Rocky Reef Bottomfish Recovery in Skagit County

Phase II Final Report:

Assessment of Eight Potential Marine Reserve Sites & Final Site Recommendations

Skagit County Marine Resources Committee

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Figures:
1. Potential MPA Candidate Sites – Kim Berry, Skagit Co. GIS

Tables:
1. Biological Matrix – Paul Dinnel (Skagit MRC), Michelle L. McConnell (Consultant)
2. Social Matrix – Paul Dinnel (Skagit MRC), Michelle L. McConnell (Consultant)
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1. Bloated Rockfish – Paul Dinnel (Skagit MRC)
2. Edmonds Underwater Park – Wayne Palsson (WDFW)

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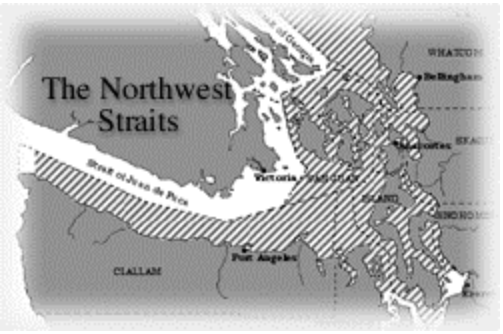
Introduction

Grass Roots Effort to Restore Marine Resources

In the 1990s, the federal government proposed creation of a Northwest Straits Marine Sanctuary to help manage our local marine ecosystem and to start rebuilding various depleted marine resources and their habitats. Some local residents felt that this "top down" approach was too heavy handed and interfered with local stewardship efforts. As a result, the federally proposed Sanctuary concept was abandoned in favor of a more grass roots approach to stewardship.

In 1998, Senator Patty Murray (D) and Congressman Jack Metcalf (R) jointly proposed creation of the Northwest Straits Marine Conservation Initiative and the Northwest Straits Commission (NWSC) to oversee an experimental local stewardship program to improve our marine resources. Following passage of their bill, the NWSC was formed and it subsequently assisted with creation of Marine Resource Committees (MRCs) in each of the seven North Sound counties. Each county MRC was asked to focus on a set of eight benchmarks for improving local marine resources. Among those benchmarks were:



Map 1: The Northwest Straits (Source: Northwest Straits Commission)

- Achieve a net gain in high-value habitat and ecosystem functions
- Achieve measurable increases in factors that support bottomfish recovery
- Establish a scientifically-based regional system of Marine Protected Areas

The newly formed Skagit MRC reviewed marine-related issues for our county waters and concluded that the decline in abundances of local bottomfish species should be a high priority issue. As a result, Skagit MRC applied for and received NWSC funding to address bottomfish restoration efforts.

Phase I – Skagit County Bottomfish Recovery

Phase I of the Skagit MRC's rocky reef bottomfish recovery project was conducted during 2000 and 2001. This phase considered possible management alternatives for bottomfish recovery and concluded that, for rockfish in particular, creation of several no-fish Marine Protected Areas (= Marine Reserves) was an

important step for bottomfish recovery. Bottomfish Marine Reserves would essentially establish "islands of broodstock" for bottomfish species of concern. These areas would help to prevent over fishing and attendant wide-ranging fishery closures by protecting large females that produce the bulk of the eggs and larvae for the next generations. Results of Skagit MRC's Phase I bottomfish study can be found in McConnell et al. (2001).

The Value of Marine Reserves

The world's fishery resources are showing increasing signs of depletion, including local bottomfish species in the Skagit County waters of the Northwest Straits region and Puget Sound ecosystem. Eastern Pacific fish stocks have suffered decreases due to natural weather cycles (El Nino, Pacific Decadal Oscillation) and the natural cycles of predator-prey relationships, but have also been heavily impacted by human activities – both directly by high harvest rates and indirectly by the development and industrialization associated with our ever-increasing human population. Over 40% of fish stocks worldwide are considered heavily to fully exploited, depleted or recovering. Atlantic cod, haddock, and yellowtail flounder fisheries have collapsed on the East Coast of the United States, abalone on the West Coast, and many Pacific Coast groundfish species are now considered at a stage of near collapse. (Murray et al. 1999).

Here in the Puget Sound, the condition of rocky reef bottomfish is of serious concern due to the rapid decline seen over the last few decades. These bottomfish include various rockfish species as well as lingcod, greenling, cabezon and numerous other species like sculpins and wolf eels. Decreases in abundance of species that are popular for commercial and sport harvest are mostly due to a substantial increase in catch rates over the last two decades. The Boldt and Rafeedie Decisions in the 1970s and 1990s reaffirmed that the Treaty Tribes of Washington State are guaranteed 50% of the salmon and other marine resources as part of their original 1850s treaty agreement with the US Government. As this ruling put more strain on the already stressed salmon stocks, the Washington Department of Fish and Wildlife (WDFW) urged people to "go bottomfishing" to reduce some of the harvest pressure on salmon. Bottomfish catches rose rapidly in the mid-1980s but soon started to drop by the late-'80s and into the '90s. For example, 400,000 pounds of lingcod catch were recorded in 1983. That number had dropped to only a few thousand pounds by 1993, with rockfish catches showing similar trends as anglers saw their catch per unit of effort drop by 50%. Regulations and catch limits were adjusted to try to manage this decline with the 10 rockfish per day limit dropping to only 1 rockfish per day allowed in 2000.

These harvest reductions are a result of fewer and smaller fish failing to maintain the reproductive output needed to sustain healthy fish populations. As catch limits have dropped, fishers more often throw back smaller fish in hopes of landing larger ones. While this catch-and-release strategy is protective for many species of fish, rockfish species suffer very high mortality rates when hauled to the surface because of their large air bladders that cannot compensate for rapid depth changes. As a consequence, copper rockfish egg production in 1990 was only about 20% of that recorded in the late-'70s. (PSAT 2002). Evidence from around the world supports the idea that marine reserves, which limit or prohibit fishing, can protect large spawning females that produce larvae and replenish surrounding waters. In this way, areas next to marine reserves can be open to bottomfishing when populations recover without endangering these species. An example from forest management is leaving some large seed-bearing trees on a ridge to reseed surrounding areas following a timber harvest. Additional factors that may affect rockfish vulnerability and the value of marine reserves are included in the comments submitted by Mary Lou Mills (WDFW) in Appendix M.

Photo 1. Bloated Rockfish (Source: P. Dinnel, Skagit MRC)

Edmonds Underwater Park

Bottomfish population declines have prompted action from numerous groups in the Puget Sound. A shining example is the Edmonds Underwater Park (EUP) started by citizens and the City of Edmonds for recreational diving. Harvest is banned in this area. Established in 1970 and monitored since the early 1990s, the EUP has shown strong evidence of rockfish and lingcod recovery. For example, dive surveys from 1993 to '96 found that copper and black rockfish, as well as lingcod, are more abundant and larger in the EUP as compared to similar habitat that is open to fishing outside the protected area. Copper rockfish and lingcod were 10 times more abundant and black rockfish were 3-9 times more abundant. Copper rockfish were also nearly 1.5 times larger at EUP than at other sites. Egg production estimates also showed that copper rockfish and lingcod at EUP produce 50 and 10 times more eggs, respectively, in the protected area.

Photo 2: Edmonds Underwater Park (Source: W. A. Palsson, WDFW)

San Juan County

Similar protected areas now exist in San Juan County including the WDFW Shady Cove Marine Reserve near Friday Harbor on San Juan Island and eight voluntary, "no-take" Bottomfish Recovery Zone (BRZ) marine reserves throughout the county. Recent Shady Cove monitoring data show that copper rockfish and lingcod are twice as abundant and larger as compared to fish at nearby Turn Island (a fished area). The BRZ "no-take" sites, established in 1998 by the San Juan Marine Resources Committee (MRC), have yet to show any substantial differences in bottomfish abundances and sizes in the four years following their creation (Eisenhardt 2002). There may be several reasons for this: 1) The BRZ sites are new – established only four years ago. One to two decades may be required for significant recruitment and growth of many species (especially the long-lived rockfish species), 2) the present San Juan County BRZ sites may be too small, thus allowing many fish to exit the reserve boundaries and be caught, and 3) site-use surveys conducted by Koski (2001) have shown that there is little or no difference in fishing effort between the BRZ sites and unprotected reference sites. Therefore, either voluntary compliance may be too low to yield positive results or fishing pressure at all sites during Koski's survey was so low that it was difficult to detect any significant differences.

Voluntary vs. Enforced

The Skagit MRC began the Bottomfish Recovery Project with the intent of adopting the San Juan County BRZ model. The Skagit process was thus originally conceived as establishing *voluntary* no-fishing reserves designated by the County Board of Commissioners and monitored by local volunteers. Voluntary compliance with no-fishing protections is all that the County could require since it does not have the authority or resources to enforce State fishing regulations. However, increased understanding of Tribal treaty rights and new agency developments over the last year have required a modified approach.

First, the MRC acknowledges that without participation by the Treaty Tribes of Washington, success of any marine reserves would be diminished. WDFW and the Treaty Tribes are co-managers of salmon and other marine resources like bottomfish, so the Tribes and the State should ideally agree on designation of any no-fishing marine reserves and joint enforcement efforts. The Skagit Board of County Commissioners have requested that the Treaty Tribes be supportive of any voluntary reserves that would be established by the Commissioners. However, the Tribes are not in a position to negotiate this type of agreement with the County, as they reserve their negotiations for State and Federal level entities.

Second, WDFW recently announced plans to establish *enforced* no-fishing marine reserves in the North Sound region, including Skagit County waters. WDFW views such marine reserves as effective management tools to restore the depleted bottomfish stocks and feels that creation of a network of marine reserves will help to alleviate the potential for ESA listing of one or more rockfish species. WDFW staff discussed their plans with the Skagit MRC and we decided to shift our focus towards coordinating with the State's process for establishing *enforced* marine reserves.

Third, the concept of restoring bottomfish species using voluntary compliance does not seem to be working. Input from fishers at local public meetings suggests that many (most?) feel that voluntary compliance simply will not work. Although most fishers may respect voluntary recovery zones, others will choose not to, resulting in significant fishing pressure on recovering fish stocks. This was the case at the Edmonds Underwater Park where compliance with a no-fishing designation was ignored by a few fishers. As a result, those managing the underwater park requested that WDFW officially close the area to fishing. This provision was eventually adopted by WDFW. And, so far, similar non-compliance seems to be the case for the San Juan Island County voluntary BRZs (Koski 2001) where no significant reduction in fishing pressure in the voluntary reserves has been observed despite strong educational and on-the-water stewardship programs. In other words, those who "buy in" to the reserve concept (the vast majority of fishermen) help to protect and restore our fish resources while the few who don't care (or disagree), catch the broodstock without fear of any penalties.

Another concern about establishing voluntary reserves is the potential impact on tribal treaty rights. Establishment of voluntary reserves puts the tribes in a bind. If they choose to observe the voluntary no-fish zones, they have suffered a defacto "taking" of their treaty right to fish in their Usual and Accustomed (U&A) places without any tribal agreement. If, on the other hand, the tribes ignore the voluntary zone designations, they then become the "bad guys" and suffer negative public response. This puts the treaty tribes in a "no win" situation and reduces the opportunity for joint efforts between tribal and non-tribal entities to improve our marine resources.

For these reasons, Skagit MRC now encourages the creation of *enforced* bottomfish marine reserves that are supported by strong public education programs, on-the-water stewardship, and routine enforcement by the co-managers.

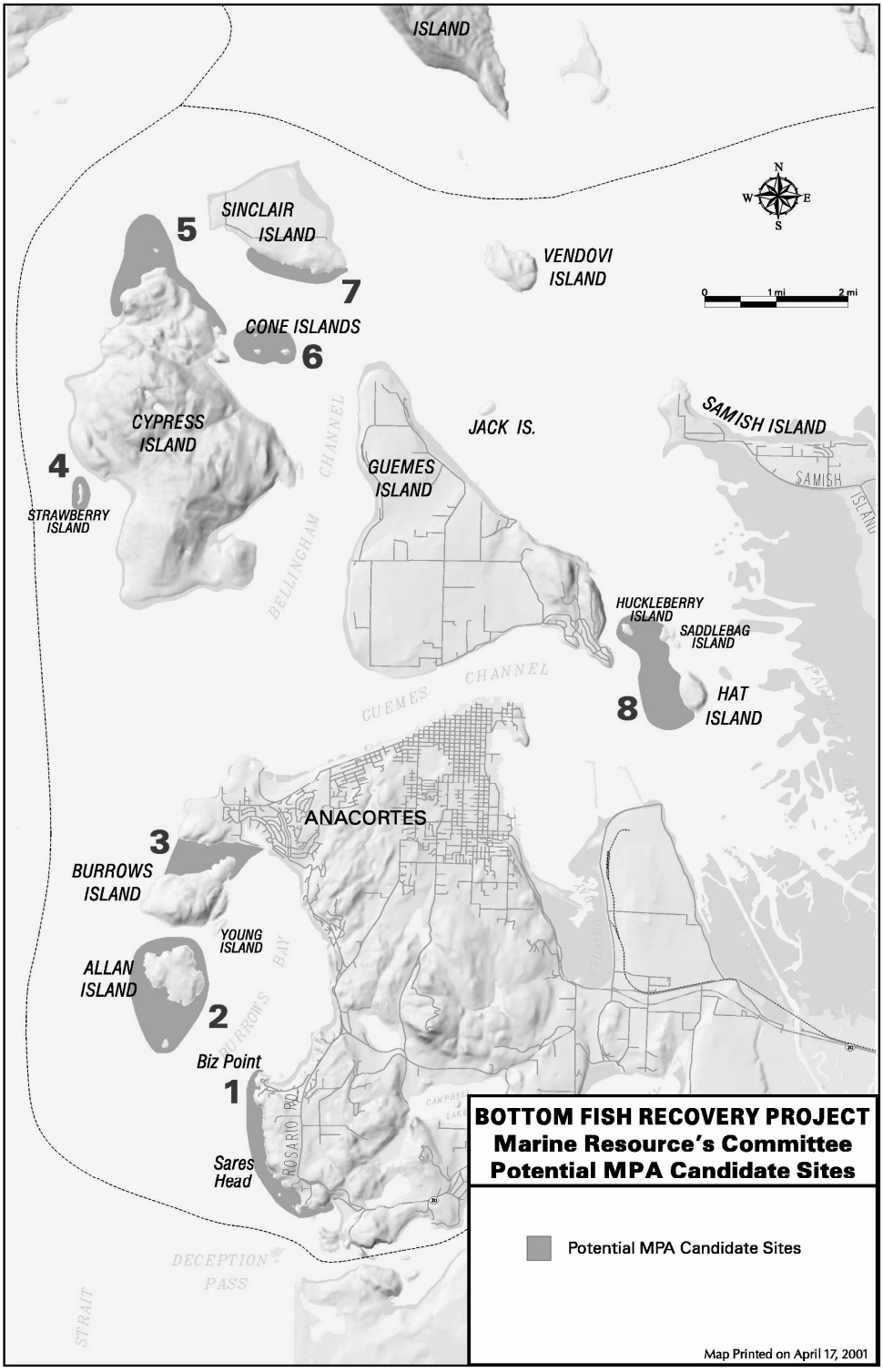
Preliminary Site Selection - Phase I Results

The Skagit MRC began Phase I of our Rocky Reef Bottomfish Recovery project in 2000. Multiple public education and outreach meetings were held to share data with interested county citizens and to get public input from fishers and divers with firsthand knowledge of the resources. By combining the best available science and citizen feedback, a "long list" of eight potential candidate sites was identified (Fig. 1). These sites are:

1. **Rosario Area** (North Bowman Bay to Biz Point)
2. **Allan Island** (including Williamson Rocks & Dennis Shoals)
3. **Burrows Channel**
4. **Strawberry Island**
5. **North Cypress Island** (including Towhead Island & Cypress Reef)
6. **Cone Islands**
7. **South Sinclair Island**
8. **Padilla Bay Islands** (including Hat, Dot, Saddlebag & Huckleberry Islands)

Figure 1. Eight Potential Marine Reserve Candidate Sites in Skagit County

Phase I results are published in the *Phase I Final Report* (McConnell et al. 2001). A Phase I project summary sheet is provided in Appendix A.



State Parks Proposal for Rosario

A small portion of the Rosario area (Site #1) was proposed for Marine Reserve status by the Washington State Parks and Recreation Commission. This proposal was submitted to the State Fish & Wildlife Commission during 2002. The State Parks proposal stated:

> *This proposal would create a conservation area (closed to all non-Indian fishery harvest) in marine waters near Rosario Head. This would include tidelands, bedlands, and waters adjacent to Fidalgo Island within a line beginning at the high tide mark at the sound tip of Rosario Head, then due east to the 10 fathom contour, then northwesterly to the southwest end of Northwest Island, then from the northwest end of Northwest Island due north to the intersection with the high tide line on Fidalgo Island, then following the high tide line southerly to the point of origin.*
>
> *The Washington State Parks and Recreation Commission has asked that WDFW create a no-harvest zone near Rosario Head. WDFW is supportive of this because many rockfish and other bottomfish populations have significantly declined in Puget Sound. The Department believes that marine protected areas can be an effective tool to help rebuild population abundance and natural biological characteristics when combined with other, more generally applied harvest restrictions. This proposed conservation area is a natural rocky reef habitat and potentially could contribute to a broader system of no-harvest areas throughout Puget Sound if developed in the future as a more comprehensive management strategy.*

Skagit MRC requested that WDFW delay adoption of any Rosario Marine Reserve until due consideration was given to MRC Site #1 (see letter in Appendix B), which encompasses an area many times larger than the State Parks proposal. Based on Skagit MRC's request and support by WDFW staff, the Washington Fish & Wildlife Commission delayed any action on the Rosario site.

Phase II - Assessing the Eight Potential Candidate Sites

Following selection of eight candidate Marine Reserve sites in Skagit County, Skagit MRC recognized the need for further evaluation of each of the candidate sites on the basis of biological, social and regulatory criteria. To satisfy this need, the Skagit MRC, in consultation with Wayne Palsson, WDFW (pers. comm. and Palsson 2002), developed a matrix of fishery, habitat, and social criteria with which we could more objectively rank the eight candidate sites. Biologists and other resource experts later suggested that some criteria originally contained in the matrix be dropped and the list be reorganized into separate Biological and Social categories. Ranking values for the biological matrix came from agency, tribal and university biologists during a Technical Review Workshop. Input for the social matrix came from the Technical Review Workshop, as well as from non-tribal fishers and divers during a public meeting held in Anacortes and from questionnaires mailed to interested citizens who had attended previous public meetings for the project.

Assessment Matrices

The original assessment matrices for rating the eight candidate sites included 23 habitat, fishery and social criteria. Criteria dropped from the reorganized biological matrix were Currents for Larval Dispersal, and Absence of Predatory Fish due to lack of data and conditions that are too unpredictable to use in designating or designing a reserve site. For the same reason, one criterion, Upland Ownership, was also dropped from the social matrix.

The 10 criteria included in the final biological matrix were Habitat Complexity, Habitat Depth, Habitat Size, "Edge Effect" Minimized, Presence of Kelp Beds, Absence of Marine Mammals, Absence of Derelict Nets, Historical Use by Rockfish, Present Rockfish Density, and Presence of Juvenile Rockfish. The social matrix criteria included Degree of Historical Monitoring, Degree of Commercial Salmon Fishing, Degree of Sport Salmon Fishing, Degree of Tribal Salmon Fishing, Present Degree of Habitat Protection, Ease of Stewardship, Educational Value, Local Sport Fisher Agreement, Local Commercial Fisher Agreement, Local Diver Agreement, WDFW Concurrence and Treaty Tribe Concurrence. Subsequent to the Technical Review Workshop, the last two social criteria (WDFW and Treaty Tribe concurrence) were separated into a third small matrix. This third "regulatory" matrix (including any sub-factors added by WDFW and/or the tribes) will have to be addressed at a later date by WDFW and the Treaty Tribes, if and when they do indeed enter into negotiations on the issue of marine reserves.

Technical Review Workshop

The goal of the Technical Review Workshop, held March 8, 2002 in Mount Vernon, was to have agency biologists and other resource experts rank the relative importance of the eight rocky reef areas as bottomfish marine reserve candidate sites using the matrix criteria. The relative assessment was meant to assist the Skagit MRC in prioritizing the candidate sites rather than a comprehensive assessment where sites are compared to real or hypothetical "perfect conditions."

Workshop participants included representatives from WDFW, Washington Department of Natural Resources, Washington State Parks, WWU's Shannon Point Marine Center, Walla Walla College, Northwest Indian Fisheries Commission, Skagit Systems Cooperative, Swinomish Tribal Community and Puget Sound Action Team along with members of the Skagit MRC. Representatives from University of Washington, National Oceanic & Atmospheric Administration, and the Lummi, Nooksack, Samish, Sauk-Suiattle and Tulalip tribes were invited to participate but did not attend. Participant names and notes from the workshop are listed in Appendix C.

The daylong workshop produced a completed biological matrix and an incomplete social matrix, with 17 of the original 23 assessment criteria receiving individual scores and calculated averages for all eight candidate sites. Five of the social criteria were left blank so that participants at the upcoming public meeting could assign those values. The Workshop participants also determined weighting factors for each assessment criterion since not all were considered equally important. Final score averages were then adjusted by the weighting factor to give a final score for each site/criterion. Meeting notes, including some participant comments, are included in Appendix D.

Public Meeting

The goals of the public meeting, held May 9, 2002 in Anacortes, were: 1) to share the results of the Technical Review Workshop with interested citizens and 2) to gather further input for site rankings. Participants used Public Input Worksheet forms (see Appendix E) to give their scores for five of the social criteria for each site. Criteria included on the Worksheet were: Degree of Commercial Salmon Fishing, Degree of Sport Salmon Fishing, Degree of Tribal Salmon Fishing, Local Sport Fisher Agreement, Local Commercial Fisher Agreement, and Local Diver Agreement. During group discussion, it was recommended

that participants not assign values for Degree of Tribal Salmon Fishing, as this criterion was best left to the treaty tribes to address at a future time.

Letters of invitation were sent to 57 interested citizens on the project mailing list, and press coverage was provided by several local newspapers (see Appendix F). Over twenty members of the public attended with 58% identifying themselves as a sport fisher on the sign-in sheet. Only 16% identified themselves as a commercial fisher, including one person who identified themselves as a sport fisher, commercial fisher, diver *and* a concerned citizen. Over half the audience hailed from the Anacortes area with an additional 30% equally divided between Mount Vernon & Burlington. An additional 14 citizens added their name to the mailing list.

Worksheets were submitted by 16 of the public meeting participants with 75% giving scores for Degree of Sport Salmon Fishing for all sites. Response rates were lower for Degree of Commercial Salmon Fishing (38 - 56%) and Local Sport Fisher Agreement (38 – 44%). Only one participant each submitted scores for Local Commercial Fisher Agreement and Local Diver Agreement. Some additional written comments were submitted on a Worksheet as well (see Appendix G).

Additional Public Input

Due to lower than anticipated attendance at the Public Meeting, a questionnaire form of the Public Input Worksheet was developed and sent to 71 interested citizens on the project mailing list with a cover letter inviting participation. A supply of the Public Input Questionnaire (Appendix H) was also delivered to the dive shop in Anacortes and to a meeting of the local Puget Sound Anglers' chapter in Anacortes to encourage citizen input.

Questionnaires were returned by 34 citizens with 56 - 76% giving scores for Local Sport Fisher Agreement and 53-82% giving scores for Degree of Sport Salmon Fishing for the eight sites. Response rates were lower for Degree of Commercial Salmon Fishing (35 - 44%), Local Commercial Fisher Agreement (26%) and Local Diver Agreement (29 – 35%). Response rates are given as a range of percentages due to the fact that not all citizens gave scores for all eight sites in the matrix. Additional written comments were also submitted (see Appendix I).

Matrix Results

Biological Criteria

Based on input from the Technical Review Workshop (Tables 1 and 3), the sites with the top three total biological scores include #1 Rosario Area (56.0), #2 Allan Island, Williamson Rocks & Dennis Shoals (52.7), and #5 North Cypress Island, Towhead Island & Cypress Reef (47.5). Next are #4 Strawberry Island (41.2) and #3 Burrows Channel (39.9). The three sites with the lowest total scores were #7 South Sinclair Island (31.9), #6 Cone Islands (26), and #8 Padilla Bay Islands (19.3). With 10 assessment criteria and a maximum score of 10 for each, the total score possible was 100.

Rosario had the top score of all eight sites for Habitat Complexity, Depth and Size as well as Present Rockfish Density, and Presence of Juvenile Rockfish. The Rosario, Allan Island, Strawberry Island and North Cypress Island sites all shared the same top score of 6.2 out of 10 for Historical Use by Rockfish. North Cypress Island had the top score of 6.8 out of 10 for Presence of Kelp Beds, Cone Islands rated the highest with 1.3 out of 10 for Absence of Marine Mammals, and Padilla Bay Islands had the top score for Absence of Derelict Nets with 2.2 out of 10.

Table 1. Biological matrix; average weighted scores from the Technical Review Workshop input. See Appendix J for the unweighted values and the weighting factors used.

Potential Candidate Site	Habitat Complexity	Habitat Depth	Habitat Size	"Edge Effect" Minimized	Presence of Kelp Beds	Absence of Marine Mammals	Absence of Derelict Nets	Historical Use by Rockfish	Present Rockfish Density	Presence of Juvenile Rockfish	**Total Score** *(100 possible)*
#1 Rosario Area	9.6	7.7	7.8	3.4	5.6	0.8	0.3	6.2	7.2	7.5	**56.0**
#2 Allan Island	8.7	7.5	7.4	3.0	5.6	0.2	0.7	6.2	6.8	6.6	**52.7**
#3 Burrows Channel	6.0	3.6	3.2	3.8	4.0	1.0	2.1	4.3	3.6	8.3	**39.9**
#4 Strawberry Island	7.0	5.4	3.8	1.9	3.2	1.1	1.1	6.2	4.8	6.6	**41.2**
#5 N. Cypress Island	8.0	4.8	5.4	2.8	6.8	1.0	2.0	6.2	5.6	5.0	**47.5**
#6 Cone Islands	4.0	3.2	2.2	1.4	2.0	1.3	2.0	5.0	1.6	3.3	**26.0**
#7 S. Sinclair Island	5.5	2.5	2.2	3.1	3.2	1.2	2.0	5.6	3.2	3.3	**31.9**
#8 Padilla Bay Islands	2.0	5.9	1.6	1.7	1.6	0.8	2.2	1.9	0.8	0.8	**19.3**

Social Criteria

There were nine criteria included in the final social matrix (Table 2). Those that received values at the Technical Review Workshop were Degrees of Historical Monitoring, Present Degree of Habitat Protection, Ease of Stewardship and Educational Value. Participants at the Public Meeting and citizens who submitted Public Input Questionnaires gave values for Degree of Commercial Salmon Fishing, Degree of Sports Salmon Fishing, Local Sport Fisher Agreement, Local Commercial Fisher Agreement, and Local Diver Agreement. Overall, 50 Public Input Worksheet (16) and Questionnaire (34) forms were received from interested citizens. Weighting factors for all social criteria, except those ranked by public input, were determined by input at the Technical Review Workshop. For those criteria ranked by the public, all weighting factors were set to 1.00 so as to give equal importance to commercial and sports fishers and divers.

Based on the combined input from the Technical Workshop, the Public Meeting and additional public input, the sites with the top three total scores include: #8 Padilla Bay Islands (42.9), #3 Burrows Channel (38.8), and #2 Allan Island (36.6). The three sites with the lowest rankings were: #4 Strawberry Island (30.7), #1 Rosario (28.5) and North Cypress Island (26.9) (Tables 2 and 3).

There was little difference in the rankings for Degree of Historical Monitoring for any of the sites (0.9-1.2). The highest potential conflicts with commercial fishing were at #1 Rosario (3.1 – see Table 2 footnote); the lowest conflict was at the Cone Islands (7.7) and Padilla Bay (7.0) sites. For sports salmon fishing, the highest potential impact was again at Rosario (1.8 – again, see Table 2 footnote), followed closely by North Cypress Island (2.3) and Strawberry Island (2.7). Least impact to sport salmon fishing was at Padilla Bay (6.1). Strawberry Island (3.4), and both North Cypress (3.1) and Cone Islands (3.1) had the highest values for Present Degree of Habitat Protection. For Ease of Stewardship, Burrows Channel (5.7), Padilla Bay (5.4) and Rosario (4.5) rate highest. Burrows Channel (5.6) and Rosario (5.4) also rate highest for Educational Value.

When it comes to public agreement with sites becoming bottomfish reserves, commercial fishers most preferred (or least objected to) South Sinclair Island (6.5), Allan Island (5.8) and Cone Islands (5.7), in that order. Sport fishers preferred South Sinclair Island (6.1), Padilla Bay (5.6) and Allan Island (5.1). Divers' top preferences were South Sinclair Island (7.7), Padilla Bay (6.9) and BOTH Rosario and Burrows Channel (tied at 5.8).

Table 2. Social matrix; average weighted scores from the Technical Review Workshop (unshaded criteria) and combined input from the public meeting and mailed questionnaires (shaded criteria). For unweighted values and the weighting factors see Appendix K.

Potential Candidate Site	Degree of Historical Monitoring	Degree of Commercial Salmon Fishing	Degree of Sports Salmon Fishing	Present Degree of Habitat Protection	Ease of Stewardship	Educational Value	Local Sport Fisher Agreement	Local Commercial Fisher Agreement	Local Diver Agreement	**Total Score** (90 possible)
		See	Footnote							
#1 Rosario Area	1.2	3.1	1.8	1.4	4.5	5.4	3.7	1.6	5.8	**28.5**
#2 Allan Island	0.9	5.7	5.1	1.0	3.6	3.9	5.1	5.8	5.5	**36.6**
#3 Burrows Channel	0.9	5.7	4.4	1.4	5.7	5.6	5.0	4.4	5.8	**38.8**
#4 Strawberry Island	1.2	4.9	2.7	3.4	3.0	2.7	3.7	3.9	5.2	**30.7**
#5 N. Cypress Island	0.9	6.1	2.3	3.1	2.1	1.5	2.6	3.9	4.4	**26.9**
#6 Cone Islands	0.9	7.7	4.9	3.1	2.1	1.2	4.9	5.7	4.1	**34.6**
#7 S. Sinclair Island	0.9	6.3	5.4	0.3	2.1	0.6	6.1	6.5	7.7	**35.9**
#8 Padilla Bay Islands	0.9	7.0	6.1	2.4	5.4	3.6	5.6	5.0	6.9	**42.9**

Footnote: The values for these two criteria are recorded as the inverse of the public input rankings (i.e., 10 minus the average public value) since the "degree of salmon fishing" constitutes an impact – not a benefit – to reserve creation. For example, Rosario has the highest Degree of Commercial Salmon Fishing (public ranking = 6.9), thus, it was given the lowest score (10 minus 6.9 = 3.1).

Overall Site Rankings

The overall rankings for biological and social factors (Table 3) show that there is little agreement between the two. For instance, Rosario rates highest biologically, but seventh socially, and Padilla Bay ranks last biologically but first socially. Only one site (Allan Island) ranks in the top half biologically and socially, and only one site (Cone Islands) ranks in the bottom half for both.

Table 3. Overall biological and social rankings for the eight Candidate Marine Reserve sites.

RANKING	BIOLOGICAL	SOCIAL
FIRST	#1 Rosario Area	#8 Padilla Bay Islands
SECOND	#2 Allan Island	#3 Burrows Channel
THIRD	#5 North Cypress Island	#2 Allan Island
FOURTH	#4 Strawberry Island	#7 South Sinclair Island
FIFTH	#3 Burrows Channel	#6 Cone Islands
SIXTH	#7 South Sinclair Island	#4 Strawberry Island
SEVENTH	#6 Cone Islands	#1 Rosario Area
EIGHTH	#8 Padilla Bay Islands	#5 North Cypress Island

If biological and social scores are added together to form a combined ranking, the results are (high to low):

Site	Combined Rank
Allan Island	89.3
Rosario	84.5
Burrows Channel	78.7
North Cypress Island	74.4
Strawberry Island	71.9
South Sinclair Island	67.8
Padilla Bay Islands	62.2
Cone Islands	60.6

One option open to the Skagit MRC is to recommend that the top 3-4 sites ranked above be considered for Marine Reserve status. However, this overlooks one important factor not yet discussed – the need for a ***network*** of reserves that will best export fish larvae to non-reserve areas and to habitats where larvae will survive and grow to help replenish bottomfish populations.

The Larval Dispersal Question

Originally, a matrix criterion titled "Currents for Larval Dispersal" was included in the biological matrix, but was deleted due to lack of data. However, since the Technical Review Workshop was held, we have become aware of an oil spill model computer program that may have some utility for predicting how larval fish might be dispersed from each of the candidate Marine Reserve sites. This oil spill model, known as the "General NOAA Oil Modeling Environment" (GNOME) model has been formulated and improved over the years by modelers at the NOAA (National Oceanic & Atmospheric Administration) Sand Point facility. The goal of this model is to trace the movement of spilled surface oil by integrating water current, wind, and oil characteristics data. Although good arguments can be made that subsurface fish larvae and surface oil might not behave the same way, we felt that this model might none-the-less give a reasonable first order approximation of what might happen to larvae hatched in various locations.

A series of GNOME model outputs (one for each of the eight potential marine reserve sites) was included in the draft version of this report. However, subsequent discussions with NOAA personnel (See comments submitted by NOAA in Appendix M) provided information that a better statistical evaluation of larval movements might be available by using the "Trajectory Analysis Planner" (TAP) model. This model produces a statistical summary of particle positions over numerous randomly sampled tidal scenarios. For the output shown in this report, 1,000 simulated particles (actually Langrangian Elements) were hypothetically released on the surface of the water at each of the eight potential marine reserve sites. Wind speed was set to zero so that water currents were the main transport factor. The model was then run to simulate a one-day period using 100 randomly selected tidal cycle scenarios for each marine reserve site. In this case, the randomly selected starting times were chosen from April 15 to May 15, 2002, a period of time when bottomfish larvae are known to be present in the water column. The TAP model then computed and displayed the relevant statistics from the numerous trajectories (i.e., courses or routes traveled by the particles) tested. Doing this gives a better appreciation of the possible particle movements from any one site. The results are then displayed in color figures using different colors to represent the percentage of time that particles may have passed through any given area. Therefore, red ("100%") indicates a very high probability that at least 5 particles would have passed through that particular square of the grid. The greens and blues indicate moderate probabilities of particle trajectory passing through and no color indicates a very low probability. (See Appendix L for examples)

The following description of the TAP model procedures and how to interpret the TAP outputs were supplied by NOAA (C. J. Beegle-Krause and Christopher Barker, NOAA/HAZMAT, Seattle, WA, pers. comm.):

The TAP images were generated by NOAA's Trajectory Analysis Planner (TAP) application. TAP provides a way to view the results of many trajectories generated by NOAA's GNOME model. To generate these images, 100 different scenarios from each proposed marine reserve were started at random times between April 15th and May 15th, 2002. TAP tracks the trajectory of each individual particle, and a count is maintained each time a given particle passes through a given region. The result is that, for each individual simulation, we know all the regions that the particles have passed through. By combining the results of many simulations, we can see which regions are most likely to have been visited by larvae, regardless of the particular phase of the tide in which an individual fish may have spawned. This gives a picture of where larvae are likely to get to, given a number of fish spawning at random times near the beginning of May.

These images show the regions that have the highest probability of larvae visitation in red and orange, and the lowest probability in light blue.

The header portion of the images (Appendix L Figures A to H) indicates the settings selected for TAP to use to calculate and display the resulting statistics. The TAP application was designed for use in oil spill response planning, and thus the terminology reflects that use.

***Shoreline Impact Analysis**: is the analysis mode used. For oil spill planning, users are most often concerned with impacts to shoreline, but in the marine reserve application, larval count sites were considered over the whole water region.*

***Season**: is the time period over which trajectories were modeled. In this case April 15th to may 15th (a period of time that bottomfish larvae are likely to be in the water column).*

***Time**: is the length of time after the particles were released that is represented in the view window. One day was chosen as the simulation period to capture the spread from a complete tidal cycle. The larvae would most likely continue to spread after this time period, but there is not enough knowledge of either larval behavior or the circulation in the region to have confidence in the model results for the movement beyond one day.*

***Oil Type**: is set to Non-Weathering, so that no weathering is simulated.*

***Amount Released**: is scaled to the number of particles released; 1000 bbl represents 1000 particles in this case.*

***Level of Concern:** is the number of particles that must pass through a location in order for that location to have been considered visited. In this case, it is set to 5*

particles out of the total 1000 particles. Reaching this Level of Concern indicates that a statistically significant number of larvae have passed through that region.

Readers should, however, keep in mind that there are significant caveats in using any surface particle model to mimic larval fish dispersal. First, subsurface currents (and particles, especially those close to the bottom) may not move in the same direction or speed as surface currents. Second, larval fish behavior probably affects their position in the water column and may substantially change their movements in relation to surface particle movements. Nonetheless, results of model simulations might be very valuable for providing first-order approximations regarding larval movements and provide a basis for generating movement hypotheses that can be field-tested in the future.

Trajectory Analysis Planner (TAP) Model Results

Outputs from the TAP model are shown in Appendix L, Figures A to H. The 1-day model runs generally showed the following:

- The further south (i.e., Rosario, Allan Island, and Burrows Channel) that the insertion of particles occurs, the further south the particles go. Particles released in these three southern locations generally stayed in an area bounded by Guemes and Cypress Islands to the north and the north end of Whidbey Island to the south.
- Insertion of particles in the four northern areas (i.e., Strawberry Island, North Cypress Island, Cone Islands, and South Sinclair Island) results in a more northerly distribution of particles after one day. Particles released in these northern locations generally ranged from Lummi Island in the north to the Deception Pass area in the south.
- Addition of particles near Hat Island in Padilla Bay resulted in substantial particle retainment in Padilla/Fidalgo Bays and a plume of particles being dispersed through Guemes Channel into the Burrows Bay area.
- Regardless of the location of particle insertion, most particles moved back and forth in a north/south direction between Lummi Island and north Whidbey Island. Very few of the particles were transported westward into the San Juan County portion of the archipelago.

Certainly, a substantially greater amount of dispersion of particles (and larvae) will be expected to take place over a 4-8 week period of time, the amount of time that larval bottomfish are expected to be in the water column. Given this expectation, one of two scenarios may be possible:

1. Particles (and larvae) will end up very widely dispersed throughout most of the San Juan Archipelago and into the Straits of Juan de Fuca and Georgia, or
2. Particles (and larvae) will continue to slosh back and forth in a north/south direction and end up widely dispersed only throughout the eastern portion of the San Juan Islands (i.e., Lummi Island to north Whidbey Island).

If outcome #1 is correct, then a few large reserves located throughout the San Juan Island Archipelago, without particular regard to their exact siting, might work just fine. However, if outcome #2 is likely, then an integrated network of reserves, spread fairly evenly throughout North Puget Sound might be best. In either case, a well-designed network would be most certain to guarantee widespread distribution of bottomfish larvae over a wide area.

Skagit MRC Recommendations

In making recommendations for future locations for Marine Reserves in Skagit County waters, Skagit MRC bases its recommendations on the output from the biological and social matrices as well as the output from the TAP particle dispersion model. It is our studied opinion that if rocky reef bottomfish Marine Reserves are created in Skagit County waters, they should be located in the following areas:

1. **Rosario Area – Allan Island Area:** One reserve should be created at *either* Site #1 Rosario (Biz Point to Bowman Bay) or Site #2 Allan Island (to include Williamson Rocks and Dennis Shoals). Both sites have excellent rocky reef habitat and kelp beds and scored the highest of all eight candidate sites for biological factors (Table 3). Creation of a Marine Reserve at Rosario (at least a reduced one) is favored by State Parks and the Walla Walla College Marine Station to help preserve wildlife in the heavily used Deception Pass State Park area. On the other hand, Rosario scored very low (seventh) on the social matrix output, while Allan Island scored second (Table 2). There appears to be substantially greater salmon fishing, both commercial and sport, at Rosario, and the Rosario area appears to be more impacted by derelict fishing nets. In addition, the Allan Island area is closed to commercial salmon fishing (except reef nets) (WAC 220-47-307), at least at this time. Thus, a Marine Reserve around Allan Island might be the best bet for this area. In addition, a small reserve, with nearshore protection as its focus, could also be implemented near Walla Walla College Marine Station and Deception Pass State Park. This particular reserve, however, need not include bottomfish protection if a reserve is created at Allan Island for that purpose.
2. **North Cypress – South Sinclair – Strawberry Island:** One or two Marine Reserves should be created in the Cypress/Sinclair Island area. Three sites have priority in this area: Site #4 Strawberry Island, Site #5 North Cypress Island and Site # 7 South Sinclair Island. A reserve at the Cone Islands is not recommended since this site scored seventh on the biological matrix output. The TAP particle dispersal model suggests that larvae originating in any of these areas may be better dispersed within Skagit County waters than those coming from the Allan Island/Rosario area. Of these three sites, North Cypress Island scored highest biologically (third) but last socially (Tables 1 and 2). Both Strawberry Island and South Sinclair Island scored in the middle of the pack on both matrices (Strawberry: forth biologically and sixth socially; Sinclair: sixth biologically and forth socially). Given the weak social support for North Cypress Island, Skagit MRC does not recommend creation of a reserve in this location. Instead, we recommend that reserves be considered for both Strawberry Island and South Sinclair Island. This would result in two fairly wildly spaced reserves in north

County waters and in areas that might result in best larval dispersal to the rest of Skagit County waters, as suggested by the TAP dispersal model.

3. **Burrows Channel**: The inner portion of Burrows Channel on the north side (Skyline Cabana to the linear center of Burrows Channel) should be considered for protection as a no-fish zone. While this area is fairly small and would not lead to substantial larval production, it would still provide an excellent diver attraction, with very good opportunities for stewardship and education (this site scored highest for stewardship and education on the social matrix output). One trade-off would be closure of shore fishing at Washington Park along this stretch of shoreline, but the outer portion of Burrows Channel could be left open to fishing.
4. **Padilla Bay Islands**: Site #8 (Padilla Bay Islands area) is a wild card. This site scored lowest biologically, but highest socially (Tables 1-3). Thus, fisher acceptance is high, even though habitat quality might be lacking. On the plus side, the Padilla Bay islands (Hat, Dot and Saddlebag) are under the protection of the Padilla Bay National Estuarine Research Reserve and State Parks. This site provides good opportunities for both stewardship and education, and the TAP dispersal model output suggest that larvae produced at this site would remain in the Padilla Bay area, with some export to the Burrows Bay area. A main concern for this site is the questionable habitat quality. Anecdotal information from fishers suggests that this area once produced good bottomfish catches (species unknown) many decades ago. The prime question to be answered about this site is if it has good rockfish habitat, since it is this group of fishes that will most benefit from marine reserves. Skagit MRC suggests that the Padilla Bay site not be considered for Marine Reserve status at this time, but that additional exploration be considered.

Gear Restrictions in Skagit Marine Reserves

Bottomfish reserves are specifically designed to protect bottomfish from capture and to protect their habitats and food webs from destruction. Thus, any fishing gear or development activities that do impact fish health in any way should be prohibited within the boundaries of marine reserves. Clearly, this means that all forms of bottomfishing gear (e.g., baited hooks, lures, jigs, spear guns, fish traps) should be prohibited. Just as clearly, certain fishing gear and methods that do not harm bottomfish might be allowed, including crab pots and rings, hand collection of scallops, sea urchins, sea cucumbers, etc. Less clear are shrimp pots, which may remove a food source for bottomfish, and salmon trolling or gill nets, which have some potential for catching bottomfish.

Skagit MRC encourages the fishery co-managers to review the potential impacts of fishing gear and methods on bottomfish (especially rockfish) and restrict only those gear and methods that are necessary to protect bottomfish.

Artificial Reefs

Edmonds Underwater Park (EUP) is an excellent example of what a marine reserve can do with proper stewardship – many fish and large fish. Yet, essentially all of the bottomfish habitat at EUP is artificial – from tires and blocks to sunken vessels. While a distinct emphasis should be placed on recovery of natural reefs in North Puget Sound, the use of artificial reef structures should be considered for augmenting bottomfish habitat in selected areas of Skagit County (e.g., east side of Allan Island, Padilla Bay, possibly others).

Several decades ago, WDFW actively supported construction of artificial reefs to enhance fishing opportunities. However, increased understanding of the dynamics of these reefs suggested that they acted as magnets – attracting fish from other areas and making those fish easier to catch. In this day of stressed bottomfish populations, the idea of artificial reefs being used to enhance fishing does not work. Thus, WDFW has curtailed most artificial reef creation. However, we suggest that artificial reefs may have a beneficial effect if established within the boundaries of marine reserves in areas where bottomfish habitat is sub-optimal, if reef creation does not interfere with tribal salmon net-fishing activities. Skagit MRC encourages WDFW and the Treaty Tribes to investigate this possibility.

Rockfish Bag Limit

In 2000, the daily bag limit for rockfish in Puget Sound waters was reduced from 10/day to only 1/day to help protect declining rockfish populations. At that time, WDFW felt that this low bag limit would eliminate any "directed" fishing for rockfish, but allow fishers to retain 1 rockfish/day caught as by-catch in other fisheries (i.e. salmon). However, input from fishers at Skagit MRC public meetings suggested that a "directed" fishery still remains for rockfish and that some fishers are "high-grading" (releasing small fish until a large one is caught) or engaging in catch-and-release fishing. While catch-and-release fishing works to conserve most fish stocks, the opposite is true for rockfish since expansion of their air bladders render most rockfish dead or incapacitated, on the surface (i.e., easy prey).

Skagit MRC has strong concerns about maintaining the 1 rockfish/day bag limit. We feel that this limit further stresses rockfish stocks that have been seriously depleted and sends the wrong message to the fishing public. Thus, Skagit MRC strongly recommends that WDFW adopt a zero bag limit for rockfish until significant recovery occurs. However, another possible alternative is to close all fishing for rockfish except during the hook and line open season for lingcod, when a one or two rockfish bag limit might be allowed.

Conclusions

Skagit MRC has undertaken a two-year scoping study on the issue of bottomfish marine reserves in Skagit County waters. We have found that "no-take" reserves may be the only viable way to restore and preserve rockfish populations, and that the public generally supports bottomfish restoration. We have found that bottomfish habitat does not have to be optimum to be effective, but protection of bottomfish broodstock (especially rockfish species) in reserves will require strong fisher buy-in and cooperation. It will also require enforcement by the fishery co-managers since even a small degree of poaching can remove vulnerable rockfish broodstock. But local fishers have also told us that they don't want their favorite, productive fishing areas (primarily for salmon) closed. So, the keys to creating successful marine reserves seems to hinge on 1) finding areas with reasonable habitat that impacts salmon fishing the least and/or 2) adjusting salmon gear and methods that can be used within any bottomfish reserve.

Co-Manager Role in Marine Reserve Creation

Skagit County will not be designating any marine reserves within county waters, voluntary or otherwise. Skagit MRC and the County Board of Commissioners recognize the importance of obtaining co-manager (WDFW/Treaty Tribes) agreement prior to any marine reserve creation. To this end, Skagit MRC provides this report to the co-managers with the explicit hope that it will stimulate co-manager discussions that will lead to eventual creation of additional marine reserves in North Puget Sound. Skagit MRC further believes that unilateral creation of marine reserves by WDFW may well be counter-productive in the long run since this could be interpreted as a defacto "taking" of tribal treaty rights to fish in their Usual and Accustomed (U&A) places, or, should they choose to fish in marine reserves, they then become perceived as the "bad guys." Skagit MRC feels that patience, understanding and partnerships are more beneficial than antagonism and animosity in restoring our natural resources. We of the Skagit MRC look forward to the opportunity to work with WDFW and the Treaty Tribes in further efforts to discuss creation of rocky reef bottomfish marine reserves to help restore the depleted populations of these culturally, economically, and recreationally important fish species.

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Appendix A - Phase I Project Summary & 8 Sites Map

Appendix B - MRC Letter to WA Fish & Wildlife Commission

Appendix C - Technical Workshop Participants

Appendix D - Technical Workshop Notes & Comments

Appendix E - Public Input Worksheet Form

Appendix F - Press Coverage

Appendix G - Public Meeting/Worksheet Notes & Comments

Appendix H - Public Input Questionnaire Form

Appendix I – Written Comments from Submitted Questionnaires & MRC Responses

Appendix J - Raw Biological Matrix Scores & Weighting Factors

Appendix K - Raw Social Matrix Scores & Weighting Factors

Appendix L – Trajectory Analysis Planner (TAP) Model Output

Appendix M – Comments Submitted on DRAFT Phase II Final Report & Skagit MRC Responses