Regional Information Report No. 5J12-28

An Evaluation of the Port Graham Salmon Hatchery for Consistency with Statewide Policies and Prescribed Management Practices

by

Mark Stopha

December 2012

Alaska Department of Fish and Game **Division of Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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AN EVALUATION OF THE PORT GRAHAM SALMON HATCHERY FOR CONSISTENCY WITH STATEWIDE POLICIES AND PRESCRIBED MANAGEMENT PRACTICES

by
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The Regional Information Report Series was established in 1987 and was redefined in 2006 to meet the Division of Commercial Fisheries regional need for publishing and archiving information such as project operational plans, area management plans, budgetary information, staff comments and opinions to Board of Fisheries proposals, interim or preliminary data and grant agency reports, special meeting or minor workshop results and other regional information not generally reported elsewhere. Reports in this series may contain raw data and preliminary results. Reports in this series receive varying degrees of regional, biometric and editorial review; information in this series may be subsequently finalized and published in a different department reporting series or in the formal literature. Please contact the author or the Division of Commercial Fisheries if in doubt of the level of review or preliminary nature of the data reported. Regional Information Reports are available through the Alaska State Library and on the Internet at http://www.adfg.alaska.gov/sf/publications/

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ABSTRACT

The salmon hatchery program in Alaska is governed by policies, plans, and regulations that emphasize protection of wild salmon stocks. A rotational series of hatchery evaluations will examine the consistency of each hatchery with those policies and prescribed management practices. The evaluation includes a review of hatchery management plans and permits, an assessment of each hatchery program's consistency with statewide policies, and recommendations to address any deficiencies.

This report reviews the Port Graham Hatchery, a salmon hatchery located on the Kenai Peninsula in the community of Port Graham, Alaska. The hatchery was operated by the Port Graham Hatchery Association from 1992 to 2007, rearing primarily pink and sockeye salmon.

Juvenile sockeye salmon from the English Bay Lakes broodstock were released back to the English Bay Lakes system and into Port Graham. Pink salmon broodstock from the Port Graham River were incubated in the hatchery and released into Port Graham.

The hatchery showed poor egg-to-fry survival due to poor hatchery practices. Infectious hematopoietic necrosis virus was a chronic problem in the sockeye salmon program. Contribution of hatchery fish to the harvest and escapement were not evaluated. Fry releases were not consistently marked; therefore, parent broodstock of sockeye salmon fry stocked into the English Bay Lakes system could not be screened to know that the parents were offspring of naturally-spawned parents, per the State of Alaska Genetic Policy.

In 2007, Port Graham Hatchery suspended operations due to budget constraints. Trail Lakes Hatchery, operated by the Cook Inlet Aquaculture Association, took over the sockeye salmon program, and was able to improve egg-to-fry survival and mark all fish released. The pink salmon program was discontinued.

Key words: Port Graham, Port Graham Hatchery, hatchery evaluation, hatchery, Port Graham Hatchery Association

INTRODUCTION

Alaska's constitution mandates that fish are harvested sustainably under Article 8, Section 4: "Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the state shall be utilized, developed and maintained on the sustained yield principle, subject to preferences among beneficial uses." Due in part to historically low salmon harvests, Article 8, Section 15 of Alaska's Constitution was amended in 1972 to provide tools for restoring and maintaining the States fishing economy: "No exclusive right or special privilege of fishery shall be created or authorized in the natural waters of the State. This section does not restrict the power of the State to limit entry into any fishery for purposes of resource conservation, to prevent economic distress among fishermen and those dependent upon them for a livelihood and to promote the efficient development of aquaculture in the State." Alaska's salmon hatchery program was developed under this mandate and designed to supplement—not replace—sustainable naturally spawning wild stock production.

Alaska's modern salmon fisheries enhancement program began in 1971 when the Alaska Legislature established the Division of Fisheries Rehabilitation Enhancement and Development (FRED) within the Alaska Department of Fish and Game (ADF&G; FRED Division 1976). In 1974, the Alaska Legislature expanded the program, authorizing private nonprofit (PNP) corporations to operate salmon hatcheries: "It is the intent of this Act to authorize the private ownership of salmon hatcheries by qualified nonprofit corporations for the purpose of contributing, by artificial means, to the rehabilitation of the state's depleted and depressed salmon fishery. The program shall be operated without adversely affecting natural stocks of fish

in the state and under a policy of management which allows reasonable segregation of returning hatchery-reared salmon from naturally occurring stocks."

Salmon restoration efforts came in response to statewide annual salmon harvests of 30 million fish, among the lowest catches since 1900 (Figure 1). The FRED Division and PNPs engaged in a variety of activities to increase salmon production. New hatcheries were built to raise salmon, fish ladders were constructed to provide adult salmon access to previously nonutilized spawning and rearing areas, lakes with waterfall outlets too high for adult salmon to ascend were stocked with salmon fry, log jams were removed in streams to enable returning adults to reach spawning areas, and nursery lakes were fertilized to increase juvenile salmon growth (FRED Division 1975). A combination of favorable environmental conditions, limited fishing effort, abundance-based harvest management, habitat improvement, and hatchery production gradually boosted salmon catches, with recent commercial salmon harvests (2002–2011) averaging 170 million fish (Vercessi 2012).

In Alaska, the purpose of salmon hatcheries is to supplement naturally spawning wild stock production for public benefit. Hatcheries are efficient in improving survival from the egg to fry or smolt stage. In natural production, survival of eggs to fry or smolt is highly variable. Estimates for pink salmon survival in two Southeast Alaska creeks ranged from less than 1% to 22%, with average survivals from 4% to 9% (Croot and Margolis 1991). Under hatchery conditions, egg to fry survival is usually 80% or higher.

Alaska hatcheries do not grow fish to adulthood, but incubate fertilized eggs and release resulting progeny. Juvenile salmon imprint on the release site and return to the release location as mature adults. Per state policy, hatcheries generally use stocks taken from close proximity to the hatchery so that any straying of hatchery returns will have similar genetic makeup as the stocks from nearby streams. Also per state policy, Alaska hatcheries do not selectively breed. Large numbers of broodstock are used for gamete collection to maintain genetic diversity, without regard to size or other characteristic.

Hatchery production is limited by freshwater capacity and freshwater rearing space. Soon after emergence, all pink and chum salmon fry can be transferred from fresh water to salt water. Most Chinook, sockeye, and coho salmon, on the other hand, must spend a year or more in fresh water before fry develop to smolt and can tolerate salt water. These species require a higher volume of fresh water, a holding area for freshwater rearing, and daily feeding. They also have a higher risk of disease mortality due to the extended rearing phase. There are economic tradeoffs between the costs of production versus the value of fish at harvest. Although Chinook, sockeye, and coho salmon garner higher prices per pound as adults, chum and pink salmon are more economical to rear in the hatchery setting and generally provide a higher economic return.

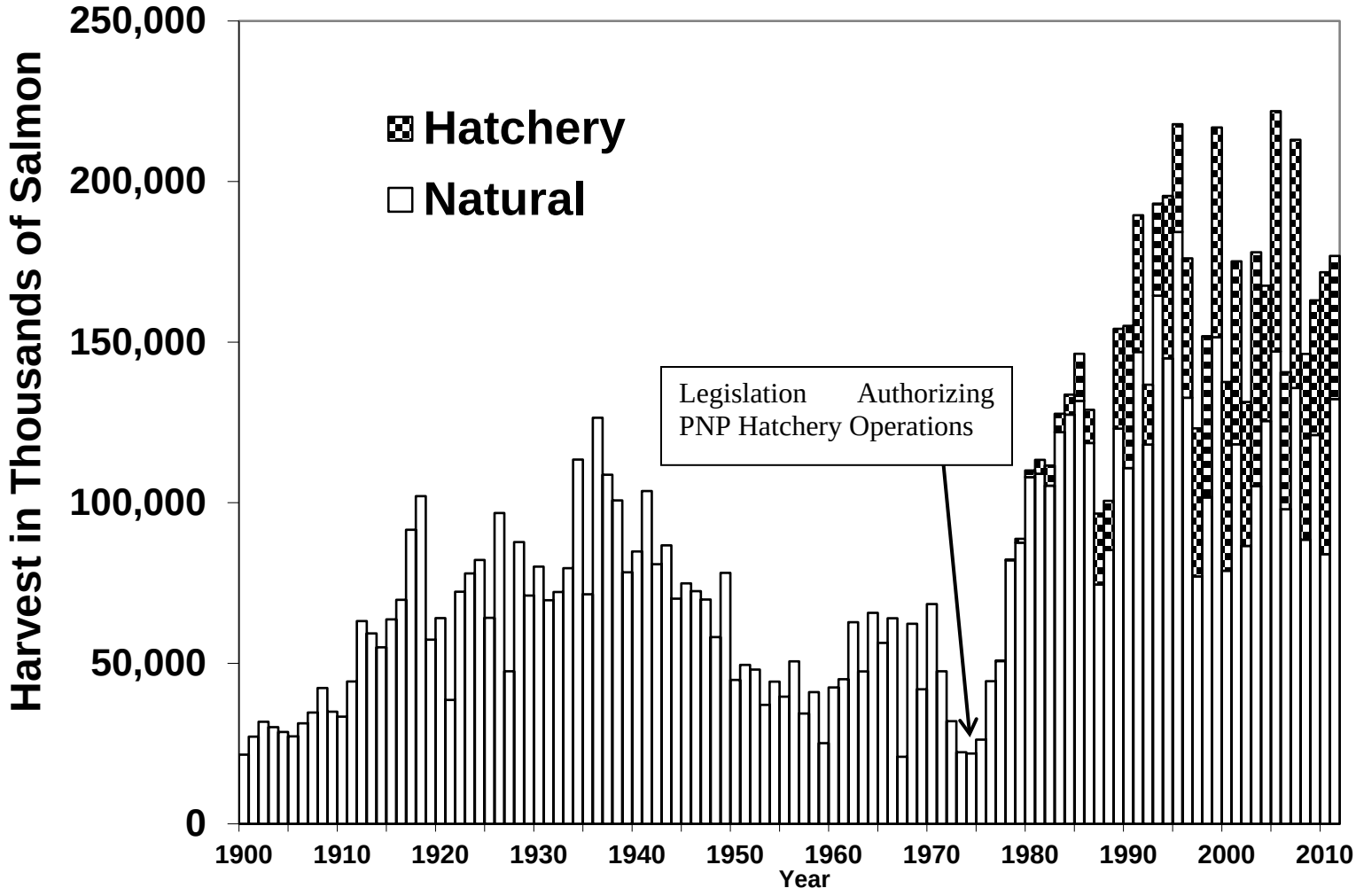

Figure 1.–Commercial salmon harvest in Alaska, 1900 to 2011. *Source:* ADF&G.

Pink salmon, which have the shortest life cycle of Pacific salmon (two years), provide a quick return on investment and provide the bulk of Alaska hatchery production. From 2002 to 2011, pink salmon accounted for an average 71% of Alaska hatchery salmon returns by number, followed by chum salmon (21%), sockeye salmon (5%), coho salmon (2%) and Chinook salmon (<1%; Farrington 2003, 2004; White 2005–2011; Vercessi 2012).

The salmon marketplace has changed substantially since the hatchery program began. As the first adult salmon were returning to newly built hatcheries in 1980, Alaska accounted for nearly half of the world salmon supply, and larger harvests in Alaska generally meant lower prices to fishermen. Some believed the increasing hatchery production in some parts of the state was depressing salmon prices in others (Knapp et al. 2007). By 1996, rapidly expanding farmed salmon production surpassed the wild salmon harvest for the first time (Knapp e. al. 2007) and wild salmon prices declined precipitously as farmed salmon flooded the marketplace in the U.S., Europe, and Japan. Alaska responded to the competition by improving fish quality at harvest and implementing intensive marketing efforts to differentiate Alaska salmon from farmed salmon. By 2004, these efforts paid off through increasing demand and prices.

Today, Alaska typically accounts for just 12% to 15% of the global supply (ASMI 2011). Alaska's diminished influence on world salmon production means that Alaska's harvest volume has little effect on world salmon prices. Prices paid to fishermen have generally increased over the past decade despite large fluctuations in harvest volume (http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyfisherysalmon.salmoncatch, accessed 10/01/2012). The exvessel value of hatchery harvest increased from $46 million in 2002 to $136 million in 2011[1]. First wholesale also showed an increasing trend, with the value of hatchery fish increasing from $160 million in 2002 to $314 million in 2011[2]. Pink and chum salmon, on average, accounted for over 75% of the annual hatchery exvessel and first wholesale values from 2002 to 2011.

Over the past decade (2002–2011), hatcheries contributed an average 35% of the total Alaska salmon harvest in numbers of fish (Farrington 2003, 2004; White 2005–2011; Vercessi 2012). With world markets currently supporting a trend of increasing prices for salmon, interest in increasing hatchery production by Alaska fishermen, processors, support industries, and coastal communities has increased as well. In 2010, Alaska salmon processors encouraged hatchery operators to expand pink salmon production to meet heightened demand (Industry Working Group, 2010).

Alaska's naturally spawning wild salmon populations are sustainably managed to ensure adequate numbers of adults spawn, and the naturally spawning wild harvest is arguably at its maximum, given fluctuations due to environmental variability and imperfect management precision. Other than regulatory actions, such as reductions of salmon bycatch in other fisheries or changes in fishing methods that would allow more precise management of escapement, hatchery production is the primary opportunity to substantially increase the harvest.

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1 Exvessel value for hatchery harvest is the total harvest value paid by fish buyers to fishermen for all salmon from http://www.adfg.alaska.gov/index.cfm?adfg=commercialbyfisherysalmon.salmoncatch (accessed 02/04/2012), multiplied by the hatchery percent of the commercial harvest in Farrington 2003, 2004; White 2005– 2011, and Vercessi 2012.

2 First wholesale value is the price paid to primary processors for processed fish from ADF&G Commercial Operators' Annual Reports multiplied by the hatchery percent of the commercial harvest.

Part of the reason for the rise in price of Alaska salmon was a message of sustainable fisheries management to a growing audience of discriminating buyers. ADF&G applied to the Marine Stewardship Council (MSC) for certification as a sustainably managed fishery. In 2000, the MSC certified the salmon fisheries managed by ADF&G as *sustainably managed*, and the state's salmon fisheries remained the only MSC-certified salmon fishery in the world for nearly a decade. Salmon fisheries elsewhere (Annette Islands Indian Reserve salmon; British Columbia pink and sockeye salmon; and Iturup Island, Russia, pink and chum salmon) were later certified for much smaller geographic areas, and in some cases, only for specific salmon species (MSC 2012). Alaska's certification was MSC's broadest and most complex, covering all five salmon species harvested by all fishing gear types in all parts of the state. Achievement of statewide certification was a reflection of the state's commitment to abundance-based fisheries management and constitutional mandate to sustain naturally spawning wild salmon populations.

MSC certified fisheries are reviewed every five years. When Alaska salmon fisheries were recertified in 2007 (Chaffee 2007; Knapman et al. 2009), a condition of certification was to "Establish and implement a mechanism for periodic formal evaluations of each hatchery program for consistency with statewide policies and prescribed management practices. This would include a specific evaluation of each program relative to related policies and management practices."

The Alaska Seafood Marketing Institute changed to a new sustainable fishery certification under the Food and Agriculture Organization in 2011. The hatchery evaluations started under the MSC certification continued as an important systematic assessment of Alaska salmon fishery enhancement and its relation to naturally spawning wild stock production at a time of heightened interest for increased hatchery production and potential impacts on naturally spawning wild salmon production. ADF&G established a rotational schedule to review PNP hatchery programs. Musslewhite (2011a, 2011b) completed hatchery reviews for the Kodiak region in 2011, and (Stopha and Musslewhite 2012) completed the hatchery review for Tutka Bay Lagoon Hatchery in Cook Inlet. This report for the Port Graham Hatchery is the second for the Cook Inlet region. Following completion of hatchery reviews in Cook Inlet, reviews of hatcheries in Prince William Sound, Southern Southeast Alaska, and Northern Southeast Alaska will follow.

OVERVIEW OF POLICIES

Numerous Alaska mandates and policies for hatchery operations were specifically developed to minimize potential adverse effects to naturally spawning wild stocks. The design and development of the hatchery program is described in detail in McGee (2004): "The success of the hatchery program in having minimal impact on wild stocks can be attributed to the development of state statutes, policies, procedures, and plans that require hatcheries to be located away from significant wild stocks, and constant vigilance on the part of ADF&G and hatchery operators to improve the program through ongoing analysis of hatchery performance." Through a comprehensive permitting and planning process, hatchery operations are subject to continual review by a number of ADF&G fishery managers, geneticists and pathologists.

A variety of policies guide the permitting of salmon fishery enhancement projects. They include *Genetic Policy* (Davis et al. 1985), *Regulation Changes, Policies, and Guidelines for Fish and Shellfish Health and Disease Control* (Meyers 2010), and various fisheries management policies, such as the Sustainable Salmon Fisheries Policy (5 AAC 39.222). These policies are used by ADF&G staff to assess hatchery operations for genetic, health, and fishery management issues in the permitting process.

The State of Alaska ADF&G *Genetic Policy* (Davis et al. 1985; Davis and Burkett 1989) sets out restrictions and guidelines for stock transport, protection of naturally spawning wild stocks, and maintenance of genetic variance. Policy guidelines include banning importation of salmonids from outside the state for enhancement (except transboundary rivers); restricting transportation of stocks between the major geographic areas in the state (Southeast, Kodiak Island, Prince William Sound, Cook Inlet, Bristol Bay, Arctic-Yukon-Kuskokwim, and Interior); requiring the use of broodstock with appropriate phenotypic characteristics; maintaining genetic diversity by use of large populations of broodstock collected across the entire run; and limiting the number of hatchery stocks derived from a single donor stock.

The *Genetic Policy* also recommends the identification and protection of "significant and unique" wild stocks: "Stocks cannot be introduced to sites where the introduced stock may have significant interaction or impact on significant or unique wild stocks." Davis and Burkett (1989) suggest that regional planning teams (RPTs) are an appropriate body to designate those stocks. In addition, the *Genetic Policy* recommends the designation of watersheds to serve as wild stock sanctuaries to preserve genetic variability: "These sanctuaries will be areas in which no enhancement activity is permitted except gamete removal for broodstock development."

Salmon fishery enhancement efforts are guided by comprehensive salmon plans for each region. These plans are developed by the RPTs, which are composed of six members: three from ADF&G and three appointed by the regional aquaculture association Board of Directors (5 AAC 40.310). According to McGee (2004), "Regional comprehensive planning in Alaska progresses in stages. Phase I sets the long-term goals, objectives and strategies for the region. Phase II identifies potential projects and establishes criteria for evaluating the enhancement and rehabilitation potentials for the salmon resources in the region. In some instance, a Phase III in planning has been instituted to incorporate Alaska Board of Fisheries approved allocation and fisheries management plans with hatchery production plans."

The *Alaska Fish Health and Disease Control Policy* (5 AAC 41.080) is designed to protect fish health and prevent spread of infectious disease in fish and shellfish. The policy and associated guidelines are discussed in *Regulation Changes, Policies, and Guidelines for Fish and Shellfish Health and Disease Control* (Meyers 2010). It includes regulations and guidelines for fish transports, broodstock screening, disease histories, and transfers between hatcheries. The *Alaska Sockeye Salmon Culture Manual* (McDaniel et al. 1994) also specifies practices and guidelines specific to the culture of sockeye salmon. As with the *Genetic Policy*, these regulations and guidelines are used by the principal pathologist and ADF&G geneticist to review hatchery plans and permits.

The *Alaska Policy for the Management of Sustainable Salmon Fisheries* (5AAC 39.222) mandates protection of naturally spawning wild salmon stocks in the management of salmon fisheries. Other applicable policies include the *Policy for the Management of Mixed-Stock Salmon Fisheries* (5AAC 39.220), the *Salmon Escapement Goal Policy* (5AAC 39.223), and local fishery management plans (5AAC 39.200). These policies require biologists to consider the interactions of naturally spawning and hatchery salmon stocks when reviewing hatchery management plans and permits.

The guidance provided by these policies is sometimes very specific, and sometimes less so. For example, the *Alaska Fish Health and Disease Control Policy* mandates the use of an iodine solution on salmon eggs transported between watersheds—a prescribed practice that requires

little interpretation. In contrast, several policies prioritize the protection of naturally spawning wild stocks from the potential effects of fisheries enhancement projects without specifying or mandating how to assess those effects. These less specific policies provide principles and priorities, but not specific direction, for decision making.

A key principle of Alaska policy is to protect naturally spawning wild salmon stocks. The initial rotation of these reports will assess the consistency of individual hatcheries with state policies by (1) confirming that permits have been properly reviewed using applicable policies and (2) identifying information relevant to each program's consistency with state policies. Future reports may assess regional effects of hatcheries on naturally spawning wild stocks and fishery management.

OVERVIEW OF HATCHERY PERMITS AND PLANS

The FRED Division built and operated several hatcheries across the state in the 1970s and gradually transferred operations of most facilities to PNP corporations. Regional aquaculture associations (RAAs), comprised of commercial salmon fishing permit holders, operate most of the PNP hatcheries in Kodiak, Cook Inlet, Prince William Sound, and Southeast Alaska. Each RAA's Board of Directors establish goals for enhanced production, oversee business operations of the hatcheries, and work with ADF&G staff to comply with state permitting and planning regulations. RAAs may vote to impose a salmon enhancement tax on sale of salmon by permit holders in their region to finance hatchery operations. Independent PNP corporations, not affiliated with a RAA, also operate hatcheries in several areas of the state. Both the RAAs and independent PNP hatchery organizations may sell salmon returning to their hatcheries or release sites to pay for operations. These sales are referred to as *cost recovery*. Several organizations have tourist and educational programs that contribute to the financial support of their programs, as well.

Public participation is an integral part of the PNP hatchery system. Hearings are held before a hatchery is permitted for operation. RPTs comprised of ADF&G and RAA personnel hold public meetings to define desired production goals by species, area, and time in a comprehensive salmon plan (5 AAC 40.300). RPTs review applications for new hatcheries to determine compatibility with the comprehensive salmon plan, and also make recommendations to the ADF&G commissioner regarding changes to existing hatchery operations, new hatchery production, and new hatchery facilities. Municipal, commercial, sport, and subsistence fishing representatives commonly hold seats on both RAA and independent PNP hatchery organization boards, providing broad public oversight of operations.

Alaska PNP hatcheries operate under four documents required in regulation (5 AAC 40.110–990 and 5 AAC 41.005–100) and statute (AS 16.05.092): hatchery permit with basic management plan (BMP), annual management plan (AMP), fish transport permit (FTP), and annual report (Figure 2). The hatchery permit authorizes operation of the hatchery, specifies the maximum number of eggs of each species that a facility can incubate, specifies the authorized release locations, and may identify stocks used for broodstock. The BMP is an addendum to the hatchery permit and outlines the general operations of the hatchery. The BMP may describe the facility design, operational protocols, hatchery practices, broodstock development schedule, donor stocks, harvest management, release sites, and consideration of naturally spawning wild stock management. The BMP functions as part of the hatchery permit and the two documents should

be revised together if the permit is altered. The permit and BMP are not transferrable. Permits remain in effect unless revoked or withdrawn.

Hatchery permits/BMPs may be amended through a permit alteration request (PAR). Requested changes are reviewed by the RPT and ADF&G staff and a recommendation is sent to the commissioner for consideration. If approved, the permit is amended to include the alteration. Reference to a *permit* or *hatchery permit* in this document also includes approved PARs to the hatchery permit unless otherwise noted.

The AMP outlines operations for the current year and is in effect until superseded by the following year's AMP. Per 5 AAC 40.840, it should "organize and guide the hatchery's operations, for each calendar year, regarding production goals, broodstock development, and harvest management of hatchery returns." Typically, AMPs include the upcoming year's egg-take goals, fry or smolt releases, expected adult returns, harvest management plans, FTPs required or in place (described below), and fish culture techniques. The AMP must be consistent with the hatchery permit and BMP.

An FTP is required for egg collections, transports, and releases (5 AAC 41.001–41.100). The FTP authorizes the individual specific activities described in the hatchery permit and management plans, including broodstock sources, gamete collections, and release sites. All proposed FTPs are reviewed by the ADF&G fish pathologist, fish geneticist, regional resource development biologist, Division of Commercial Fisheries regional supervisor, Division of Sport Fish regional supervisor, and deputy director of the Division of Commercial Fisheries, before final consideration by the ADF&G commissioner. An FTP is issued for a fixed time period and includes both the specifics of the planned operation and any conditions added by ADF&G.

Each hatchery is required to submit an annual report documenting egg collections, juvenile releases, current year returns and contributions to fisheries, and projected returns for the following year. Information for all hatcheries is compiled into an annual ADF&G report (e.g., Vercessi 2012) to the Alaska Legislature (AS 16.05.092).

The administration of hatchery permitting, planning, and reporting requires regular and direct communication between ADF&G staff and hatchery operators. The serial documentation from hatchery permit/BMP to AMP to FTP to annual report necessarily spans generations of hatchery and ADF&G personnel, providing an important history of each hatchery's species cultured, stock lineages, releases, returns, and pathology.

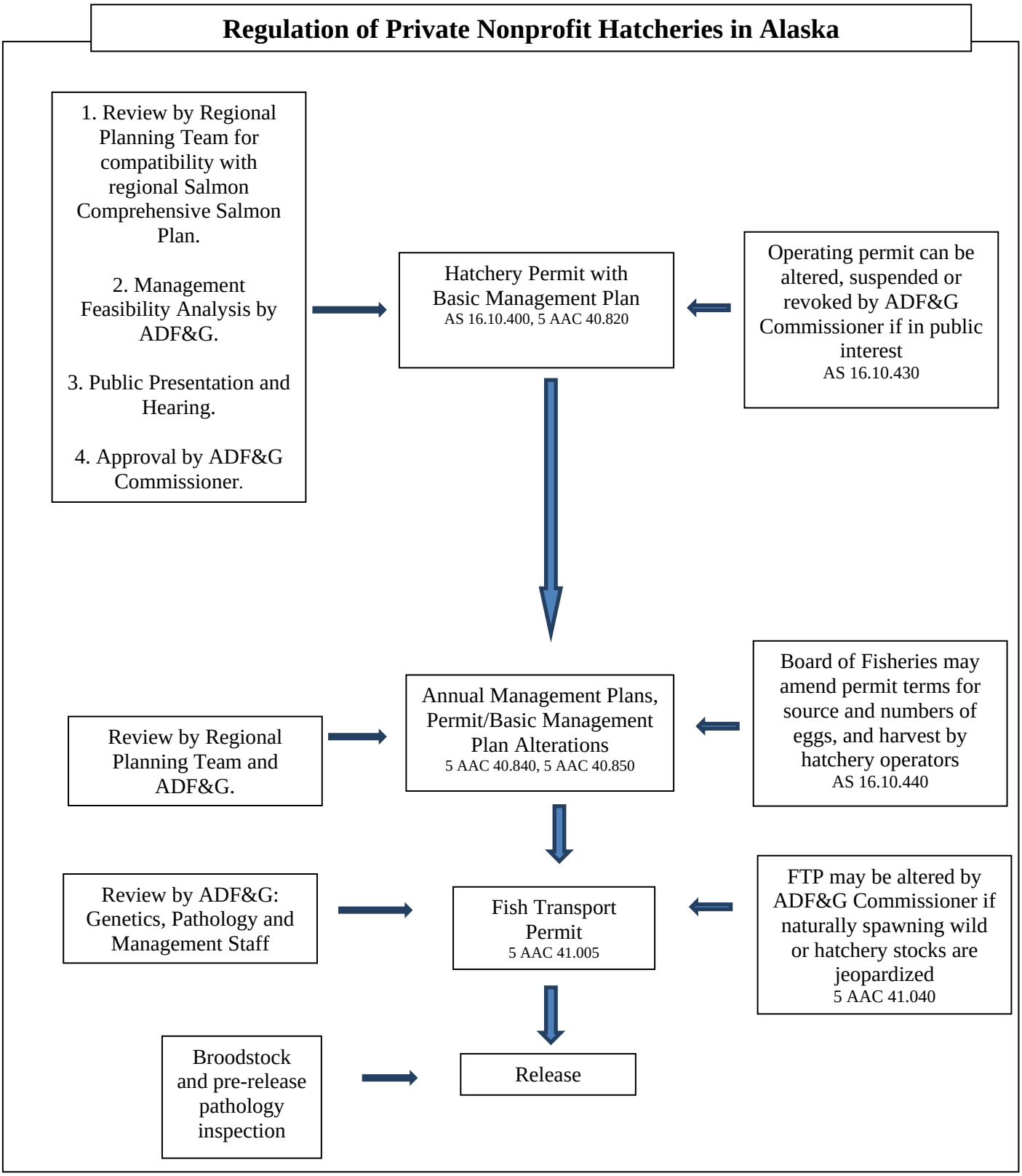

Figure 2.–Diagram of Alaska Hatchery Permitting process.

PORT GRAHAM HATCHERY OVERVIEW

The Port Graham Hatchery (PGH) is located about 30 miles southwest of Homer in Cook Inlet (Figures 3 and 4). The nonprofit Port Graham Hatchery Corporation (PGHC) applied for a hatchery permit in 1991. The stated goal of the hatchery in the hatchery permit application was to provide a steady supply of salmon for the local cannery, which had closed following the 1989 Exxon Valdez oil spill after a decade of declining harvests: "For the long term, the best opportunity for the villages is to get back into fish processing. To achieve this there will need to be a reliable supply of high quality salmon for the processing plant. The solution is to develop a salmon hatchery in the village. This would provide a substantial return directly to the processing plant and, since these fish would be harvested in the immediate vicinity of the plant, they would maintain their quality thus making it possible to produce higher quality products."

The application made no mention of providing fish for other purposes, such as the common property commercial fisheries. This raised alarm among a number of user groups. The Port Graham Hatchery Corporation is a nonprofit corporation of the Port Graham Village Council, which is the community government. The Port Graham Corporation, a for-profit village corporation, owns the cannery and the land on which the cannery and hatchery are located. As stated earlier, RPTs evaluate enhancement and rehabilitation projects for the salmon resources in the region. State regulations regarding the RPTs review of hatchery applications are as follows.

5 AAC 40.170. REGIONAL PLANNING TEAM REVIEW

(a) The appropriate regional planning team, as established under 5 AAC 40.300, shall review each application to determine if the proposed hatchery is compatible with the appropriate regional comprehensive salmon plan. The regional planning team shall use the following application review criteria:

> (1) The contribution the proposed hatchery would make to the common property fishery;
>
> (2) The provisions for protection of the naturally occurring stocks from any adverse effects which may originate from the proposed hatchery;
>
> (3) The compatibility of the proposed hatchery with the goals and objectives of the comprehensive salmon plan for the region; and
>
> (4) Whether the proposed hatchery would make the best use of the site's potential to benefit the common property fishery.

(b) An applicant may review the regional planning team determination and comment on it by letter to the commissioner.

In their review to the ADF&G commissioner, the Cook Inlet RPT indicated uneasiness with the application: "As the application stands there is no way to assuring there will be an annual contribution to the common property fishery. This is true because of the unusual vertical integration of processing in the proposal." (unpublished letter to the commissioner obtained from Sam Rabung, Division of Commercial Fisheries PNP Hatchery Coordinator, ADF&G, Juneau).

Fishing groups also raised concerns over the application. The United Cook Inlet Drift Association asked the ADF&G Commissioner to deny the permit, in part, because there was no mention of contributions of hatchery salmon to the common property fishery, only to the local

cannery (T. Matthews, United Cook Inlet Drift Association, Letter to the ADF&G Commissioner regarding the Port Graham hatchery application dated January 27, 1992).

The executive director of the Southeast Alaska Seiners Association wrote that although their organization does not normally get involved in PNP permits outside their region, the Port Graham application raised statewide issues because the primary impetus for the hatchery was to supply the local cannery, with no mention of contributing to the common property fisheries. "Hatcheries are supposed to contribute to common property fisheries and to benefit commercial fishermen. This permit proposes to do neither. Until the fundamental purposes of the state's hatchery program is secured, this permit should be denied." (unpublished letter from K. Troll, Southeast Alaska Seiners Association, to the ADF&G Commissioner regarding the Port Graham hatchery application dated January 27, 1992; obtained from Sam Rabung, Division of Commercial Fisheries PNP Hatchery Coordinator, ADF&G, Juneau).

Cook Inlet Aquaculture Association (CIAA) asked the commissioner to deny or modify the permit because there could be no segregation of natural and hatchery stocks in Port Graham Bay (unpublished letter from T. Mears, CIAA, to the ADF&G Commissioner regarding the Port Graham hatchery application dated May 26, 1992; obtained from Sam Rabung, Division of Commercial Fisheries PNP Hatchery Coordinator, ADF&G, Juneau) as required in Alaska Statue (AS 16.10.420 (10), and because the fish would not contribute to common property fisheries.

After review of comments regarding the fishery, the hatchery permit and BMP were issued in 1992. The BMP included a mission statement to address some of the concerns of the organizations above: "The mission of the Port Graham hatchery is two-fold; (1) provide a reliable supply of salmon for processing in the Port Graham salmon processing plant, (2) provide a significant number of salmon for harvest in the commercial fishery." (ADF&G 1992). The hatchery was constructed in 1992 by the Port Graham Hatchery Corporation as an independent PNP hatchery. The operation was not affiliated with CIAA, or the RAA.

The hatchery began as a pink salmon incubation facility. Pink salmon broodstock were initially collected from the Port Graham River, eggs incubated at the hatchery, and fry released into Port Graham Bay. The escapement goal for the Port Graham River at the beginning of hatchery operations was 20,000 to 40,000 fish (Otis 2001). The pink salmon fishery in Port Graham had been closed for several years prior to hatchery operations due to low escapements. Pink salmon escapements improved, reaching the lower goal of 20,000 fish in 1990 and 1991 (unpublished memorandum from Wes Bucher to James Brady [Regional Manager, Division of Commercial Fisheries, ADF&G] regarding the Port Graham hatchery FTP and egg take stipulations, dated August 5, 1992); obtained from Sam Rabung, Division of Commercial Fisheries PNP Hatchery Coordinator, ADF&G, Juneau).

Based on historic pink salmon escapement levels, the area biologists for the divisions of Sport Fish and Commercial Fisheries developed initial provisional guidelines for "balancing natural spawning escapement and hatchery broodstock requirements" as follows:

- Less than 6,000 fish returning to stream: no broodstock.
- Between 6,000 and 80,000 fish: 50% of fish above 6,000 for broodstock until 40,000 total escapement is reached.
- Over 80,000 fish: 100% of the fish for broodstock after 40,000 fish are escaped into the river.

The area biologists stressed that the Port Graham River would be managed for naturally spawning wild stock escapement and warned that weak returns in 1992 may preclude PGH meeting their broodstock goals. The 1992 return was weak as forecasted and no broodstock was taken.

It appears from the AMPs that broodstock was taken from the Port Graham River spawners in 1993 and 1994 and from English Bay River pink salmon in 1999. The 1999 broodstock collection from English Bay River was due to the loss of 1997 brood year pink salmon eggs in a fire and the low escapement to the Port Graham River in 1999. In all other years, it appears egg takes were from fish returning to the hatchery.

In 2002, the pink salmon escapement goals were updated (Otis 2001), with a new Port Graham River pink salmon escapement goal of 7,000 to 20,000 fish. Under the new escapement goals, the broodstock egg-take schedule for the Port Graham River was adjusted to require the lower escapement goal of 7,000 fish met before any broodstock was taken. After escapement to the river reached 7,000 fish, half of the escapement above 7,000 fish and below 20,000 fish could be taken for broodstock. All fish above a 20,000 fish escapement could be taken for broodstock.

During the first year of operation (1992), the hatchery took transfer of the English Bay Lakes (EBL) sockeye salmon enhancement program from the State of Alaska's Big Lake Hatchery. The EBL system is the largest stock of sockeye salmon in the southwest portion of Cook Inlet. Low returns to EBL in the late 1980s resulted in very restrictive management for the system. As a result, the ADF&G FRED Division initiated an enhancement program, with an egg take of wild broodstock from the system in 1989, incubation of the eggs at the Big Lake Hatchery, and release of fry back into EBL the following year. ADF&G worked with the village of Nanwalek at English Bay for egg collections, fry stockings, and operation of a smolt/adult weir. Nanwalek continued their support role when egg incubation and fry rearing was moved from Big Lake Hatchery to PGH.

FRED Division staff surmised that reduced escapements to the lakes from 1985 to 1990 led to reduced nutrient availability from carcasses and decreased fertility in EBL. Edmundson et al. (1992) indicated that the fast flushing rate of the EBL system would negate the benefits of lake fertilization and that stocking fry directly into the lake could overgraze available zooplankton in the lake. In order to increase returns to EBL through enhancement, rearing and feeding hatchery fry in lake net pens was suggested as a method to increase returns to EBL without decimating the zooplankton food base.

Sockeye salmon fry were initially reared in net pens in EBL from 1991 to 1993, through a cooperative arrangement between ADF&G, the Village of Nanwalek, Chugachmiut, Inc., and PGH. During these years there were periodic sockeye salmon health issues (e.g., gill parasites and furunculosis), but no incidences of infectious hematopoietic necrosis virus (IHNV) endemic to the watershed (Schollenberger 1993). Beginning in 1994, sockeye salmon fry were regularly infected with the IHNV when reared in the lake net pens.

In January 1998, the hatchery was destroyed by fire. A separate building used for coho salmon production was used to accommodate pink salmon egg takes until the hatchery was rebuilt in December 1999. The new hatchery had the capacity to incubate the full permitted level for pink (110 million), sockeye (1.35 million) and coho (0.4 million) salmon eggs.

In 2004, PGH contracted with CIAA to incubate EBL sockeye salmon eggs and rear the fry at Trail Lakes Hatchery (TLH). Some fry were reared at TLH until the fall and then released directly to EBL. The remaining fry were reared at TLH until the following spring, transported to net pens at PGH for imprinting, and released (Hammarstrom and Dickson 2006)

The hatchery discontinued pink salmon operations in 2007, due to budget constraints. PGH conducted the sockeye salmon egg take at EBL from 2004 to 2009 and the eggs were transported under a cooperative agreement to TLH, operated by CIAA, for incubation and rearing. In 2010, the EBL project was transferred from the PGH permit to the TLH permit.

A coho salmon program was permitted for a five-year period (1995 to 2000) to take eggs from Port Graham River broodstock and return the resulting fry to the river (Appendix A). However, gametes were only collected in 1996 and 1997. In 1998, no eggs were collected because the fire that destroyed the hatchery necessitated using the coho salmon incubation building for sockeye and pink salmon incubation until the new hatchery was built. In the other two permitted years, returns to the river were too low to allow an egg take.

PGH experienced low egg-to-fry survivals for pink and sockeye salmon (Appendix B). According to ADF&G pathology lab inspection reports, poor survivals were attributed to egg fungus caused by inadequate picking of dead eggs, failure to disinfect eggs, poor water quality, poor broodstock condition, and inexperienced staff.

PGH pink salmon annual releases ranged from 255,000 in 2007 to over 57 million in 2002 (Appendix C). No pink salmon were released in 1993 because escapement to the Port Graham River was not sufficient to allow an egg take. Sockeye salmon releases ranged from 84,000 in 2007 to over 900,000 in 1998 and 1999. No sockeye salmon were released in 1995, 2000, or 2001 due to IHNV. About 30,000 coho salmon smolt were released in 1997.

Adult returns to the hatchery began in 1995. Cost recovery and broodstock collection at the hatchery occurred within the Port Graham Special Harvest Area (SHA; Figure 4). Cost recovery at EBL occurred within the EBL SHA (Figure 5). In years with returns, pink salmon returns ranged from 9,000 in 1996 to 1.4 million in 2004 (Appendix D). Sockeye salmon returns ranged from 1,000 in 2011 to 92,000 in 2003. Adult coho salmon returns from the one year release were not evaluated.

Commercial harvest in the Port Graham subdistrict targets returns to the Port Graham River and EBL and showed higher average catches during the period of hatchery operation, as compared to the decades prior to hatchery operations. For pink salmon, in the decade before hatchery operations (1982–1991), the harvest in Port Graham subdistrict was 8,000 fish per year and the 20-year average (1972–1991) was about 19,000 fish per year (unpublished memorandum to James Brady, Regional Management Biologist, ADF&G Division of Commercial Fisheries, regarding the Port Graham Hatchery FTP and Egg Take Stipulations, dated August 5, 1992, obtained from Sam Rabung, Division of Commercial Fisheries PNP Hatchery Coordinator, ADF&G, Juneau). The average commercial harvest during the 1995 to 2007 period of PGH production averaged nearly 200,000 fish per year, including several years of no harvest. For sockeye salmon, the 10-year average (1982–1991) harvest in Port Graham subdistrict was about 6,000 fish per year, with the 20-year average (1972–1991) harvest at about 10,000 fish per year (unpublished memorandum to James Brady, Regional Management Biologist, ADF&G Division of Commercial Fisheries, regarding the Port Graham Hatchery FTP and Egg Take Stipulations, dated August 5, 1992, obtained from Sam Rabung, Division of Commercial Fisheries PNP

Hatchery Coordinator, ADF&G, Juneau). Average commercial harvest during the 1995 to 2011 period of PGH and TLH production averaged nearly 15,000 fish per year, again including several years of no harvest (Appendix D).

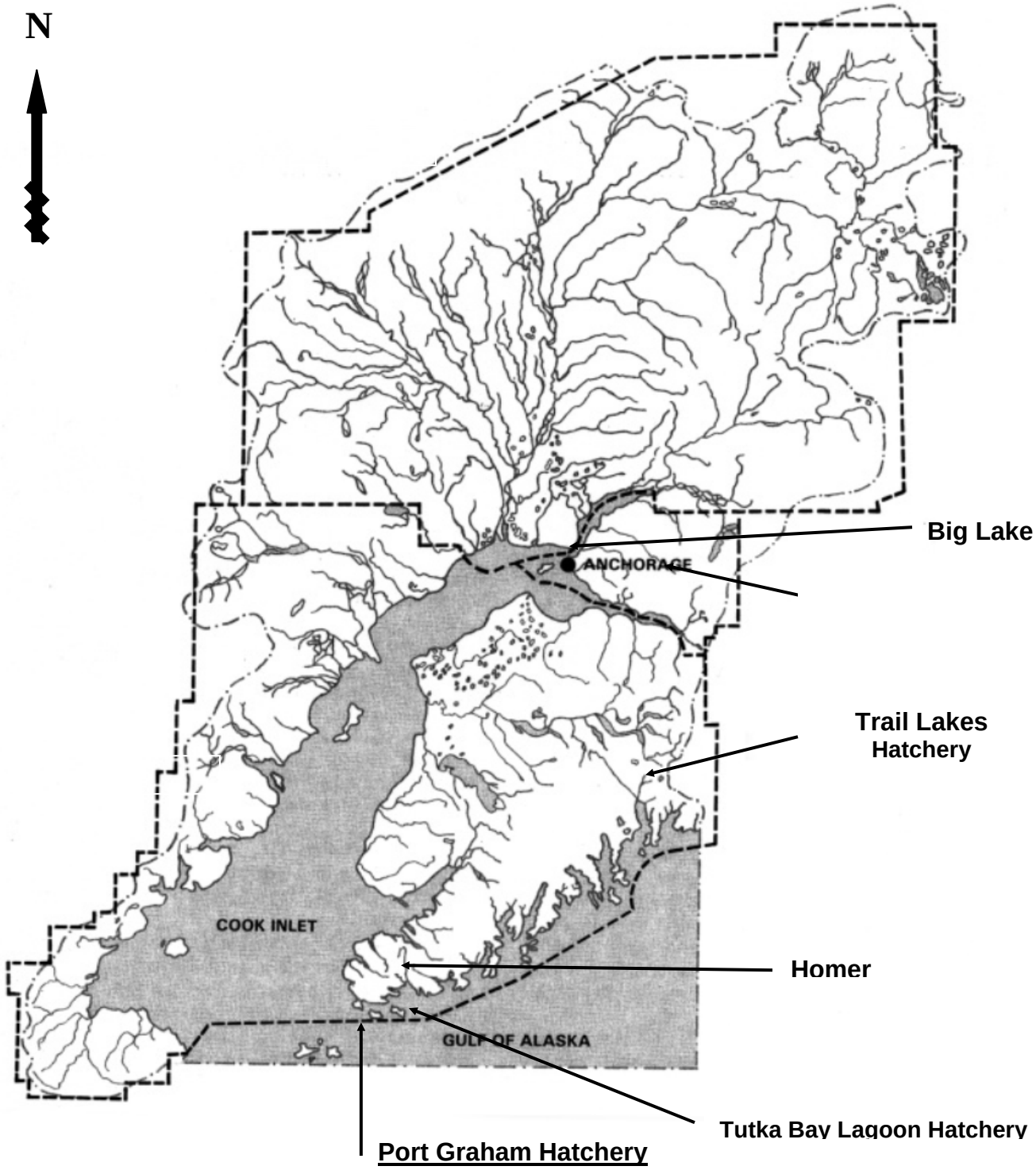

Figure 3.–Port Graham Lakes Hatchery.

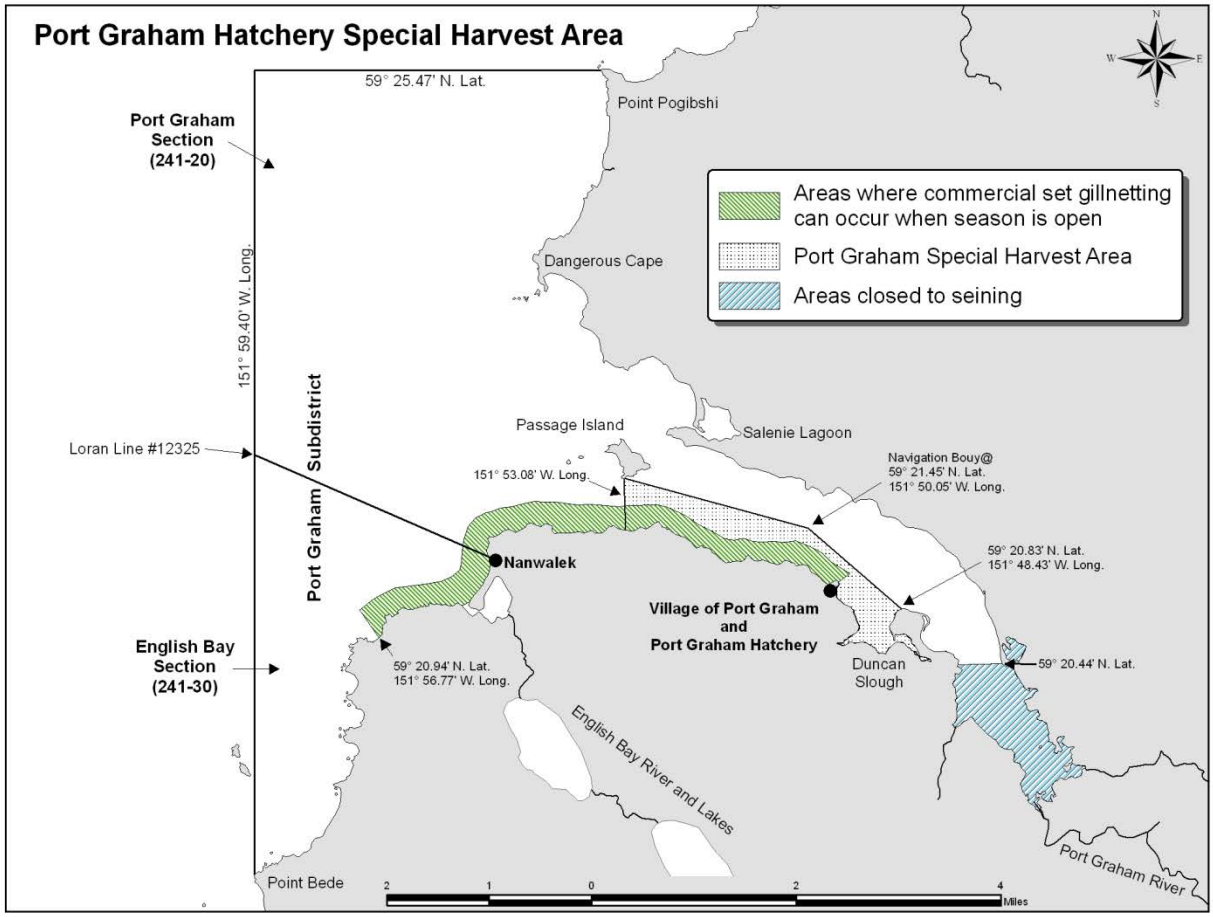

Figure 4.–Port Graham Special Harvest Area.

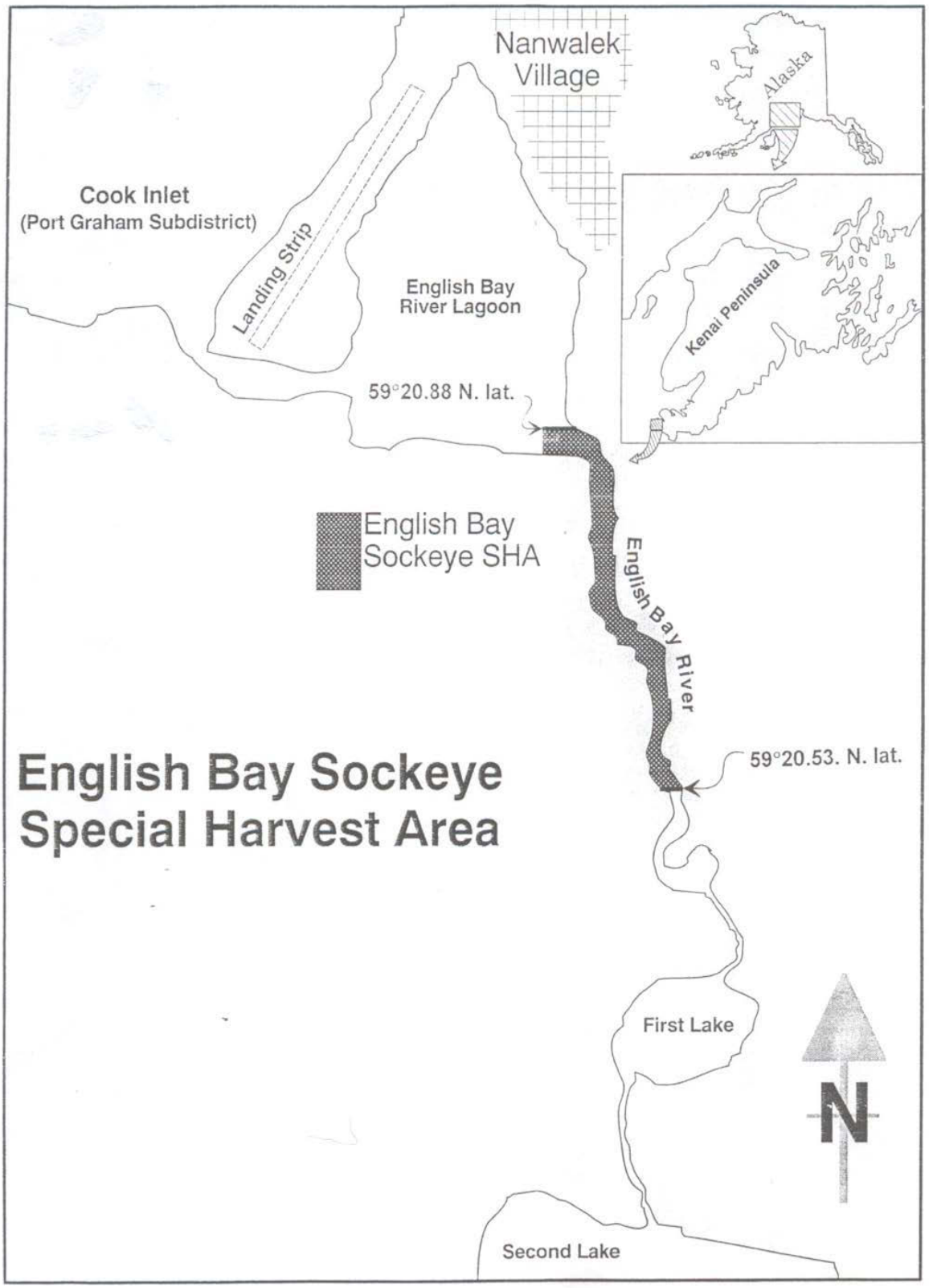

Figure 5.–English Bay sockeye salmon Special Harvest Area.

PROGRAM EVALUATIONS

HATCHERY PERMITS AND OPERATING PLANS

Hatchery permit, BMP, AMP, and FTP documents for PGH were reviewed to determine that they met the following guidelines:

- They are current.
- They are consistent with each other.
- They are an accurate description of current hatchery practices.

The BMP was not updated for permit alterations approved after the hatchery permit was issued. Several inconsistencies exist as a result. The sockeye and coho salmon programs are not in the BMP. Provisions for taking pink salmon eggs in the Port Graham River do not match the egg-take language in the AMP.

Egg takes exceeded permitted levels in many years, but the author found no indication ADF&G staff was concerned about the overages (Appendix E). It should be noted that egg take and release numbers reported in the annual reports are estimates and not actual counts.

FTPs were acquired as necessary for hatchery operations (Appendix F).

COMPREHENSIVE SALMON ENHANCEMENT PLAN

EBL sockeye salmon, Port Graham River pink salmon, and Port Graham River chum salmon are identified as significant stocks by the Cook Inlet Regional Planning Team (CIRPT) in the Cook Inlet Regional Salmon Enhancement Plan, Phase 2 (2007). No drainages near Port Graham were designated as wild stock sanctuary/reserves. These designations were made in 2007, well after the hatchery began operations in 1992.

CONSISTENCY WITH POLICY

The policies governing Alaska hatcheries were divided into three categories for this review: genetics, fish health, and fisheries management. The key elements of the policies in each of those categories are summarized in Tables 1 through 3. These templates identifying the key elements of state policies were used to assess compliance of the PGH salmon program with each policy element in Tables 4 through 6.

Table 1.–Key elements of the ADF&G *Genetic Policy*.

I. Stock Transport	
Use of appropriate local stocks	This element addresses Section I of the *Genetic Policy*, covering stock transports. The policy prohibits interstate or inter-regional stock transports, and uses transport distance and appropriate phenotypic characteristics as criteria for judging the acceptability of donor stocks.
II. Protection of wild stocks	
Identification of significant or unique wild stocks	Significant or unique wild stocks must be identified for each region and species as stocks most important to that region. The Regional Planning Teams should establish criteria for determining significant stocks and recommend such stock designations.
Interaction with or impact on significant wild stocks	Priority is given to protection of significant wild stocks from harmful interactions with introduced stocks. Stocks cannot be introduced to sites where they may impact significant or unique wild stocks.
Use of indigenous stocks in watersheds with significant wild stocks	A watershed with a significant wild stock can only be stocked with progeny from the indigenous stocks. The policy also specifies that no more than one generation of separation from the donor system to stocking of the progeny will be allowed.
Establishment of wild stock sanctuaries	Wild stock sanctuaries should be established on a regional and species basis. No enhancement activities would be allowed, but gamete removal would be permitted. The guidelines and justifications describe the proposed sanctuaries as gene banks of wild type variability.
III. Maintenance of genetic variance	
Maximum of three hatchery stocks from a single donor stock	A maximum of three hatchery stocks can be derived from a single donor stock. Offsite releases, such as for terminal harvest, should not be restricted by this policy if the release sites are selected so that they do not impact significant wild stocks, wild stock sanctuaries, or other hatchery stocks.
Minimum effective population size	The policy recommends a minimum effective population size of 400. It also recognizes that small population sizes may be unavoidable with Chinook and steelhead.
Use of all segments of donor stock run timing	To ensure all segments of the run have the opportunity to spawn, sliding egg-take scales for donor stock transplants will not allocate more than 90% of any segment of the run for broodstock.
Genetics review of Fishery Transport Permits (5 AAC 41.010 – 41.050)	
Review by geneticist	Each application is reviewed by the geneticist, who then makes a recommendation to either approve or deny the application. The geneticist may also add terms or conditions to the permit to protect wild or enhanced stocks.

Table 2.–Key elements of Alaska policies and regulations pertaining to fish health and disease.

Fish Health and Disease Policy (5 AAC 41.080; amended by Meyers (2010))	
Egg disinfection	Within 48 hours of taking and fertilizing live fish eggs or transporting live fish eggs between watersheds, all eggs must be treated with an iodine solution. This requirement may be waived for large scale pink and chum salmon facilities where such disinfection is not effective or practical.
Hatchery inspections	According to AS 16.10.460, inspection of the hatchery facility by department inspectors shall be permitted by the permit holder at any time the hatchery is operating.
Disease reporting	The occurrence of fish diseases or pathogens listed in 5AAC 41.080(d) must be immediately reported to the ADF&G Fish Pathology Section.
Pathology requirements for Fishery Transport Permits (FTPs) (5 AAC 41.010 – 41.050)	
Disease history	Applications for FTPs require either a complete disease history of the stock or a broodstock inspection and certification if the disease history is not available.
Isolation measures	Applications must list the isolation measures to be used during transport, including a description of containers, water source, depuration measures, and plans for disinfection.
Pathology review of FTPs	Each application is reviewed by the pathologist, who then makes a recommendation to either approve or deny it. The pathologist may also add terms or conditions to the permit to protect fish health. Transports of fish between regions are discouraged.
Sockeye Salmon Culture Policy	
Alaska Sockeye Salmon Culture Manual	The Sockeye Salmon Culture Policy is designed to control the occurrence of infectious hematopoietic necrosis virus (IHNV) in Alaska. The policy specifies the use of a virus-free water supply; rigorous disinfection procedures; compartmentalization of eggs and fry; and immediate destruction of infected fish, followed by disinfection. The *Alaska Sockeye Salmon Culture Manual* prescribes procedures and fish culture practices developed to control IHNV.

Table 3.–Key elements of Alaska fisheries management policies and regulations relevant to salmon hatcheries and enhancement.

Sustainable Salmon Fishery Policy (5 AAC 39.222)	
I. Management principles and criteria	
Assessment of wild stock interaction and impacts	As a management principle, the effect of enhanced stocks on naturally spawning wild stocks should be assessed. Naturally spawning wild stocks should be protected from adverse impacts from enhanced stocks.
Use of precautionary approach	Managers should use a conservative approach, taking into account any inherent uncertainty and risks.
Salmon Escapement Goal Policy (5 AAC 39.223)	
Establishment of escapement goals	Management of fisheries is based on scientifically-based escapement goals that result in sustainable harvests.
Mixed Stock Salmon Fishery Policy (5 AAC 39.220)	
Wild stock conservation priority	The conservation of naturally spawning wild stocks consistent with sustained yield is the highest priority in management of mixed-stock fisheries.
Fisheries management review of FTPs (5 AAC 41.010 – 41.050)	
Review by management staff	All proposed FTPs are reviewed by the regional supervisors for the Divisions of Commercial Fisheries and Sport Fish, the deputy director of Commercial Fisheries, and the local Regional Resource Development Biologist before consideration the commissioner of ADF&G. Department staff may recommend approval or denial of the permit, and recommend permit conditions.

Genetics

Pink Salmon

Pink salmon broodstock was collected from the local Port Graham River stock (Table 5). In 1999, a PAR was submitted to use English Bay River pink salmon as a second broodstock source for release at PGH after fire destroyed the entire pink salmon hatchery population in 1998 (Appendix A). In evaluating the PAR, the area biologist noted that the *Genetics Policy* states: "Stocks cannot be introduced to sites where the introduced stock may have significant interaction or impact on significant or unique wild stocks." Both the Port Graham River and English Bay River are significant stocks (CIRPT 2007), but these designations were not in place until 2007. The area biologist also noted that due to the close proximity of the two systems, (the English Bay River is about 7 miles from the Port Graham River), the two stocks likely have "similar if not identical genetic characteristics". Two other biologists evaluating the PAR made similar remarks and called for an evaluation study using thermal marks to assess straying.

The PAR was approved, an FTP was issued for the project for one year only, and no straying study was required. Eggs were taken only at English Bay River in 1999 and therefore broodstock used in 2001 were likely a combination of English Bay River and the Port Graham River stocks.

In 1999, another PAR was also submitted to use Tutka Bay Lagoon Hatchery pink salmon for broodstock. The PAR was denied by the ADF&G commissioner due to genetic concerns (Appendix A). ADF&G staff were concerned that the Tutka Bay stock had become domesticated from 20 years of hatchery operations, and that stocking these fish at Port Graham could result in returns to the Port Graham River that could swamp the existing naturally spawning wild fish and displace the wild genes with the domesticated genes (unpublished comments on PAR obtained from Sam Rabung, Division of Commercial Fisheries PNP Hatchery Coordinator, ADF&G, Juneau).

Sockeye Salmon

Initially, the EBL sockeye program entailed taking broodstock from EBL, incubating the eggs at PGH, and releasing the fry back into EBL. Later permit alterations allowed for rearing fry in lake net pens prior to release to EBL.

Considerations of genetic issues were stated in the PGH AMPs for the EBL sockeye program. The AMP indicated that care should be taken to remove fish for cost recovery at intervals to ensure that representative numbers from all segments of the run are allowed to escape. The AMP also discussed the need to consider age composition, run timing, and ultimately genetic integrity of the wild stock. The 1996 AMP, for example, stated: "Brood stock collection needs to be carefully implemented to ensure that stock characteristics and life history is not changed or manipulated for the entire sockeye population merely through the choice of brood stock. The following need to be carefully considered when designing final brood stock and egg-take procedures: a) Sockeye salmon tend to return to natal redds to spawn. b) The natural population has both lake and stream spawners throughout the entire system from First Lake to Fifth Lake. d) Large numbers of spawners have been observed in the vicinity of the juvenile rearing pens suggesting they are pen-reared fish. d) Pen reared juveniles far outnumber naturally occurring juveniles. It is expected that the survival rate of pen reared juveniles is much higher than naturally reared fish, further diluting progeny with no artificial ancestry." (unpublished Port

Graham Hatchery 1996 Annual Management Plan, received from Sam Rabung, PNP Hatchery Coordinator, ADF&G Juneau)

Subsequent AMPs did not contain this language. However, egg takes were generally conducted over the course of three to five weeks in September each year.

The *Genetic Policy* states: "When enhancing a stream using the indigenous stock, the fish used for stocking shall not be removed from the wild system to a hatchery for more than one generation." Sockeye salmon released into the EBL system were not 100% marked until 1999 (Appendix C). Therefore, it was not possible to determine if returning adults used as broodstock were from hatchery or naturally spawning wild parents. When CIAA took over the project from PGH in 2010, the TLH AMP (ADF&G 2011) indicated that broodstock used for the EBL project should only be from adult returns from nonhatchery-reared parents. During the egg takes, gametes were isolated by breeding pair, and otoliths taken from broodstock. After otolith reading, only offspring from nonhatchery parents were stocked into the lakes. Fry from hatchery-reared parents were used in other projects.

One PAR for sockeye salmon was denied for genetic concerns. In 2005, PGH submitted a PAR to add Desire Lake (a late-run stock) as an alternative brood source when returns to EBL were not large enough to allow an egg take. The ADF&G commissioner denied the request to protect against potential negative genetic impacts if Desire Lake fish strayed to the EBL system.

Coho Salmon

The coho salmon program used broodstock from Port Graham River for fry release back to the river. All coho salmon were coded-wire-tagged and adipose fin-clipped during the sole release in 1997. The antigen for Renibacterium salmoninarum, the causative agent for bacterial kidney diseasewas detected in the coho salmon broodstock. A state fish pathologist noted that the finding of the antigen "caused hatchery personnel to select for acceleration from the incubators with the lowest prevalence of the antigen, rather than making a random selection. This was appropriate for pathology concerns but not for genetic concerns" (unpublished Port Graham Hatchery inspection report from 1991, obtained from Sam Rabung, Division of Commercial Fisheries PNP Hatchery Coordinator, ADF&G, Juneau).

Surplus coho salmon eggs that should have been randomly culled and disposed of as required in the AMP were held through the fry stage, when PGH attempted to amend their permit to stock fry elsewhere. Their PARs were denied due to genetic incompatibility and lack of information on stocks at requested stocking locations (Appendix A).

Significant Stocks

Significant and wild stock sanctuary designations indicate special importance. Priority is given to protection of significant wild stocks from harmful interactions with introduced stocks. A watershed with a significant wild stock can only be stocked with progeny from the indigenous stocks, with no more than one generation of separation from the donor system to stocking of progeny. Wild stock sanctuaries serve as gene banks of wild type variability; no enhancement activities are allowed, but gamete removal is permitted. EBL sockeye salmon and Port Graham River pink salmon were identified as significant stocks in 2007, after both projects had been in operation for over a decade. No wild stock sanctuaries were designated in the area of the PGH.

Table 4.–The Port Graham Hatchery salmon enhancement program and its consistency with elements of the ADF&G *Genetic Policy*. (See Table 2).

I. Stock Transport	
Use of appropriate local stocks	Port Graham River pink salmon were the source of broodstock for the PGH. English Bay Lakes sockeye salmon broodstock were taken from the EBL system, incubated at PGH, and released back to the EBL. Port Graham River coho salmon were used as broodstock for the Port Graham program.
II. Protection of wild stocks	
Identification of significant or unique wild stocks	Port Graham pink salmon are a significant stock, but the *significant* designation occurred in 2007 (CIRPT 2007), well after hatchery operations began in 1992. The operation of the hatchery in the presence of the significant stock complied with state policy by not introducing a new stock that could impact the significant stock. EBL sockeye salmon are a significant stock, but the *significant* designation occurred in 2007 (CIRPT 2007), after the project had been in operation for 15 years. Sockeye salmon gametes were taken from EBL broodstock, incubated at PGH, and the offspring returned to EBL.
Interaction with or impact on significant wild stocks	Straying is addressed with intensive harvest of returning fish in SHAs adjacent to release sites. ADF&G can restrict fishing to meet escapement goals to EBL. No straying studies were conducted or required in the AMPs or FTPs. Pink salmon from English Bay River were used as broodstock for one year after the fire destroyed the hatchery and incubating pink salmon fry. English Bay is about 7 miles from Port Graham River and the two stocks may be genetically indistinguishable, but this has not been assessed by DNA analyses.
Use of indigenous stocks in watersheds with significant wild stocks	Port Graham is the indigenous stock in the watershed and used as the donor stock for pink and coho salmon releases at Port Graham. EBL sockeye salmon are the indigenous stock used for stocking the EBL. Only fry hatched from gametes taken directly from EBL are stocked back to EBL per the *Genetic Policy*. Both stocks were designated as significant stocks long after the projects began.
Establishment of wild stock sanctuaries	No wild stock sockeye salmon sanctuaries are listed for lower Cook Inlet.
III. Maintenance of genetic variance	
Maximum of three hatchery stocks from a single donor stock	The English Bay Lakes sockeye salmon are used as a donor stock for barriered-lake stocking projects in Lower Cook Inlet, for a release at Tutka Bay Lagoon, and for the project returning fry back to English Bay Lakes. All projects except Tutka Bay Lagoon are releases for terminal harvest and not broodstock development, in accordance with the *Genetic Policy.* The Port Graham pink and coho salmon stocks were released only at the Port Graham Hatchery.

-continued-

Table 4. Page 2 of 2.

III. Maintenance of genetic variance	
Minimum effective population size of 400	Well over 400 fish are necessary to meet egg-take goals for the pink salmon and sockeye salmon projects. The state geneticist required 60 pairs for the coho salmon project, which was permitted for a five-year period, but for which only one egg take occurred.
Use of no more than 90% of any run segment of donor stock so all segments of donor stock run can spawn	Management plans required minimum escapement goals be met for both pink and sockeye salmon prior to broodstock collections in natal systems (Port Graham River for pink salmon and English Bay Lakes for sockeye salmon). After minimum escapements were met, only a portion of the rest of the escapement could be taken until the upper escapement goal was met. Therefore, 90% of any part of the run could not be taken following these plans.
Genetics review of FTPs (5 AAC 41.010 – 41.050)	
Review by geneticist	The geneticist approved the pink salmon program FTP without comment. For the EBL sockeye salmon program, the geneticist recommended that an assessment of the impact of the enhancement program on the EBL native stocks should be evaluated by the appropriate area staff on the initial FTP. When the EBL project moved incubation from PGH to TLH in 2004, the geneticist recommended thermal marking of all fish, and to look for strays at Moose Creek and Hidden Lake, which are downstream from the TLH. The brief coho salmon program required 60 adult pairs to be used as broodstock, with the eggs randomly culled to produce the maximum permitted number of 40,000 eggs.

Fish Health and Disease

From 1992 to 2000, the state pathology inspection reports noted several issues with hatchery operations at PGH (Appendix G, Table 6). The state has minimum egg-to-fry survival guidelines in regulation (5AAC 40.860). From 1993 to 2006, egg-to-fry survivals were below these standards in 7 of 13 years for pink salmon and 5 of 10 years for sockeye salmon (Appendix B). A PAR to begin a sockeye salmon release from PGH was denied in 2005, in part because of a failure to meet the minimum survival standards from egg to fry for both sockeye and pink salmon (Appendix A).

For pink salmon, fungus on eggs leading to reduced survival was the most common remark made by state pathologists. Other recommendations in pathology inspection reports included regular egg picking, chemical treatment of eggs, and treatment of seawater used for fungus control.

Sockeye salmon mortality was a chronic issue. Major mortalities in 1996 and 1997 prompted a visit from members of the state pathology laboratory. The ADF&G pathology report from the visit noted that fish were dying just prior to hatch. Investigators indicated that poor water circulation and egg fungus were likely contributors to the high mortality.

In 1995 and 2001, all fry were destroyed per state health policy when diagnosed with IHNV. In 2000, three net pens of IHNV-infected fry were mistakenly released into the EBL by PGH staff. In 2003, PGH was prohibited from rearing sockeye salmon fry in net pens in EBL after several years of IHNV outbreaks.

PARs in 2006 and 2010 were denied for health and disease considerations. The 2006 PAR to rear sockeye salmon in Port Graham Bay was denied due to past poor hatchery practices and pathology concerns that were not addressed. The 2010 PAR to release sockeye salmon smolt into Port Graham Bay was denied because the hatchery was nonoperational and PGH had been unable to meet performance standards.

Table 5.–The Port Graham Hatchery salmon enhancement program and its consistency with elements of the Alaska policies on fish health and disease. (See Table 3).

Fish Health and Disease Policy (5AAC 41.080; amended by Meyers 2010)	
Egg disinfection	Pathology inspection reports indicate sockeye salmon and coho salmon eggs were treated at 100 ppm betadine/iodophor. Pink salmon eggs were treated with betadine/iodophor during the first two inspections in 1993 and 1995, but may not have been disinfected in subsequent years. In the 1997 inspection report, the inspector recommended disinfection when production numbers and survivals are low.
	A 1997 pathology inspection report recommended that sockeye salmon eggs be disinfected with iodophor for 1 hour per the *ADF&G Sockeye Culture Manual*, rather than the 15-minute period indicated in hatchery records.
	The 1999, 2000, 2002, 2004, and 2006 inspections recommended betadine/iodophor disinfection of pink salmon eggs.
Hatchery inspections	Hatchery inspections were conducted regularly from 1992 through 2006 (Appendix G).
Disease reporting	Saltwater gill disease reported in pink salmon in one year. Fungus control of pink salmon eggs was a chronic issue.
	Pathology reports indicate regular IHNV presence in EBL adult sockeye salmon, with subsequent transmission to fry rearing in net pens in the lake. Fry diseases included an internal parasite and trichophyra.
	Pathology reports indicated no health issues with coho salmon.
Pathology requirements for FTPs (5AAC 41.010)	
Disease history	Samples for disease history of EBL sockeye salmon, and PGH pink and coho salmon were requested by ADF&G and supplied by PGH.
Isolation measures	No isolation measures were required for pink and coho salmon transports. The FTP for sockeye salmon states “As required by standard sockeye egg-take procedures.”
Pathology review of FTPs	The FTPs for the PGH programs were reviewed and approved by the pathologist.

Fisheries Management

At EBL, escapement is monitored from a weir in the river outlet. ADF&G regulates egg takes, subsistence fishing, and commercial fishing based on the strength of the return from the weir counts. Semiweekly escapement goals were established in the PGH AMP.

Fishery management plans are similar for the Port Graham pink salmon and EBL sockeye salmon programs. Wild broodstock collections in both systems are limited until lower escapement goals were reached. Afterwards, an increasing number of fish are allowed for broodstock until the upper escapement goal is reached, after which all additional fish can be taken for broodstock.

The Port Graham area is managed to achieve the naturally spawning wild stock sustainable escapement goals for pink salmon and chum salmon. Prior to 2002, the pink salmon escapement goal range was 20,000 to 40,000 fish and from 2002 forward the goal was 6,000 to 20,000 fish. For chum salmon, prior to 2002 the escapement goal range was 4,000 to 8,000 fish and from 2002 forward the goal was 1,500 to 4,800 fish (Otis 2001).

The lower pink salmon escapement goal of 20,000 fish was not met during PGH operations from 1992 to 2002. The updated lower escapement goal of 7,000 fish was met every year from 2002 forward. For chum salmon, escapement goals were met for most years of PGH operations (Appendix H).

At EBL, the sockeye salmon escapement goal prior to 2002 was 10,000 to 20,000 fish and from 2002 forward the goal was 6,000 to 13,500 fish. The lower escapement goal was achieved every year from 1994 to 2010 (Appendix H).

Pink salmon from PGH were thermally marked from 1999 through 2004 and in 2007 (ADF&G Tag and Otolith Lab database 2012). A portion of the pink salmon release was coded-wire-tagged in 1994 and 1997 (Appendix C). All coho salmon were tagged in the sole release in 1997 and sockeye salmon were periodically thermally marked and coded wire tagged. Coded wire tags were recovered for sockeye salmon in 1997 and 1998 and pink salmon in 1998, in local fisheries.

The Nanwalek sockeye project has operated a weir to count outmigrating sockeye salmon smolts and returning adults on the EBL River since the early 1990s. Nanwalek sockeye project annual reports provided estimates of numbers and age-class of smolt outmigrants and returning adults. Hatchery contribution was estimated during years of coded wire tagging.

Table 6.–The Port Graham Hatchery salmon enhancement program and its consistency with elements of Alaska fisheries management policies and regulations. (See Table 4)

Sustainable Salmon Fishery Policy (5 AAC 39.222)	
I. Management principles and criteria	
Assessment of wild stock interaction and impacts	SHAs at EBL and PGH provide escapement corridors for wild fish and discreet harvest areas for hatchery broodstock and cost recovery. A weir at EBL River enumerates smolt outmigration and returning adults. The adult escapement was not sampled for otolith marks or tags, nor were formal studies required in FTPs to assess wild stock interactions. In years where fish were otolith marked, the AMP stated that otoliths would be sampled from the catch, escapement, and cost recovery and sent to the Douglas Island Pink and Chum (DIPAC) hatchery in Juneau for reading. However, no record was found that this occurred either in ADF&G or DIPAC records (Rick Focht, DIPAC, personal communication).
Use of precautionary approach	ADF&G may restrict fishing to meet wild stock escapement goals in the Port Graham River and EBL. Broodstock is not taken until the lower escapement goal is reached.
Salmon Escapement Goal Policy (5 AAC 39.223)	
Establishment of escapement goals	Sustainable escapement goals are established for EBL sockeye salmon and Port Graham pink salmon.
Mixed Stock Salmon Fishery Policy (5 AAC 39.220)	
Wild stock conservation priority	Management plans are in place for EBL and Port Graham River to meet the lower escapement goal before broodstock is taken. The use of SHAs for adult salmon returning to release sites allows their targeted harvest and minimizes incidental catch of other stocks. Escapement goals for Port Graham pink and chum salmon and EBL sockeye salmon were met nearly every year of enhancement operations.
Fisheries management review of FTPs (5 AAC 41.010 – 41.050)	
Review by management staff	All FTPs for PGH programs were reviewed and approved by fisheries management staff.

OTHER REQUIREMENTS

ANNUAL REPORTING AND CARCASS LOGS

All hatcheries are required to submit an annual report to ADF&G that summarizes their production and activities for the year (AS 16.10.470). The annual report must include "information pertaining to species; broodstock source; number, age, weight, and length of spawners; number of eggs taken and fry fingerling produced; and the number, age, weight, and length of adult returns attributable to hatchery releases, on a form to be provided by the department." The completed report is due on December 15. Annual reports were received for all years of operation from PGH.

Beginning in 2008, Alaska hatcheries were required to document the disposal of the carcasses of salmon used for broodstock (5 AAC 93.350). The hatchery must record the number of males and females used each day, and whether they were fertilized, unused, or used for roe sales. A maximum of 10% of the total number of females can be used for roe sales without using the carcass; the proceeds from any excess must be surrendered to ADF&G. The author found no PGH carcass logs submitted for 2009, the only year since 2008 that eggs were collected. The 2009 Annual Report for Port Graham indicated no carcasses were disposed of. Carcasses were likely given away as was the custom in other years (Sam Rabung, Division of Commercial Fisheries PNP Hatchery Coordinator, ADF&G, Juneau, personal communication).

DISCUSSION

The EBL program was transferred by contract from PGH to TLH in 2007. The program was transferred directly to TLH's permit in 2010. CIAA is currently assessing taking over operation of PGH.

RECOMMENDATIONS

Although PGH is not operating at this time, the facility remains permitted with active FTPs. The following recommendations are made, should the hatchery restart operations.

1. The PGH BMP should be updated to reflect all permit alterations and changes to the AMP.
2. Egg takes should not exceed permitted capacity.
3. PGH should implement all recommendations from ADF&G pathology staff to meet minimum egg-to-fry survival rates in state regulation.
4. All sockeye salmon should be marked and only naturally-spawned adults used for broodstock in the EBL program.

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APPENDICES

Appendix A.–History of Port Graham Hatchery Permit and Permit Alteration Requests, 1992–2010.

Date	Description	Permitted Capacity (green eggs) Pink (millions)	Coho (thousands)	Sockeye (millions)
8/3/1992	Original permit number 33 issued to Port Graham Hatchery Corporation. Permitted total of 110 million pink salmon eggs. Broodstock source was the Port Graham River. BMP stated that no more than 3 million eggs per year (the contribution of 4000 adults) allowed from the Port Graham River wild return. Remainder of broodstock to be developed from hatchery returns.	110		
12/11/1992	PAR approved for 1.35 million sockeye salmon eggs. Broodstock from the EBL system. Resulting fry released back into the EBL system.	110		1.35
7/21/1995	PAR approved for 40,000 coho salmon eggs. Broodstock source was Port Graham River. Resulting fry released back to the Port Graham River.	110	40	1.35
6/18/1996	PAR approved to establish SHA in English Bay River to harvest sockeye salmon for cost recovery and broodstock.	110	40	1.35
05/07/1997	PAR denied to increase coho salmon permitted capacity from 40,000 to 150,000 eggs. PGH did not cull 40,000 eggs and destroy the remainder from the required 60 pair broodstock as required in their AMP. The PAR was an attempt to stock the balance of the undestroyed fry elsewhere. The PAR was denied based on genetic unsuitability for some suggested stocking locations and a lack of knowledge of other stocking locations.	110	40	1.35
04/10/1998	PAR denied for an experimental release of age-0 coho salmon smolts from net pens at PGH. These fish had to be moved from the coho building at PGH to provide rearing space for pink and sockeye salmon after the hatchery was destroyed by fire. The commissioner provided an alternative to stock fry into a barriered portion of the Port Graham river that was inaccessible to adult salmon, but soon would be when a planned fish ladder was constructed.	110	40	1.35
5/27/1999	PAR approved to add English Bay River pink salmon as an additional brookstock source for the PGH.	110	40	1.35
9/09/1999	PAR denied to use TBLH pink salmon as broodstock for the PGH, due to genetic concerns.	110	40	1.35

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Date	Description	Permitted Capacity (green eggs) Pink (millions)	Coho (thousands)	Sockeye (millions)
6/04/2003	PAR approved to add a PGH sockeye salmon smolt release project of 1.8 million eggs, raising permitted level for sockeye salmon to 3.15 million eggs. Permit alteration to expire in two years.	110	40	3.15
6/23/2004	PAR approved to rear 150,000 brood year 2003 sockeye salmon fry to presmolt state for release to English Bay Second Lake prior to October 2004. Project approved for 2004 calendar year only.	110	40	3.15
03/07/2005	PAR denied to add Desire Lake sockeye salmon as an alternative brood source when EBL does not provide sufficient broodstock due to violation of *Genetics Policy*.	110	40	1.35
06/12/2006	PAR denied to start a sockeye salmon production return to Port Graham Bay using vertical raceways due to poor egg to fry survival and unsatisfactory hatchery management practices.	110	40	1.35
07/01/2010	PAR denied to release sockeye salmon smolt from Port Graham Bay due to insufficient staffing and resources at PGH.	110	40	1.35

Appendix B.–Egg-to-fry survival in percent at Port Graham Hatchery. Numbers in bold represent years where survival was below the minimum state standard in regulation.

Year	Species		State Survival Guideline[a]
	Pink	Sockeye	
1993	81	79	68
1994	85	**15**	68
1995	83	**2**	68
1996	**62**	**24**	68
1997	Eggs lost in hatchery fire	Eggs lost in hatchery fire	68
1998	**59**	88	68
1999	84	90	68
2000	81	81	68
2001	**60**	No egg take	68
2002	76	**54**	68
2003	**63**	82	68
2004	**47**	**61**[b]	68
2005	**56**	No egg take	68
2006	**65**	No egg take	68

[a] Egg to fry survival data collected from annual reports submitted by the Port Graham Hatchery.

[b] Half of the approximately 3.1 million eggs taken in 2004 were transferred to Trail Lakes Hatchery. The 61% shown in this table represents the survival of those eggs that remained at Port Graham Hatchery.

Appendix C.–Juvenile releases of salmon incubated at Port Graham Hatchery, 1992–2007. Pink and coho salmon are Port Graham River stock. Sockeye salmon are English Bay Lakes stock.

Year	Pink Salmon	Coho Salmon	Sockeye Salmon
1992	1,810,000[a]		145,000
1993	[b]		195,000
1994	1,295,000		830,000
1995	358,000		[c]
1996	6,470,000		292,000
1997	918,000	30,000	199,000
1998	[d]	30,000	[e]
1999	4,617,000		918,000
2000	1,143,000		906,000
2001	27,299,000		[c]
2002	6,601,000		[e]
2003	57,200,000		695,000
2004	36,283,000		160,000
2005	26,568,000		203,000
2006	13,884,000		422,000
2007	13,282,000		
Grand Total	197,728,000	30,000	4,877,00

Source: Data from annual reports submitted by the hatchery, and rounded.

[a] The 1992 release was from eggs collected under an ADF&G scientific permit (F-91-053) used to gather background information for the Port Graham Hatchery hatchery permit application, which was issued in 1992.

[b] No broodstock available in 1992 for release of fry in 1993 due to low escapement.

[c] All lost to IHNV.

[d] All lost in fire.

[e] No broodstock available in 2001 due to low escapement so no releases in 2002.

Appendix D.–Adult returns of salmon to Port Graham Hatchery and English Bay Lakes and the total commercial harvest in English Bay and Port Graham sections of the Port Graham subdistrict, 1995-2011.

	Pink Salmon		Sockeye Salmon[a]	
Year	Total Return[b,c]	Commercial Harvest[d]	Total Return[b,c]	Commercial Harvest[d]
1995	20,000	10,000	19,000	2,600
1996	14,000	2,000	34,000	17,900
1997	186,000	145,000	50,000	33,100
1998	22,000	1,000	0	17,900
1999	[e]	0	19,000	700
2000	90,000	0	18,000	2,100
2001	35,000	0	14,000	0
2002	387,000	239,000	54,000	35,300
2003	92,000	600	92,000	68,500
2004	1,418,000	1,283,000	23,000	2,600
2005	596,000	511,000	0	0
2006	285,000	248,000	0	0
2007	136,000	118,000	0	4,300
2008			30,000	31,700
2009			15,000	17,800
2010				1,900
2011		700	12,600	1,400
Total	3,281,000	2,557,000	369,000	236,000

Note: The total return represents the estimated return of hatchery fish to the hatchery releases.
Note: The commercial harvest includes both hatchery and naturally spawning returns.
[a] Sockeye salmon returns include both wild and hatchery fish. Most of the return number is the broodstock taken inriver for the project.
[b] Data from annual reports submitted by Port Graham and Trail Lakes hatcheries, rounded to nearest thousand.
[c] Total return includes broodstock, broodstock escapement, and cost recovery, commercial, sport, and subsistence harvest listed in annual report.
[d] Commercial harvest data from Hammarstram and Ford (2011) and Hollowell et al. (2012).
[e] Fire destroyed hatchery in Jan 1998, destroying all the eggs; therefore, no pink salmon returned in 1999.

Appendix E.–Comparison of permitted and reported egg takes in hatchery permit, basic management plan, annual management plan, fishery transport permits and annual reports for the Port Graham salmon projects, 1993–2012.

		Permit/Basic Management Plan in Effect	Annual Management Plan	Fish Transport Permit			Annual Report
Year	Species	Eggs	Eggs	FTP No.	Expiration	Eggs	Eggs
1993	Pink	110 million	30 million	92A-0096	2013	110 million	2.0 million
	Sockeye	1.35 million	1.2 million	92A-0169	2013	1.35 million	866,000
1994	Pink	110 million	3 million				526,000
	Sockeye	1.35 million	1.3 million				1.41 million
1995	Pink	110 million	35 million				7.8 million
	Sockeye	1.35 million	2.5 million				2.2 million
	Coho[a]	40,000		95A-0083	2000	40,000	
1996	Pink	110 million	35 million				1.6 million
	Sockeye	1.35 million	1.35 million				1.6 million
	Coho	40,000	40,000				40,000
1997	Pink	110 million	35 million				15.5 million
	Sockeye	1.35 million	1.35 million				1.33 million
	Coho	40,000	40,000				38,000
1998	Pink	110 million	30 million				16 million
	Sockeye	1.35 million	1.35 million				1.33 million
	Coho	40,000	0				
1999	Pink	110 million	10 million				8 million
	Sockeye	1.35 million	1.35 million				1.46 million
	Coho	40,000	0				0
2000	Pink	110 million	110 million				34 million
	Sockeye	1.35 million	1.35 million				1.48 million
2001	Pink	110 million	31.5 million				12.4 million
	Sockeye	1.35 million	1.35 million				1.48 million
2002	Pink	110 million	110 million				77 million
	Sockeye	1.35 million	1.35 million				1.42 million
2003	Pink	110 million	110 million				57 million
	Sockeye	3.15 million	3.15 million	03A-0052	2005	1.8 million	162,000
2004	Pink	110 million	110 million				56 million
	Sockeye	3.15 million	3.15 million				1.78 million
2005	Pink	110 million	110 million				25 million
	Sockeye	3.15 million	3.15 million				0

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Appendix E. Page 2 or 2.

		Permit/Basic Management Plan in Effect	Annual Management Plan	Fish Transport Permit			Annual Report
Year	Species	Eggs	Eggs	FTP No.	Expiration	Eggs	Eggs
2006	Pink	110 million	110 million				21 million
				06A-0084	2009	1.15 million	
	Sockeye		1.35 million	02A-0169 (Amended)	2013	0.20 million	0
2007	Pink	110 million	110 million				0
	Sockeye	1.35 million	1.35 million				510,000
2008	Pink	110 million	110 million				0
	Sockeye	1.35 million	1.35 million				0
2009	Pink	110 million	110 million				0
	Sockeye	1.35 million	1.35 million				307,000
2010	Pink	110 million	0				0
	Sockeye	1.35 million	0				0
2011	Pink	110 million	0				0
	Sockeye	1.35 million	0				0

[a] PAR added 40,000 coho salmon eggs to permit for 5 years.

Appendix F.–Summary of Fish Transport Permits for Port Graham Hatchery.

FTP Number	Issued	Expiration	Summary and reviewer comments.
92A-0169	1992	2013	Issued in 1992. Incubate up to 1.35 million English Bay Lakes sockeye salmon eggs at PGH and stock resultant fry to English Bay Lakes. PGH replaced Big Lake Hatchery as the incubation facility for this project.
92A-0169	2006	2013	Amendment issued in 2006. Allocated 200,000 of the 1.35 million egg take to smolt releases at Port Graham Bay, with remainder of resultant fry from 1.15 M egg take to English Bay Lakes.
92A-0169	2008	2008	Amendment issued in 2008. Allowed a one-time increase in sockeye salmon fry from 200,000 to 260,000 for release at English Bay Lakes.
95A-0083	1995	2000	Incubate up to 40,000 Port Graham River coho salmon and release resulting fry back into Port Graham River.
03A-0052	2003	2006	Incubate up to 1.8 million English Bay Lakes sockeye salmon eggs at PGH for release of resultant smolt into Port Graham.
04A-0071	2004	2006	Incubate up to 1.4 million English Bay Lakes sockeye salmon eggs at Trail Lakes Hatchery for release of up to 200,000 fall fry in English Bay Lakes and up to 800,000 spring presmolts at Port Graham.
06A-0084	2006	2006	Incubate up to 1.15 million English Bay Lakes sockeye salmon eggs at either PGH or Trail Lakes Hatchery operated by CIAA, and release of resultant smolt into Port Graham.

Appendix G.–Pathology Inspection Report summary for Port Graham, 1992 to 2006.

Year	Observations and Issues	Recommendations
1992	Pink salmon loss due to low water flow. Sockeye salmon pinhead loss from improper feeding. Wooden raceways and baffles used for sockeye rearing. Sockeye salmon and pink salmon operations separated only by Visqueen partition with no footbaths.	Feed fish based on body weight and fish size. Replace wooden raceways and baffles with aluminum, plastic or fiberglass. Replace outlets on pink salmon incubators to increase water flow. Use footbaths in sockeye salmon incubation area. Isolate sockeye salmon modules.
1993	Hatchery rebuilt. Previous pink salmon incubator room now a well-designed sockeye salmon module with footbaths, aluminum incubator and raceway. A few galvanized pipe fittings and brass valves present in hatchery plumbing.	Remove any galvanized or brass fittings because they contain toxic metals.
1995	Sockeye salmon survival to eyed egg stage only 64%. Eggs were taken as separate gametes at EBL and fertilized at hatchery. This procedure, combined with inexperienced egg-take crew and warm temperatures likely contributed to poor survival to eyed egg stage. About 90% of sockeye salmon fry lost soon after hatch, likely due to either supersaturation or low oxygen.	Bring in experienced fish culturist for advice on improving egg takes. Obtain separate utensils for each sockeye start tank, and eliminate use of wood-handled brushes. Obtain a total dissolved gas (TDG) meter and take readings at least weekly.
1996	Low egg to fry sockeye salmon survivals in 1994 and 1995. Pathology staff received sample of sockeye alevin from PGH on 12/3/96 and advised removal of dead eggs that are showing signs of fungus. On 12/17 visit, incubator mortality continued to increase, in part due to not removing any of the dead eggs with fungus.	Hire experienced personnel, reduce organic matter in the water, reduce air buildup in water system, improve egg shocking and reloading techniques, replace sagging egg baskets with rigid frame trays to reduce egg and fry suffocation, improve treatments for egg fungus, and removal of dead eggs and fry regularly.
1997	1997 inspection was about 4 months after the 1996 inspection. Two incubators of pink salmon lost due to water shut-off. Coho eggs that should have been randomly culled and disposed of as required in the AMP were held. Previous recommendations of obtaining a device to measure oxygen levels, and improved sanitation procedures were in place. Excess coho eggs retained that were above the permitted level (40,000) kept staff away from other tasks, were an additional disease risk, and a violation of the permitted capacity for the hatchery.	Daily checks for water flow because two incubators of fry were lost when water shut off. Comply with ADF&G sockeye culture policy that requires that sockeye eggs be water-hardened in idophor for 1 hour instead of the 15 minute treatment practiced at PGH. Work with ADF&G to determine procedures for disposing of excess coho salmon eggs.

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Year	Observations and Issues	Recommendations
1999	Poor pink salmon survivals due to air entrainment in incubators and excessive loading of green eggs in incubators. Sockeye and pink production moved to coho building until new hatchery built. UV treatment non-operational.	Current sockeye incubation unacceptable and require modifications that follow ADF&G sockeye salmon culture policy if program is to continue. Reduce incubator loading of pink salmon. Disinfect pink salmon eggs according to ADF&G disease policy when production numbers and survivals are low. Reduce pink salmon start tank densities. Make UV treatment unit operational. Replace total TDG meter that was lost in fire for regular monitoring.
2000	New hatchery in operation. Sockeye incubators configured in 3 stacks, each three incubators high. Sockeye salmon eggs not routinely picked. Pink salmon production looked good. Seawater used for fungus control but seawater not treated for pathogens prior to use.	Unstack incubators so compartmentalization can be maintained. Have separate utensils for each sockeye salmon unit. Expand pink salmon gradually with emphasis on maximizing survival. Purchase TDG meter for regular monitoring. If seawater routinely used for fungus control, treat seawater for pathogens.
2002	No sockeye eggtake this year. Hatchery plans to expand to full pink salmon capacity of 110 million eggs. All fish in hatchery otolith marked. TDG meter available but regular readings not taken. Pink salmon eggs not disinfected at eggtake. Eggs shocked and picked only in incubators that have a lot of visible dead eggs present. Betadine rinse after shocking is not used. Staff attribute poor pink salmon survivals to egg-take problems.	If sockeye will be raised, unstack incubators so compartmentalization can be maintained. Have separate utensils for each sockeye salmon unit. If seawater routinely used for fungus control, treat seawater for pathogens.
2004	Significant fungus problem in pink salmon incubators. Seawater used for fungus control is not treated for pathogens. Screens on incubators did not fit properly, allowing eggs to full under perf plate and then become fungused. Due to low pink prices, PGH is considering replacing some pink salmon production with sockeye or coho salmon production. PGH pursuing grant money to purchase a filtering system for influent water and UV disinfection of seawater.	Recommend pink salmon fungus control with chemical treatment rather than seawater. Reduce pink salmon densities in incubators when survivals are poor. Disinfect pink salmon eggs with Betadine after water hardening and after shocking/picking when fungus is a problem and survivals are poor. If seawater routinely used for fungus control, treat seawater for pathogens.
2006	Higher than normal pink salmon green egg to eyed egg mortality. Incubators overloaded with eggs. Unfiltered seawater treatments for fungus not adequate, resulting in significant fungus problems in incubators. Pink salmon eggs of poor quality due to poor quality broodstock. Consultant hired to improve pink salmon production. Hatchery building and equipment deteriorated since last inspection. Hatchery office boilers for heat were broken.	Recommend pink salmon fungus control with chemical treatment rather than seawater. Reduce pink salmon densities in incubators to improve survival. Disinfect pink salmon eggs with Betadine after water hardening and after shocking/picking when fungus is a problem and survivals are poor. Purchase commercially available vertical raceways for rearing sockeye salmon fry in Port Graham Bay.

Appendix H. –Estimated escapement, in thousands of fish, for pink and chum salmon to the Port Graham River and sockeye salmon to the English Bay Lakes.

Year	Port Graham River Pink Salmon	Port Graham River Chum Salmon	English Bay Lakes Sockeye Salmon[a]
1990	20.1	2.6	3.0
1991	29.0	1.1	6.6
1992	5.4	1.4	5.6
1993	12.8	2.5	8.1
1994	7.6	5.2	12.7
1995	10.0	3.8	20.7
1996	7.0	3.7	11.1
1997	12.5	4.1	14.4
1998	12.6	5.1	14.1
1999	9.7	6.6	14.6
2000	15.6	11.4	11.2
2001	10.3	6.0	10.5
2002	58.5	5.3	15.6
2003	14.9	2.9	19.4
2004	44.0	1.2	15.4
2005	69.1	0.7	8.2
2006	31.2	2.2	15.5
2007	25.6	1.9	16.1
2008	24.7	1.8	12.0
2009	14.0	1.0	18.2
2010	16.6	1.4	11.2
Escap. Goal (2002)	7.0–19.85	1.45–4.8	6.0–13.5
Escap. Goal (pre-2002)	20.0–40.0	4.0–8.0	10.0–20.0

Note: New escapement goals were established in 2002.

[a] For English Bay Lakes, escapement figure derived from total weir count minus the number of fish collected for hatchery broodstock.(Hammarstrom and Ford 2011).

[b] The 1992 release was from eggs collected under an ADF&G scientific permit (F-91-053) used to gather background information for the Port Graham Hatchery hatchery permit application, which was issued in 1992.