digging into sand on the beach, which could result in the disturbance of sand dunes.

- **More Information is Needed on Marine Resource Impacts**

Very little information is available on the impacts of desalination plants on the marine environment. For example, few if any monitoring studies have been conducted on the marine resource impacts of discharges from plants operating in the Middle East, Saipan, the Virgin Islands, and Cuba. Although a number of brackish water desalination plants are operating in Florida, these plants are not permitted to discharge directly to the ocean because the ocean waters are shallow out to about 10 to 15 miles from shore and do not dilute the discharges adequately. The brine is discharged either into deep, confined aquifers or to saline streams or lakes that discharge to estuaries.

An extensive analysis was conducted of the impacts of ocean discharges from a MSF desalination plant that operated in Key West, Florida during the 1960s and mid-1970s. The following studies were done to characterize dispersion of the effluent: 1) measurements of the concentration of metals in marine sediments; 2) dye observations and in situ diver observations; 3) temperature inversion analysis; and 4) semiweekly analysis of water conditions, including temperature, salinity, copper, alkalinity, pH, and oxygen. In addition, the following studies were conducted to determine impacts on the biological community:

1) analysis of foraminifera, small shelled protozoans;

2) wooden settlement panels that collected organisms over known exposure times and on substrates that were uniform in size and material;

3) surveys of organisms within transects;

4) laboratory bioassays;

5) surveys of organisms within one-meter square quadrats at twenty monitoring stations;

) transplants of selected species into particular effluent regimes to study their survival and growth;

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7) analysis of biomass samples;

8) collection of benthic diatoms and protozoans in glass microscopic slides in special racks (diatometers);

9) analysis of plankton tows; and

10) Carbon 14 measurements of photosynthesis.

The studies found that the effluent mixed turbulently with ambient water at the point of discharge. The density of this mixture was greater than that of the ambient water in the harbor where the effluent was discharged, so the mixture sank to the harbor bottom, filled up the harbor basin which was deeper than the surrounding waters, and then flowed into more shallow water. The temperature of the effluent averaged about 0.5 to 0.9°F above ambient temperatures and the effluent salinity was 0.2 to 0.5% above ambient salinity. The analyses found that the changes in temperature and salinity did not by themselves cause damage to marine organisms, but did result in lower mixing rates for copper in the effluent. Copper concentrations, which were often 5 to 10 times ambient levels, were found to be toxic to marine organisms. The studies also found that effluent discharged following startup of the plant after maintenance procedures had higher copper concentrations and caused more biological damage than effluent discharged during normal operations. (The high levels of copper detected may have due to a copper grating that was later replaced, not to the desalination process itself. The internal components of many modern desalination plants are composed of titanium rather than copper.) A variety of organisms were adversely affected by the effluent. For example, sea squirts, various species of algae, bryozoans, and sabellid worms were excluded from the harbor during at least a portion of the study; no live lamellibranchs were found by the end of the study; many dead shells of various clams and oysters were found; and echinoids were killed in the shallower waters near the harbor. Two or three of the species that survived well in the area near the effluent did so because they were able to avoid the peaks associated with start-up and were able to tolerate the steady-state effluent conditions. (Source: Chesher, 1975.)

In California, discharges from the desalination unit at the Chevron Gaviota Oil and Gas Processing Plant have been monitored in accordance with the plant's NPDES permit since January 1987. The discharges have been relatively small, because the unit has been operating at reduced capacity. Discharge constituents monitored include: dissolved oxygen, copper, iron, nickel, pH, temperature, total chlorine residual, toxicity concentration in marine organisms (bioassays), arsenic, cadmium, lead, hexavalient chromium, mercury, silver, zinc, cyanide, suspended solids, particulates, grease and oil, settleable solids, flow rate, and turbidity. A plume trajectory study was not conducted, because the computer models used by the RWQCB at the time could not be applied to plumes with salinity levels greater than that of the ocean. (New computer models have since been developed.) The monitoring results to date show no violations of the permit except for high levels of zinc. (The high levels may have been a result of high levels at the intake.) Recent monitoring has shown zinc levels within permitted standards.

The Marin Municipal Water District built a pilot plant and conducted some studies of the impacts of discharges from this plant on San Francisco Bay. Bioassay studies were conducted on two waste streams - the concentrate discharged directly to San Francisco Bay, and the concentrate mixed with effluent from the Central Marin Sanitation Agency (CMSA). The studies performed for each waste stream were the 7-day chronic *Menidia beryllina* test, the 96-hour *Skeletonema costatum* growth test, the 48-hour bivalve larvae test, and the 96-hour acute *Citharichthys stigmaeus* test. The studies found that to achieve the No Observable Effect Concentration (NOEC) for these organisms, the dilution ratio for Bay water to effluent would have to be 23:1 for unmixed concentrate and 20:1 for concentrate mixed with the CMSA effluent. The study also found that the quality of the CMSA effluent was improved by mixing it with the pilot plant discharges, because the salinity increased and the buoyancy was reduced. (Source: Boyle Engineering Corp. for the Marin Municipal Water District, 1991.)

The Southern California Coastal Water Research Project (SCCWRP) Toxicology Laboratory recently completed a study of potential effects resulting from the discharge of effluent from the City of Santa Barbara desalination plant. The research was conducted for use in an EIR for the City's Long-Term Water Supply Program. The SCCWRP conducted experiments to measure the effect of elevated salinity on sensitive marine species likely to be found in the vicinity of the Santa Barbara discharge to determine if salinity stress affected an organism's sensitivity to sewage toxicity, and to document the level of toxicity in brine resulting from chemicals added during the desalination process. According to the SCCWRP, the experiments indicated that a salinity of 36.5 g/kg (the maximum expected to occur at the Santa Barbara discharge site) did not produce measurable effects on amphipod survival or giant kelp growth; however, an inhibition of sea urchin embryo development at this salinity was measured. Additional studies are needed to confirm the data and determine their applicability to other discharge situations. (Source: SCCWRP, *Coastal Currents*, Vol. 2, No. 1, Summer 1993.)

Other existing desalination plants in California have been operating only for only a short time or are very small, so the impacts of discharges from these plants cannot be compared with potential impacts from larger plants. The Santa Catalina Plant, which began operating in June 1991, is located near Areas of Special Biological Significance (ASBS), as designated by the SWRCB. The results of monitoring studies for this plant should be reviewed closely by the Commission staff to determine whether any adverse impacts have occurred and whether the staff should recommend that any changes be made to mitigation and monitoring requirements in the plant's NPDES permit.

- **Pre-Operational Monitoring and Baseline Information on Marine Resources**

The following types of pre-operational baseline information would be useful for the Coastal Commission to have in evaluating the marine resource effects of desalination plant discharges.

- Studies of the effects of discharges from a pilot plant built where a final plant will be located;

- Measurements of dispersion rates to determine how readily brine will disperse in the ocean;

- Laboratory studies to determine the effect on particle size of mixing brine and sewage water;

- Laboratory studies to determine the dispersion of metals;

- Tracer studies using small quantities of nonradioactive isotopes of metals to determine the quantity of metals that end up in the ocean microlayer;

- An inventory of marine organisms in the area of the outfall; and

- A long-term inventory of marine organisms in the microlayer.

(Sources: Post-operational monitoring recommendations from Woodward-Clyde Consultants, 1991; pers. comm. with Dr. Phillip McGillivary, NOAA, 1991; pers. comm. with Sorrel Davis, RWQCB, Central Coast Region, 1991.)

- **Post-Operational Monitoring of Marine Resources**

- Secchi Disk Depth Test to measure how much light is penetrating the water column (to determine whether there may be an impact on the benthos);

Measurements of impacts on habitat in the microlayer;

- Measurements of impacts on fish in the water column;

- Plume trajectory evaluation of depth, temperature, salinity, and density;

- Nontoxic dye tests to measure dilution;

- Sampling of sediments; and

- Measurements of salinity at various offshore sampling locations.

(Sources: Woodward-Clyde Consultants, 1991; pers. comm. with Dr. Phillip McGillivary, NOAA, 1991.)

- **Potential Mitigation Measures to Reduce Marine Resource Impacts**

- Intake and outfall siting and design to avoid sensitive locations;

- Low flow velocities at intake channels and through intake structures to minimize entrainment and impingement of marine species and to reduce the need for pretreatment;

- Intake design to reduce the potential for entrainment and impingement (e.g., screens at the intake to reduce entrainment);

Use of onshore intake wells or infiltration galleries to eliminate entrainment of marine species;

- Outfall siting and design to ensure an adequate mixing rate and dilution volume to minimize adverse impacts;

- Outfalls to the open ocean, not to estuaries or other areas with limited water circulation;

- *Siting to avoid pollutants near the intake; and*

- *Recycling or reuse of solid wastes.*

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FRIENDS OF GUEMES ISLAND

Friends of Guemes Island
7885 Guemes Island Road, #16
Anacortes, WA 98221

Statement and Supporting Materials

Presented to the Skagit County Board of County Commissioners

May 23, 2006

9:00 a.m.

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Barbara Rudge
7303 Young Rd. NW
Olympia WA, 98502

May 21, 2006

Friends of Guemes Island
c/o Gary Davis
7885 Guemes Island Road
No. 16
Anacortes, WA 98221

Re: Proposed Resolution Amending the Guemes Island Ferry Departure Schedule

Dear Mr. Davis:

You have asked me to review the proposed Resolution to extend the hours of operation of the Guemes Island Ferry ("Ferry") to identify issues of importance regarding the State Environmental Policy Act ("SEPA"). I am a planner by education and work experience and have often analyzed proposed actions for compliance with SEPA requirements. My resume is provided in A-19.

This letter is intended to provide a cursory examination of existing conditions on Guemes Island and preliminary review of the probable impacts of the proposed transportation capacity changes caused by extending hours of ferry operation. An Environmental Impact Statement on the proposal would be necessary for thorough assessment of the direct and indirect, short and long term impacts.

SEPA requires a threshold determination for any proposal that meets the definition of action and that is not categorically exempt. WAC 197-11-310. The proposal to extend hours of operation of the Ferry is a legislative proposal that qualifies as an project action under WAC 197-11-704. This action is not categorically exempt pursuant to WAC 197-11-800 et seq. Therefore a theshold determination is required.

In the documents released for public review, and in the text of the proposed resolution itself, there is no mention of a threshold determination being made. If there has not been a threshold determination, then one should be made before the County considers adoption of the Resolution.

The process of making a threshold determination requires the Responsible Official at the County to review the environmental checklist and determine if the proposal is likely to have a probable significant adverse environmental impact. WAC 197-11-330(1)(a) and (b). Impacts include short-term and long-term effects. WAC 197-11-060(4)(c). Impacts include those that are likely to arise or exist over the lifetime of a proposal or longer. Id.

> "A proposal's effects include direct and indirect impacts caused by a proposal. Impacts include those effects resulting from growth caused by a proposal, as well as the likelihood that the present proposal would serve as a precedent for future actions. For example, adoption of a zoning ordinance would encourage or tend to cause particular types of projects or extension of

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sewer lines would tend to encourage development in previously unsewered areas."

WAC 197-11-060(4)(d). Impacts may be "direct, indirect, and cumulative." WAC 197-11-060(4)(e).

Existing Conditions

Guemes Island is currently developed a a very low density, typical of islands, with older small parcels in isolated areas along the shoreline and larger parcels up to 40 acres in the interior and on the northwest side of the island. The Skagit County Land Cover Map 7 in the June 24, 2000 Skagit County Comprehensive Plan (SCCP) Map Portfolio shows that the island is vegetated heavily with immature conifers and deciduous forests with much or the remainder in fields or pasture land. The shorelines surrounding Guemes Island and adjacent Fidalgo and Cypress Islands are identified in the SCCP Map11 as priority habitat for a variety of endangered or threatened priority species.

Approximately 490 acres is designated Rural Resource in the SCCP, with areas of more intense development designated as Rural Intermediate and the remainder in Rural Reserve. Rural Reserve allows development at one unit per 10 acres or 1 per 5 acres if clustered. There is no evidence in the record that Skagit County calculated the potential number of units that could be added to Guemes Island under the density allowed in the SCCP. A review of the existing parcel sizes, as identified in the Skagit County soil classification maps dated August 30, 1996, indicates there are dozens of 10-acre parcels, approximately 47 parcels of 20 or more acres and 14 40-acre parcels, designated for development at 1 unit per five acres, if clustered. Build-out would easily exceed 300 new single family homes under the current density designation.

Transporation access to the island is limited to ferry service and private boat. Ferry service currently ends at 6 PM, Monday through Thursday. This ferry schedule has served to restrain the resident population to those willing to live with limited transporation access. Owners and visiters using vacation homes expand the population during summer months.

The island lies within the Olympic Mountain rain shadow and rainfall is low with an average rainfall of about 26 inches per year. Dry years can produce drought conditions[1] with rainfall of less than 19 inches. Aquifer recharge is also low due to the geology and soils of the island. The USGS survey of the San Juan Islands indicates that recharge in the San Juans ranges from 6 -9 % of annual rainfall compared to 28% on Whidbey Island. Ninety percent (90%) of precipitation is lost to runoff, evaporation and transpiration. Of the water that percolates into the aquifer, the general rule used for planning purposes is that 20-30% is available for withdrawal (A-2).[1]

The island was designated a sole source aquifer by the Dept. of Ecology and availability of potable water for human and livestock consumption has been a local issue for many years. The Guemes aquifer is under significant pressure with existing development conditions as evidenced by the salt water intrusion into wells in areas of denser development. Conditions become worse in years of low rainfall. The small Potlatch desalinization plant is available to some residents who pay for the service. There are

[1] See A-1 through A -18 attached.

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currently 28 connections to the plant which produces a very small supply of water to each household (on average 62 gallons per day) (A-8 to A-9).

Guemes Island is designated as part of Washington State watershed planning area WRIA 3. Skagit County began planning for the Samish sub-basin of WRIA 3 but according the Department of Ecology's 2005 Report to the Legislature (A-12), the planning process was terminated without being finalized or voted on by the Planning Unit. Skagit County WRIA 3 work gave no attention to water resource management planning for Guemes Island. There is no evidence in the record that Skagit County analysed the impact of the new housing allowed by the density designations for Guemes Island on the sustainability of the island water supply. While San Juan County has completed an extensive water resource management plan that offers some insight into the nature of the geology and water supply of the San Juan Islands and developed policies to shape development in the face of an overtaxed resource, Skagit County has apparently not even begun planning for Guemes.

In their 2002 ruling for Jefferson County, the Growth Hearings Board stipulated that the County

> "properly classify and designate vulnerable seawater intrusion areas as CARAs (critical aquifer recharge areas) using best available science, and develop and adopt protection standards to prevent further groundwater degradation from seawater intrusion". (A-4 to A-5).

While it is evident that Guemes Island should be classified as a CARA, Skagit County has not done so, nor has it attempted to develop protection standards against seawater intrusion.

Vehicle traffic on Guemes Island roads is generally light particularly after the last ferry at 6 PM. The limited ferry schedule tends to reduce traffic to those periods before and after a ferry sailing. Noise levels are very low, particularly when car traffic associated with the ferry has stopped. Cars line up and park at the south end of Guemes Island Road to take the ferry. A small commercial establishment was introduced at this location a few years ago, presumably to take advantage of the market provided by people waiting for the ferry.

The island has limited infrastructure, with no waste treatment or solid waste facilities, no schools, and limited roads sufficient to serve existing housing.

Impacts of Extended Ferry Schedule

Currently, the Guemes Island ferry only operates until 6 PM, Monday through Thursday. Those who wish to travel to and from the island after ferry hours must use a private boat. This limited transportation service discourages many people from year round living on the island. Ferry service, like any form of public transportation, influences growth and development. A comparison of Washington State Ferry San Juan Island route map and San Juan county road map (A-13 to A-14) shows the effects of a ferry on island development. Blakely Island is the sixth largest San Juan Island but it has no ferry service, no public roads and a population of 64. Shaw is nearly the same size but has ferry service, 11 miles of road and over 200 residents; its development has been greatly influenced by monasteries who own much of the island. Lopez is larger, has ferry service and over two thousand residents.

Just as the existence of a ferry link increases development on an island, so too does increased service or capacity. By increasing trips and extending the hours of ferry service, the County would provide the existing residents with more opportunity to come and go from the island, however, it would also make living on the island more attractive to new home buyers and increase demand for development of additional homes. It would also create more demand among seasonal visitors.

The short-term impact of the proposed ferry schedule would be to extend the hours of traffic using island roads until after 10 PM and would increase the existing noise levels between 6 PM and 10 PM. Lights and activity at the ferry landing and any noise from the ferry itself would continue until after 10 PM. Long term, it may be expected that new residents and visitors attracted to the island by the longer ferry service hours would create more traffic on local roads, increasing noise and air pollution.

Additional homes would cause even further pressure on potable water supplies. Home builders are currently allowed to introduce new individual wells to supply the homes they build without obtaining a water right or a permit from the Department of Ecology. As there has been no watershed planning or analysis to determine how much water is available for withdrawal or any planning to prevent saltwater intrusion by limiting withdrawals to sustainable rates, it is reasonable to conclude that additional wells would have a negative impact on the Guemes aquifer.

Current vegetation levels are likely to be decreased by new development, causing additional runoff from lawns and pavement. Lawns act like an impervious surface, causing runoff of nearly 100% of rainfall after becoming saturated, and pavement seals the ground and creates runoff that is faster, more intense and erosive. Typical suburban housing allows 90% less water to permeate into soils than existing forested vegetation (A16 toA-17). The combination of increased withdrawals and less permeation would further reduce the supply of potable water in the Guemes aquifer and cause more saltwater intrusion.

Ground water levels are directly connected with water levels in wetlands. If the ground water level is lowered by over-withdrawal, the impact to existing wetlands on Guemes, identified on Map 10 of the SCCP, might be a reduction in size or even total eradication. Species dependent on local wetlands would be impacted by a lack of drinking water and habitat. Threatened species identified as using this habitat in Map 11 of the SCCP would be directly impacted.

If the lack of potable water becomes a health issue, it may become a necessity to use other methods to provide water to residents. Possible local solutions would include expansion of the desalination plant, catchment, and hauling, all of which are expensive. Piped public water from Anacortes may be possible. The impact of the introduction of piped water would be to create intense demand for new housing and forever alter the rural nature of the island. Increased water supply would increase effluent entering on-site septic systems. The soils as identified on the Skagit County soils maps, function marginally for low density development but at higher densities are very likely to function poorly and eventually fail.

Failing septic systems are often not replaced with an appropriate system for waste treatment until the problem is a health hazard. In near shore locations, septic system

failure causes untreated effluent flows into the shore water directly impacting wildlife and their habitat. Commercial shellfish harvesting is often closed due to contaminants.

At present, residents must take the ferry to buy anything beyond that available at the small convenience store. Later hours of ferry operation would create a demand to extend hours of existing commercial operation. While existing zoning does not allow for major expansion of commercial service, additional housing would increase demand for more commercial services on the island and increase the likelihood of local decision-makers allowing new commercial zoning. If commercial services are expanded, traffic, lights and noise may be expected to increase in the vicinity of the commercial development. Commercial services may include restaurants, service stations and public bathrooms, with the potential to use large amounts of water and produce waste and vehicle pollutants.

New housing is would generate additional students. If 300 units were added to the island, approximately 225 students would be generated at .75 students per unit. This could create demand for a school on the island.

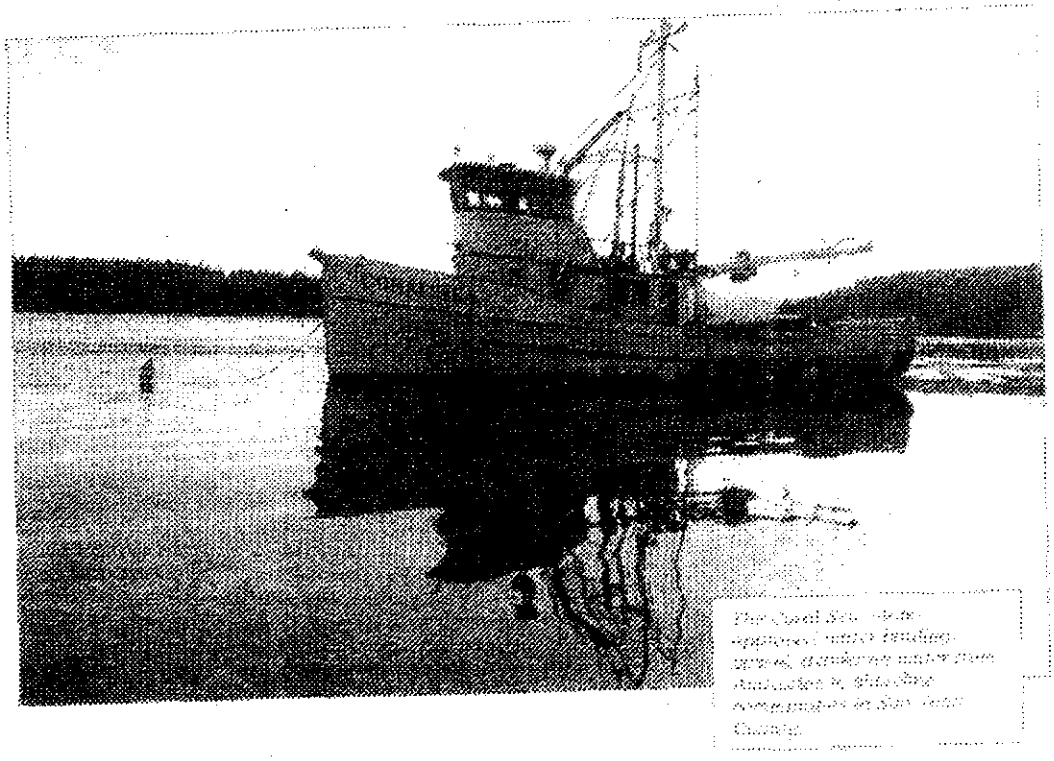
Conclusions

The Growth Management Act requires counties to develop concurrency strategies so that areas would not be developed without the availability of necessary services. Levels of service must be balanced for consistency between necessary services. Sensitive areas must not be supplied with services that attract unwanted or inappropriate development. In extending the service schedule for the ferry, local decision makers must understand the direct and indirect, short-term and long-term impacts this action would have on Guemes Island. In order to do so, they must complete the analysis for the subarea plan and water resource management plan. Within this context they must designate Guemes island as a CARA and develop protection standards to avoid further saltwater intrusion. Without this planning and analysis, the complicated issues and impacts of further development in a sole source aquifer that appears to be nearing its maximum output cannot be fully understood.

It would be appropriate for Skagit County to issue a Determination of Significance for this action so that the necessary study of the impact can be thoroughly analyzed in an Environment Impact Statement.

San Juan County Water Resource Management Plan

WRIA 2



Final
as
Revised & Adopted by San Juan County
Board of County Commissioners
October, 2004

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- Retain enough water in streams and wetlands to protect water quality and support diverse, healthy, and abundant plant and wildlife communities.
- Integrate water supply planning with growth management planning and determine the availability of water supplies in approved growth areas.
- Establish a county resource management program that addresses all water use, including exempt wells and alternative sources, and that includes decision-making based on long-term development and analysis of resource information.

Water resource conditions

Water resources in San Juan County vary dramatically from the high rainfall conditions of eastern Orcas (up to 45" of rainfall a year at Mt. Constitution) to the near-drought conditions of south Lopez (19" annual average).

Water resource planning in San Juan County is challenging due to geographic and geologic conditions. A county of islands, mostly bedrock, with 408 miles of shoreline, receiving fresh water from local rainfall only, creates many site-specific conditions for water supplies. Most of the concentrated population areas are served by surface water systems. The rural interior and highly desirable shoreline areas are served by a combination of private and community wells. Aquifer conditions vary from a few high-producing wells (50 gallons per minute) to wells that go dry or experience seawater intrusion during peak summer use.

An estimate of recharge was developed in 2001 by USGS as part of the assessment for this watershed planning process. Recharge estimates for San Juan, Orcas, Shaw and Lopez islands

	Recharge in inches	Percent of total rainfall
San Juan	1.99	6%
Orcas	1.46	5%
Shaw	1.44	5%
Lopez	2.49	9%
Whidbey	7.36	28%
Camano	7.24	25%
Sequim/Dungeness	8.00	28%

Table 1.1, Recharge comparison

must be perfected by use and it's the amount water that's actually put to beneficial use that constitutes the final water right issued by Ecology, and 2) only part of recharge is available for withdrawal. Aquifer storage capacity, the amount lost by lateral flow to the sea, the amount returned through septic systems, seasonal variations, and drought conditions all contribute to the difficulties of estimating water availability. *A general rule used for planning purposes is that 20-30% of recharge is available for withdrawal.*[5]

The assessment indicates that large portions of the county are at a point where demand for groundwater exceeds local recharge. In some of the high-demand areas, adjacent low-density rural lands help to replenish the aquifer, which is the case at Lopez Village. Most of these areas, however, have limitations due to terrain and geography, such as bedrock, narrow spits or peninsulas, and proximity to shoreline. Future development and build-out of existing parcels will only exacerbate this situation. Areas designated for high-density growth in the county's comprehensive plan that may have limited groundwater include Eastsound, Orcas Landing and Deer Harbor. See Chapter 3, Groundwater Characteristics, for more information about well capacity.

Until an adjudication or similar evaluation of the status of existing water rights is conducted, *no new permitted groundwater rights are available in San Juan County.* This leads to considerable pressure to develop exempt wells, which has been a trend in the county since the 1970s (see Figure 2.2, Water Right Allocations Over Time).

Exempt wells

Exempt wells must meet the four standards for a water right but are exempt from the requirement for a water right permit. However, exempt wells have fallen into a jurisdictional limbo throughout the state, with no regulation by Ecology (other than construction standards) and limited review by local jurisdictions during the building permit process. Exempt wells have been exploited in recent years as the only avenue to new development, since court cases and cuts to Ecology staff have stymied issuance of

[5] "The portion of groundwater withdrawn from the total natural recharge is termed the capture. No simple means exists for measuring the "available" capture and there are no adopted state-wide policies or criteria for its estimation. Normally it is no more than 50 percent of the total recharge. Carr (1983) estimates a ratio of 25 percent for Vashon Island in King County. It is possible that certain localities have little or no "available" capture. However, the probability is high that it falls between zero and 50 percent." Water Resource Assessment Technical Report, San Juan County Comprehensive Water Plan. Economic and Engineering Services, et al. 1990.

new water rights. Recent rulings by the State Supreme Court and the Western Washington Growth Management Hearings Board have addressed, in part, this gap in regulation.

In January 2002, the Western Washington Growth Management Hearings Board issued an order to Jefferson County which stated that: "The County has the overriding responsibility to protect its groundwater quality . . ."; and further, the County has authority to, "impose some form of conservation measures to reduce the withdrawal of groundwater from individual wells if that withdrawal would disrupt the seawater/freshwater balance and lead to greater seawater intrusion. The exemption of RCW 90.44.050 does not limit a local jurisdiction from complying with its mandate for protection of groundwater quality and quantity under the GMA." Jefferson County argued that exempt wells are the responsibility of Ecology and the county had no authority to regulate their development and use, other than through the building permit process. The Hearings Board found that Jefferson County failed to designate seawater intrusion areas as critical areas, failed to apply best available science, and failed to identify performance standards for protection.

In March, 2002, The State Supreme Court, in Ecology v. Campbell and Gwinn, ruled that developers could not use multiple exempt wells whose total withdrawal exceeded the 5000 gallons per day allowed under the exemption. Multiple wells for a single development were determined to be a single withdrawal, and limited to a total of 5000 gallons per day.

In 1996, San Juan County adopted stringent review standards for the use of exempt wells for new building permits and division of land. As a result, considerable progress has been made in data collection and the education of well drillers, developers, and homeowners. However, the county review process only looks at wells on a case-by-case basis, with no overview of impacts on the aquifer. Since all new groundwater development in San Juan County is occurring with exempt wells, it is essential that this Plan address future development of exempt wells in a comprehensive, scientific manner, using the four standards that apply to all water rights. In some areas of the county, groundwater development is like sand running through an hourglass. It's only a matter

of time until these aquifers are depleted or the balance is tipped to allow seawater intrusion.

Seawater intrusion

In 1982, a USGS study of San Juan County found that seawater intrusion was strongly suspected in nine percent of the wells studied (26 of 279), with most of these wells located in the southern parts of Lopez and San Juan islands. A follow-up study in 2002 by USGS on Lopez Island concluded that statistical tests of chloride concentrations indicated an increase over time.[6] High chloride concentrations and chloride concentrations increasing over time are commonly used as an indicator of seawater intrusion (see Chapter 3, page 24, for a discussion of these studies).

Seawater intrusion policies developed by the state[7] and Island, Jefferson, and Skagit counties use chloride as an indicator to establish seawater intrusion risk or protection areas. In their 2002 ruling for Jefferson County, the Hearings Board stipulated that the County "properly classify and designate vulnerable seawater intrusion areas as CARAs (critical aquifer recharge areas) using best available science, and develop and adopt protection standards to prevent further groundwater degradation from seawater intrusion". Until detailed analysis of aquifer capacity can be developed, using chloride as an indicator to define seawater intrusion risk areas is best available science.

Seawater intrusion is a condition that is not well addressed by current regulations. The maximum contaminant level for chloride as a health standard is 250 mg/L. Seawater intrusion is the replacement of fresh ground water by saline water, indicating depletion of the freshwater resource or degradation. By the time chloride levels reach 250 mg/L, a well or aquifer is already experiencing degradation. The real goal is to prevent intrusion by limiting withdrawals to sustainable rates. By starting with risk areas based on chloride levels, and requiring a combination of aquifer analysis and best management practices in order to develop new sources, a long-term management program can be established. New wells in areas at risk for seawater intrusion must be held to the

[6] Occurrence, Quantity, and Use of Ground Water in Orcas, San Juan, Lopez, and Shaw Islands, San Juan County, Washington. USGS WRIR 83-4019, and
Is Seawater Intrusion Affecting Ground Water On Lopez Island, Washington? USGS Fact Sheet 057-00.

standards for a water right, including the questions: will this new use of water impair existing rights or be detrimental to the public interest?

The WRMC adopted a recommended seawater intrusion policy in February 2004. Using chloride levels to map areas susceptible to seawater intrusion, this policy recommends a long-term evaluation of the extent and impact of seawater intrusion, and requires a greater level of analysis for approval of new water sources in designated areas. (See Appendix A, Seawater Intrusion Policy, and Figure 3.1)

Surface water availability:

Community water systems using surface water

Approximately 40% of the county's population receive their drinking water from surface water systems. On the main islands these areas include the Town of Friday Harbor, Roche Harbor, Eastsound (54% surface water), Doe Bay, Olga, Rosario Resort, Rosario Highlands, and Spring Point. These water systems serve the majority of the high-density growth areas in the county.

The Town of Friday Harbor is the only municipality in the county and has a comprehensive plan and a water system plan that match growth projections to water rights and source capacity. Roche Harbor and Rosario are privately owned systems that serve resort facilities as well as residential customers. Doe Bay, Olga, and Spring Point are private, homeowner associations. Eastsound Water Users Association (EWUA) is also a private, homeowner association but serves the urban growth area of Eastsound. The EWUA is currently struggling with growth demands that exceed its ability to provide service and is also struggling to plan for a projected build-out that exceeds both water supply and water rights. An assessment of potential storage sites was provided by consultants in the spring of 2004, with the conclusion that additional water can be provided from Cascade Creek for storage to meet Eastsound's needs[8], however, considerable time and expense will be needed to confirm and develop this potential new source.

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[7] Seawater Intrusion Control in Coastal Washington, Department of Ecology Policy and Practice. 1992 EPA 171-92-027

[8] Multi-purpose Surface Water Storage Assessment, WRIA 2. April 2004. Montgomery Water Group

and/or by diversions as part of irrigation or drinking water impoundments. Most of the county's streams, lakes, and ponds have been altered by ditching and dams for irrigation, drainage, drinking water, or hydroelectric plants.

Table 4.1

Water budget components (in inches)

Island	Water year	Precipitation	Interception loss	Simulated transpiration	Simulated direct runoff	Simulated deep percolation	Simulated change in soil moisture
Lopez	1997	30.65	6.73	14.22	5.59	3.03	0.68
	1998	21.05	5.86	12.2	2.15	1.94	-1.46
	avg	**25.85**	**6.29**	**13.21**	**3.87**	**2.49**	**-0.39**
San Juan	1997	34.99	8.24	13.4	9.77	2.24	0.48
	1998	23.59	6.73	11.65	4.1	1.75	-1.39
	avg	**29.29**	**7.49**	**12.52**	**6.93**	**1.99**	**-0.46**
Orcas	1997	40.37	9.64	13.48	14.5	1.6	0.59
	1998	25.53	7.62	11.61	6.08	1.33	-1.65
	avg	**32.95**	**8.6**	**12.54**	**10.29**	**1.46**	**-0.53**

Source: Estimates of Ground-Water Recharge, USGS WRIR 02-4114. This is a summary of annual water budget components using the deep percolation model for Lopez, San Juan, and Orcas, water years 1997-98. Components may not exactly equal precipitation because of round-off errors.

Stored surface water is an important resource in the county, capturing winter rainfall for use during dry summer months. Over the years, studies have identified potential sites for additional storage and use. As the county has grown, however, the importance of wetland and recreational areas has increased as well as impacts on water quality in the watershed and many of these locations are no longer realistic. In order to provide water to meet growth projections, the Town of Friday Harbor, Roche Harbor and Eastsound water systems are planning to increase storage by raising the height of their respective dams. There also appears to be potential for additional diversions from the Mountain Lake/Cascade Lake system without impairing existing beneficial uses of water. See Appendices D and E for reports on stream gauge results and assessment of potential storage sites.

White Paper

The Hydrologic Impact of Rainwater Catchment Systems On the Groundwater of the San Juan Islands April 21, 2004

By Ronald Mayo, PE
Lopez Island, WA 98261
fishguy@rockisland.com

Purpose - The purpose of this White Paper is to (1) consider the impact of residential rainwater catchment systems (RCS) on the groundwater of San Juan County; (2) compare this impact to exempt well systems; and (3) to demonstrate a spreadsheet model for planning catchment systems. The focus of this discussion is on systems that provide potable water to individual houses. However, this information also has application to catchment systems that provide non-potable water for stock watering or gardens. As a starting point we will consider the status and design of RCS's in San Juan County.

Choosing a Residential Catchment System - Those considering the use of a RCS should bear in mind that these systems are more participatory than a community water system. In town, the resident's job is to pay the bill, turn on the water and practice a reasonable level of conservation. When one decides on a RCS, you have become the plumber, the guy that cleans gutters, the operator who monitors stuff, the sanitarian that makes sure the treatment system works, and the policeman who limits the kid's shower time; and you still pay the bills. RCS's seldom allow much outdoor watering and conservation must be considered at all times. In drought years you may need to buy water, an expensive possibility. You will have just gotten a new hobby.

Setting – San Juan County is made up of several hundred islands with the four larger being served by ferries from Anacortes, Washington. The total area of the county is 265 square miles, with the land area being 172 SM. The current permanent population is about 15,000 increasing significantly in the summer.

Domestic water is supplied primarily from wells and surface impoundments. Alternative sources include desalinization, rainwater catchments and hauling. The aquifers that supply water are typically glacial-deposit or bedrock.

Rainfall, which is the source of most domestic water, varies from about 18 inches per year in southern Lopez to 48" at the top of Mt. Constitution on Orcas.

Current Status –In the last 10 years, about 2,700 residential water supplies have been approved of which 70 (2.6%) are RCS's. Some are for summer homes but systems for

Initial Costs - Each situation differs but after questioning several installers and owners we have defined a "typical basic system" for estimating. It would already have available 2,000 sf of roof area or more; it would have water tanks, with a combined effective storage volume of 8,000 gallons or more; and it would have all necessary treatment. The home would be for two people living full-time; they'd have a full compliment of "water saver" fixtures. Outside water use would be minimal in dry months and the owner would be conscious of the nature of the water supply. Most questioned said that an estimate of the initial costs in the range of $10,000 to $15,000 seems appropriate.

System Startup - An initial cost common to catchment systems is the need to buy "startup" water from suppliers. (The alternative being to wait for the rains to catch up.) Approved water haulers will supply water[1] to accessible sites in 2,000 gallon to 4,500-gallon loads for $0.04 to $0.20 per gallon.

Water Consumption – Predicting water consumption in catchment systems is difficult. There have been few direct measurements so we can only look at other systems for examples. The following table compares the single-family residential (SFR's) units of several systems in terms of size and consumption. It also illustrates the impact of water costs on consumption and the impact of meters.

Table 2 – Water System Examples

Water System	Eastsound	Frid. Har.	Harbor	Fish Bay	Cattle Pt	Potlatch
Island	Orcas	San Juan	Lopez	Lopez	San Juan	Guemes
Type of Units	SFR	SFR	SFR	SFR eq.	SFR	SFR
Source of Water	Surface	Surface	Well	Wells	RO	RO
Timeframe	Yr 2000	Yr 2000	Current	Current	Current	Current
Annual Total-MG	35.57	40.17	3.13	9.30	0.96	0.62
Peak Month-MG	4.74	5.36	0.45	1.33	0.13	0.06
Average Month-Gal/Conn	5,156	4,133	5,325	6,858	2,424	1,845
Nominal Connections	575	810	49	113	33	28
Peak Month-GPD/Conn	266	213	296	381	125	69
Ave.Month-GPD/Conn	172	136	175	225	81	62
Metered?	Yes	Yes	Yes	Yes	Yes	Yes
Charges Based on Meters?	Yes	Yes	No	No	Yes	Yes
Monthly Ch-@Ave Use	$ 31	$ 44	NA	NA	$ 81	$ 75
Monthly Ch-@4,000 GPM	$ 28	$ 37	NA	NA	$ 120	$ 130

*SFR=Single Family Res.

Drought Issues – While our planning model attempts to deal with drought issues, it is to be expected that a RCS will need water brought in from another location. Water is now

[1] From your island, other islands, or Anacortes.

hauled from class A systems in "approved" trucks to many islands on a routine basis. Presently Friday harbor sells large quantities of water to haulers, as does the city of Anacortes. The where the buyer is near the source the cost of a 3,500 gallon truckload is in the range of $0.04 to $0.06/gallon. On Lopez where there is currently no certified hauler or approved source, water from San Juan or Anacortes cost from $0.10 to $0.14/gallon in loads up to 4,500 gallons.

The larger question is will there by water for sale to catchments in an extreme drought year? Perhaps not but if we compare the plight of a catchment owner to the plight of one with an exempt well source, there may be little difference.

Distribution of Consumption – Lopez examples - We also have data available from 14 nominally full-time residential units (in two Lopez systems on community wells) over a two-year period. The meters are read monthly but charges aren't based on consumption. The meter readings are used primarily to locate leaks or unreasonable use. Both systems are well educated on the need for conservation. In general, the water isn't used for significant landscaping. The annual average consumption for these two systems is almost identical and averages 117 gallons/day. The monthly average distribution is shown on Table 3.

Table 3 – Comparison of Consumption

We can compare the "Lopez Examples" consumption to other systems in the County.

	Annual G/Day	Charge by Meters	Ch.for 4,000 g	Source
Eastsound-Orcas	172	Yes	$ 28	Surface
Friday Harbor-SJ	136	Yes	$ 37	Surface
Harbor-Lopez	175	No	LS	Wells
Fish Bay-Lopez	225	No	LS	Wells
Cattle Point-SJ	81	Yes	$ 120	Desal.
Potlatch-Guemes	62	Yes	$ 130	Desal.
Metered-Lopez-Table 2	117	No	LS	Wells

We'll compare these systems to a catchment system in these qualitative terms:

- The surface and well sources would be viewed as less limiting by homeowners than catchments.
- All sources would be viewed as more costly on a monthly basis than catchments.
- Catchment users might view desalinization users as models. If the desalinization systems get by on 60 to 90 gpd, that amount of water might be doable for a catchment user.

Ron Mayo, Lopez Island, 360 468 2693, fishguy@rockisland.com