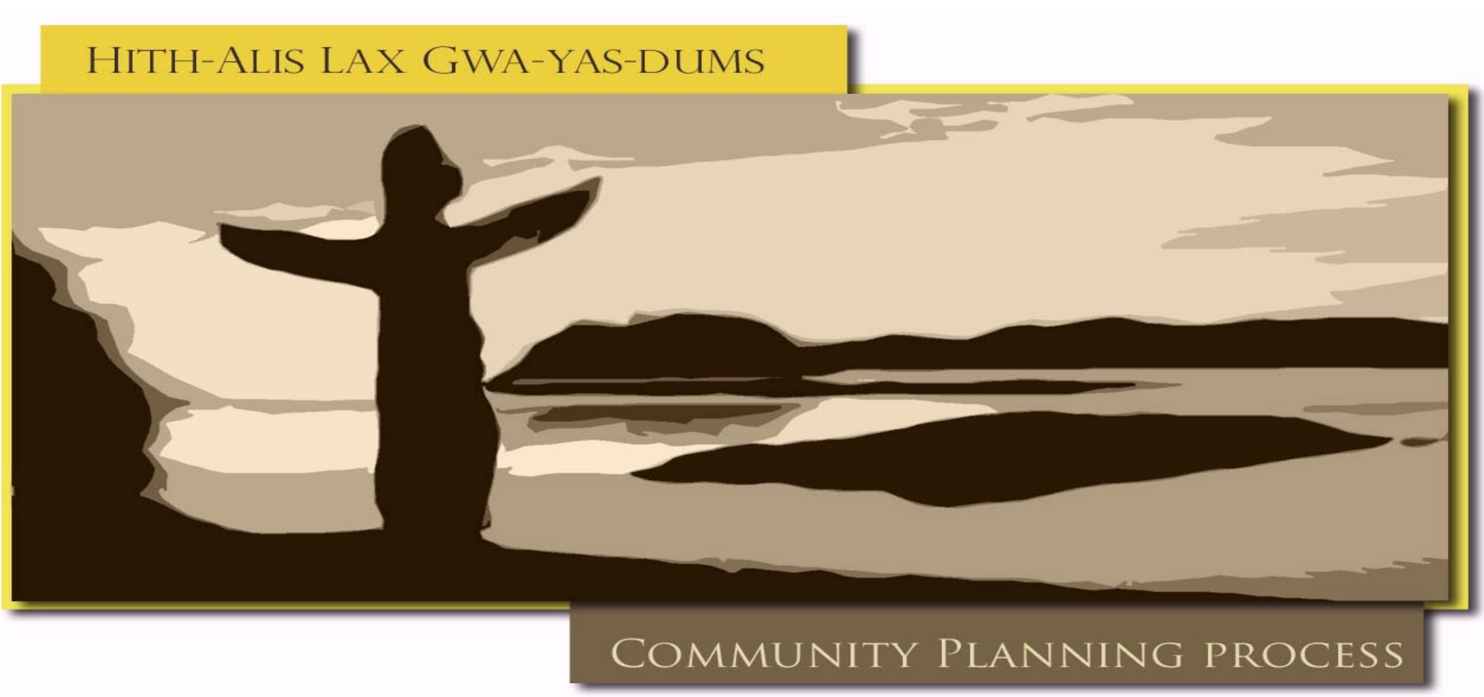
November 2, 2006

Appendix B: **Community Housing, Energy and Infrastructure Plan**

Gwa-yas-dums Village -- Gilford Island, BC



Kwicksutaineuk Ah-kwaw-ah-mish Band
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1. Introduction

The Kwikwasut'inuxw Haxwa'mis First Nations (KFN) Village of Gwa-yas-dums is a small community of between 27 and 70 permanent residents located on Gilford Island.[1] The KFN are currently addressing a number of urgent issues such as: lack of potable water (requiring the importation of bottled water); odour from the sewage treatment system; inadequate electrification (due to worn diesel-electric generator gensets); and housing (mould, causing health problems). In addition, the KFN face a host of interrelated social issues such as: lack of employment; an aging permanent population; a transient population (higher during the summer months); limited administration capacity; and, a lack of comprehensive health and recreational facilities (fostering an environment for health problems and related social concerns). The KFN Council recognizes these concerns and, with the support of INAC, has entered into a comprehensive community planning (CCP) process to address the numerous issues affecting the Nations.

As part of the broader comprehensive community planning process, a long-term land use plan has been developed for the community.[2] The land use plan identifies the need for a new housing subdivision located up the hill to the southeast of the village. This subdivision accommodates the replacement of existing houses in locations that have unacceptably high risk from terrain and geologic hazards, new land use designations, and increased housing needs based on future growth. Energy, water, wastewater, and other infrastructure now require expansion to service the new subdivision.

This report examines the options to address the physical needs of the community as they relate to housing, energy, and infrastructure systems such as water, wastewater, and solid waste. Options were examined that best meet the long-term objectives of the community, as well as addressing the need for immediate short term physical repairs or replacements relating to housing, energy, water, sewer, and solid waste management.

The process used to develop the housing, energy, and infrastructure options preferred by the community included:

- Site visits by the consultants to the community
- One-on-one survey interviews with Council members and the majority of permanent residents in the village
- Study tours to local island based communities with a group of 9 members from the KFN housing committee. Locations visited include:
    - Alert Bay Recreation Center - Tour of First Nation community buildings in Alert Bay with a presentation by a local Namgis band member and employee of the construction company that built the recreation center
    - Alert Bay houses – Tour of houses constructed by a small Namgis Band construction crew

[1] The number of people actually resident in the village varies annually and seasonally and is different from the INAC official resident figure of 66. Resident population has been in decline due to the unhealthy state of housing and water supply included limited economic development opportunities and educational facilities.
[2] See ***Appendix A: Community Site Planning Report.***

- Sointula post and beam house – Tour of a post and beam house constructed on Malcolm Island by an island based local contractor, providing suggestions for construction methods in local remote communities
- New Vancouver Houses – Tour of new community being constructed on a neighbouring island

- Tour of the Seabird Island sustainable community by CMHC
- Development of short and long term community objectives from survey results and through community meetings
- Development of alternative options in conjunction with the community
- Comparison of options against community objectives
- Presentations to the community and community meetings to discuss and decide on options

2. Housing

2.1 Current Status – Housing

Only one of the ten small reserves accessible to the KFN is currently occupied.[3] The number of people living in Gwa-yas-dums (IR1), and the number of households, has varied over the course of recorded history. The population has varied from approximately 170 in 1960s to between 27 and 70 in the first part of this decade. The numbers are dynamic and currently they are heavily impacted by health concerns related to moldy, rotten homes and non-potable water. However, it has always been an important location on a year-round basis, with an increasing population during claming season, something that continues today. In addition, increases are currently also noticeable in the summer months when children and families come to visit. Due to the lack of economic opportunity and lack of schools, many families are unable to reside full time in the village and the summer months afford a chance for children to visit relatives for extended periods of time.

According to the official INAC census, the Kwicksutaineuk Ah-kwah-ah mish Band has a population of 267 members, with 66 members or approximately 25% of the total membership currently living in Gwa-yas-dums Village on Gilford Island.[4] A majority of the remaining 201 live off-reserve in the surrounding region, especially in Alert Bay. Others are scattered throughout Vancouver Island and the lower Mainland.[5] Since 1972, the overall population has increased from 207 members to 267. This increase of 60 members over a 29 year period represents an overall increase in population of 29%. This represents an average yearly increase of 1% or 2 members per year.

Houses have varied from 10 in 1834 to 35 in 1951[6] to 21 at the initiation of the community planning process. During the course of the planning process, eight houses have been demolished and five trailers brought in for temporary transition housing.[7] The type of housing has also changed over time from long house style where many lived under the same roof to inheriting used, small, wood frame "single family" air-force houses in the 1960 from Port Hardy.[8]

Refer to Figure 1 below for housing numbers and location. Houses are listed as viewed in a clockwise rotation starting with house #1. Table 1 (page 9) lists the number of rooms, size, and the permanent residents in each house at Dec. 1st, 2005.

Housing condition and mold assessments were completed in 2002 on fourteen of the existing houses by Jacques Whitford Environmental Limited. They found building and site

[3] See Section 5 of *Appendix A: Community Site Planning Report* titled "Population, Households and Future Growth" for more detailed information on population and housing.
[4] It is important to note that KFN member roster is not consistent with INAC, and they are currently updating their member list.
[5] KFN membership list is currently out of date and it is not known what the exact regional distribution of population is.
[6] Rohner, Ronald P. The People of Gilford: A Contemporary Kwakiutl Village. National Museum of Canada. Ottawa, 1967.
[7] A transition replacement housing strategy, including number of home and where they will be built, is underway. This replacement is dependant in part on how quickly the urgent need for developing a new subdivision on the hill to the south of the current village site can be achieved. This situation is explained further detail in Section 11.
[8] Rohner, Ronald P. The People of Gilford: A Contemporary Kwakiutl Village. National Museum of Canada. Ottawa, 1967.

design deficiencies leading to moisture damage in the buildings and evidence of mold in some houses. They concluded that “all 14 houses assessed on KFN lands will likely require some form of remediation/corrective action to remove existing mold and/or mitigate future occurrences of mold” (Jacques Whitford report July 4, 2002). They provided a budget cost estimate for a mold abatement program of $873,483, resulting in an average per house cost of approximately $43, 381.

In subsequent discussions between the KFN and INAC it was decided that it would make more sense to spend the money on constructing new houses, rather than repairing the existing houses.

Figure 1: Existing Buildings

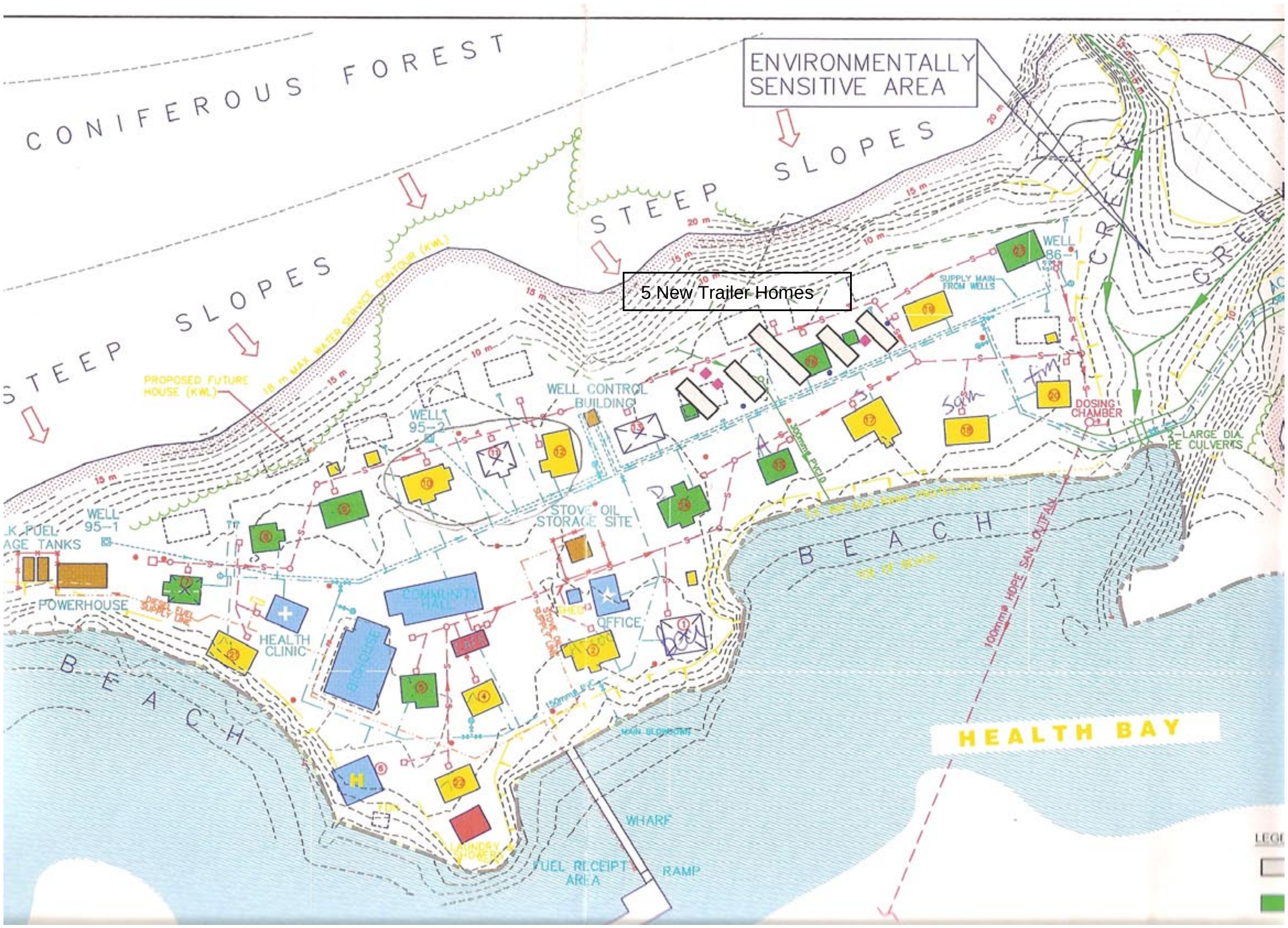


Table 1: Housing Occupancy and Size (Occupant Source: Councilor Lucy St. Germaine, December 1, 2005)

House #	# Permanent Occupants	Occupant/owner	# Bed Rooms	Size (ft^2)	Year Built
1	2	Beatrice Smith and Mary Glacer (Beatrice's niece)	4	1000	1957
2	1	Arnold Smith	6	1113	1975
4	1	Harry James	2	720	1970
5	0	ABONDONED (Alfred Smith's House)	2	832	Unknown
22	1	Calvin Johnson	2	768	1989
21	2	Caroline and Graham Scow	3	800	1982
7	0	ABANDONED			
8	1	Joel Johnson (4 daughters left, girl friend left also)	2	625	1950
9	5	Cathy Williams and Dean Coon (Cathy's son) Tiana and baby, and Percy Williams	3	1237	Unknown
10	2	Charlie Williams and Joanne Charlie (3 kids, Port Hardy Joline – Joanne Charlie's kid – Allen & Preston, Campbell River –Charlie's kids)			
11	1	Herb Chamberlin (renting from Douglas Scow)			
13	1	Lucy St. Germaine	4	960	Unknown
16	0	ABANDONED (Roy Nelson's house, Dennis Johnson, Roy's grandson, last to live there	2	768	1972
19	2	Alfred and Leonard Smith	2	750	1972
23	2	David Johnson, Terry Teringa	4	1,960	1992
20	1	Tim Willi	2	735	1982
18	4	Sam Johnson's house, Sandy Johnson lives there also with daughter Crista and her daughter Orianna	3	980	1960
17	1	Silas Coon (future? Daughter Edna Coon; granddaughter Carrie (2 weeks old) and Keith?	3	1,060	1972
15	1	Albert Wilson (he is on oxygen for health reasons)	2	720	Unknown
14	1	Doris Smith	3	1020	Unknown

To help meet immediate housing needs for those living in houses with the greatest level of mold and deterioration, INAC paid for the purchase and installation of five temporary trailer homes. These were delivered and set up on site during the summer of 2006 through a project managed by Jacques Whitford Environmental Limited. Four 560 sq ft two bedroom trailer homes and one 924 sq ft three bedroom trailer home were installed on site. The project also consisted of the demolition of eight existing houses to make way for the installation of trailers and for the construction of future housing including the removal and disposal of asbestos containing floor tile in three of the houses demolished, and the removal and disposal off island of all material in the existing but no longer used landfill.

2.2 Options – Housing

Through negotiations with INAC, the KFN have secured a commitment from INAC to provide grants of approximately $80,000 per house towards the construction of 26 new houses on Reserve. This funding consists of approximately $40,000 per house from INAC's On-Reserve Housing Program, $40,000 per house in lieu of money that INAC would have spent on remediation of existing houses, and $10,000 per house for infrastructure. The KFN are also planning to contribute approximately $20,000 per house.

This section first analyses the costs, benefits, and drawbacks associated with different methods for constructing new housing. An analysis of the costs and benefits of energy efficient housing is then presented in order to evaluate its potential. Finally, housing design guidelines, sample floor plans and building perspectives developed by the community to meet community objectives are presented.

2.2.1 Housing Construction Methods

Overview

Rebuilding the community housing is a significant task facing KFN. A key choice that will affect next steps is choosing *how* the new houses are to be constructed. While there are many ways to build a house, four options have been organized:

- **Option 1** – Pre-manufactured trailers similar to the five temporary trailers recently installed
- **Option 2** – On Site Construction with Outside Labour
- **Option 3** – On Site Construction with Local Labour
- **Option 4** – Combination Pre-manufactured Components and On Site Construction

Each of the four housing construction methods is described below. The costs, benefits, and drawbacks for each option are evaluated in Table 3: Housing Construction Options Matrix. Areas highlighted in green have significant positive impacts, and areas highlighted in red have significant negative impacts.

Housing Construction Method Options

The following four options regarding the method of constructing new houses were evaluated in terms of cost, benefits and drawbacks.

Option 1 – Emergency trailers

Option 1 - Prefabricated homes (Trailers)
Prefabricated homes similar to the five emergency trailers recently set up on site were evaluated. Construction costs and building design features are based on the actual costs incurred to supply, transport and set up the five trailers recently installed in the community.

Example – New emergency trailers shown in top photo

Option 2 – On-site construction with outside labor

Option 2* - On Site Construction with Outside Labour
Option 2 consists of outside construction crews constructing houses on site. Costs are based on current lower mainland BC construction costs for low income housing plus an allowance for barging, crew transportation and lodging, and other remote construction costs.

Example – New Vancouver

Option 3 – Local labor

Option 3* - On Site Construction with Local Labour
Option 3 consists of houses built on site by a Band based construction crew. Costs are based on construction costs reported by Namgis First Nation Band in Alert Bay, plus an allowance for barging and other transportation costs.

Examples – Namgis First Nation, Oujé-Bougoumou

Option 4 – Combination

Option 4* - Combination Pre-manufactured Components and On Site Construction:
Building block portions of buildings are pre-manufactured in an existing manufactured housing plant and assembled on site by outside construction crews.

Example – Kluskus Band with Ib Hanson Architects

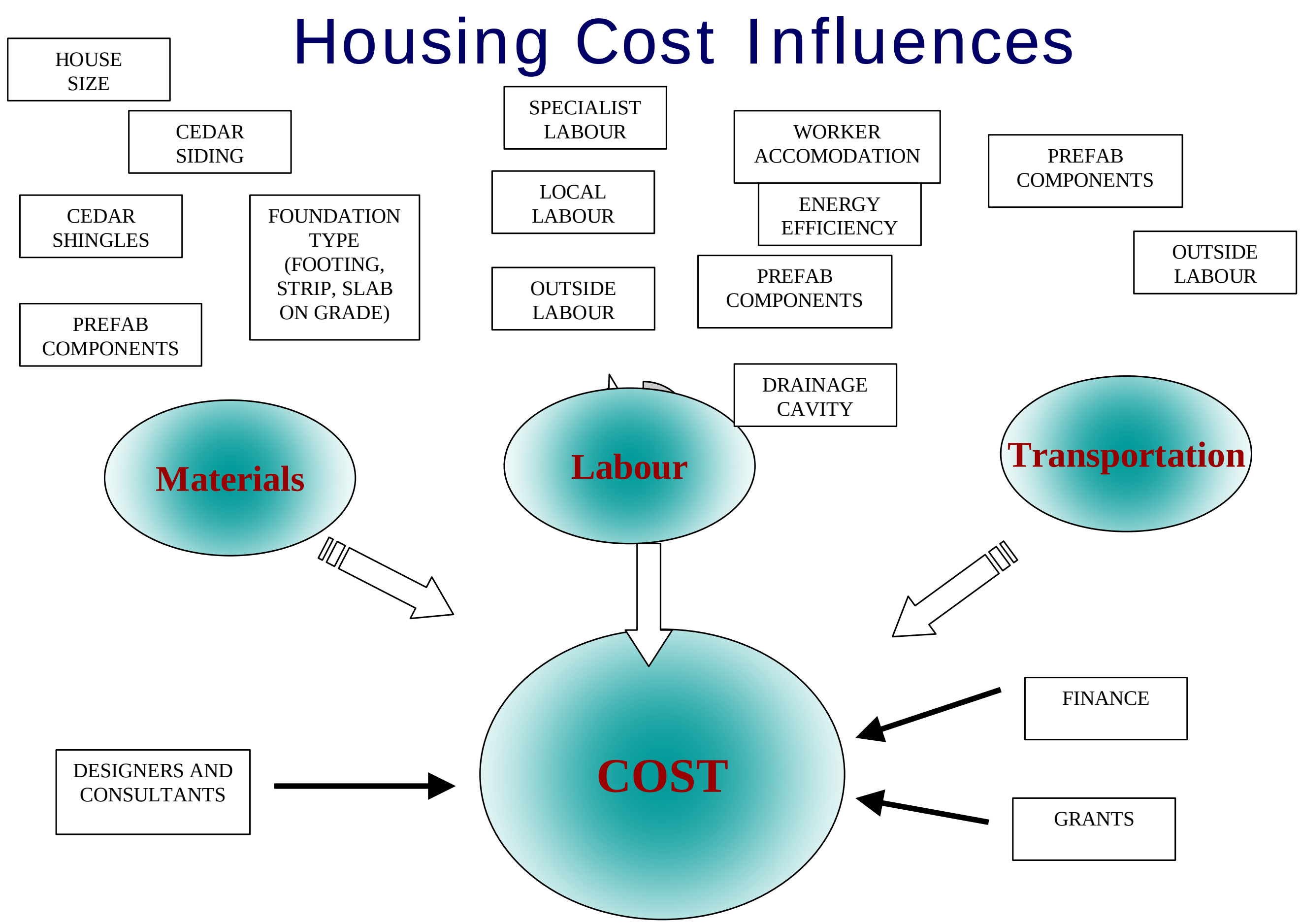
* Note: Except for the case of trailers, the method of construction does not affect the type of house that is constructed. Home design is a separate issue.

Table 2: Housing Construction Method Options Matrix

	Objective	Measurement	Option 1	Option 2	Option 3	Option 4
1	Reduced Capital Cost	Cost per 1,000 sq ft House ($)	$125,917	$174,979	$99,979	$150,000
2	Reduce O&M costs		same	same	same	same
3	Create Employment Opportunities	# Full time band member jobs (Job years)	2	2	10	5
4	Reduce Risk (Certainty)	Risk of completing construction on time and on budget (High/medium/low)	Low	Medium	High	Med High
5	Fast Speed of Construction	# Houses constructed per year	26	10	4	13
6	Increased Durability	House Life Expectancy (Years)	20	50	50	50
7	Increase Energy Efficiency	Ability to incorporate energy efficient design (Yes/No)	No	Yes	Yes	Yes
8	Increase Energy Security	Ability to accommodate different fuel types (Yes/No)	No	Yes	Yes	Yes
9	Improve Indoor Environmental Quality	Ability to incorporate an improved ventilation system and improved design to avoid moisture problems (Yes/No)	No	Yes	Yes	Yes
10	Reduce Water Consumption	Ability to incorporate low flow water fixtures (Yes/No)	Maybe	Yes	Yes	Yes
11	Ease of Remote On-Site Construction	Prefabricated components	Yes	No	No	Yes
12	Reduce O&M Effort		same	same	same	same
13	Reduce Site Impacts		same	same	same	same
14	Increase Self Sufficiency		same	same	same	same

15	Safety		same	same	same	same

Figure 2: Housing Construction Cost Influences



Housing Construction Method Recommendation

There are significant tradeoffs between the four options. For example, trailers (Option #1) have the advantage that they are easy and fast to construct and are the least expensive option, estimated at $125,000 per 1,000sq ft trailer fully installed. But trailers have a short life expectancy and are limited in their design options. The least expensive way to get custom homes built is on-site construction with local labor (Option #3), estimated at $100,000 per house for a 1,000sq ft house. This has the advantage of creating the most local jobs (10), but also has the highest risk of not being completed on time and on budget.

Option #4: Combination Pre-manufactured Components and On Site Construction is one of the better options across all objectives. It is estimated that this option will cost approximately $150,000 per 1000 sq ft house, employ about 5 community members, is fairly fast to build this and there is a medium to low relative risk of project delays.

Option #3: On Site Construction with Local Labour is a construction method that the community could aim towards in the long term, as community members can gain construction skills and capture employment benefits. For example, options for local participation could be considered once emergency housing needs have been met.

2.2.2 Energy Efficient Housing Design

Overview

There are two options available to the community in terms of incorporating energy efficient housing design into the new home construction: either (a) do it or (b) don't do it.

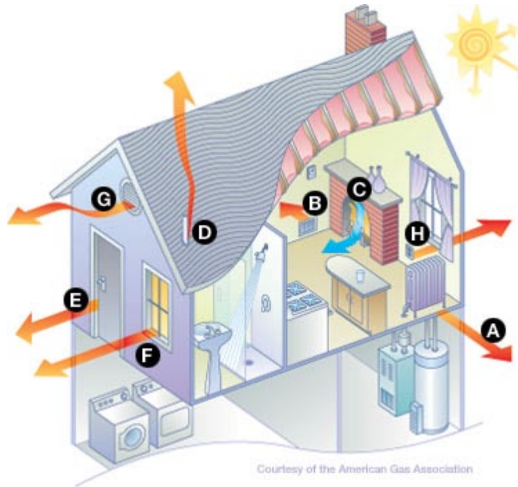
For the most part, incorporating energy efficiency into the housing design is sensible in terms of operational efficiency, occupant health, and reducing environment impacts. It has long term cost saving benefits of approximately $1,000 per year per house. Because INAC is currently paying the full costs for energy used in the community the cost savings would be realized by INAC. However there have been discussions between the KFN and INAC about the possibility of returning energy cost savings back to the KFN. Energy efficient housing also has health benefits of improved indoor air quality, and the durability and longevity of the house by removing excess moisture through improved ventilation systems. Finally, it is better for the environment, with less local air pollution, and lower emission of green house gas emissions. The drawback is that it would cost up to $5,000 more per house in up-front construction costs and there would be some additional maintenance of the ventilation system.

Currently there is a provincial program that KFN could qualify for that would put $3,500 towards the construction cost of each house. However, there is no guarantee that this program will be around for the duration of the new home construction.

With the limited housing budget of KFN, there is the possibility of this option not being incorporated despite its benefits. Therefore, KFN should negotiate additional funding from INAC based on long term benefits.

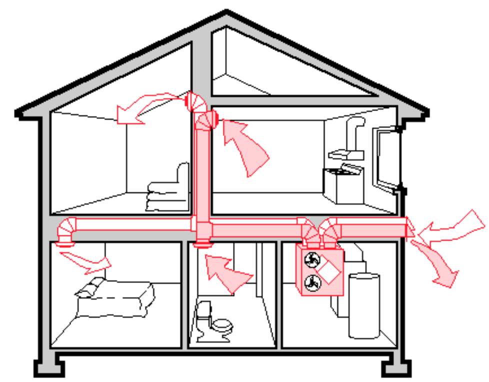
Cost effective methods for the design of energy efficient housing are described below. The additional costs, benefits and drawbacks are evaluated against community objectives in Table 2. Areas with significant benefits are highlighted in green.

Description:



- An energy efficient house will reduce heating, hot water, and electricity costs, while being more comfortable and durable.
- A good target to aim for is design to “Energuide 80” level of energy performance. “Energuide” is a commonly used rating system developed by Natural Resources Canada (NRCan)
- Typical energy efficiency measures required to meet “Energuide 80” include:
  - High efficiency space heating furnace or boiler and hot water boiler
  - Double pane low e argon filled windows
  - Higher insulation levels in walls and attic
  - Heat recovery ventilation
  - Increase air tightness

Pros:



Heat Recovery Ventilation

- Reduced energy costs.
- Increased comfort (reduced drafts, warmer walls and windows, no window sweating)
- Improved air quality from continuous heat recovery ventilation.
- Increased building durability from reduced indoor moisture levels
- Government grants available to offset increased capital costs

Cons:

- Increased capital cost - most of the increased cost is for heat recovery ventilation system which also provides ventilation and durability benefits
- Increase maintenance – filter changes on heat recovery ventilators

Table 3: Energy Efficient Housing Design Options Decision Matrix

	Objective	Measurement	Energy Efficient Design	Standard Design
1	Reduced Capital Cost	Cost per 800 sq ft House ($) (Based on Option 4)	$155,000	$150,000
2	Reduce O&M costs	Annual Energy and Maintenance Costs (Based on propane grid energy system)	$1,950	$2,925
		Simple Payback Compared to Option 2 (Years)	5.1	
3	Create Employment Opportunities	# Full time band member jobs (Job years)	same	same
4	Reduce Risk (Certainty)	Risk of completing construction on time and on budget (High/medium/low)	same	same
5	Fast Speed of Construction	# Month Extras	+ 2 weeks'	0 Weeks
6	Increased Durability	House Life Expectancy (Years)	same	same
7	Increase Energy Efficiency	Ability to incorporate energy efficient design (Yes/No)	Yes	No
8	Increase Energy Security	Ability to accommodate different fuel types (Yes/No)	same	same
9	Improve Indoor Environmental Quality	Ability to incorporate an improved ventilation system and improved design to avoid moisture problems (Yes/No)	Yes (But HRV required)	Yes
10	Reduce Water Consumption	Ability to incorporate low flow water fixtures (Yes/No)	same	same
11	Ease of Remote On-Site Construction	Easy/medium/difficult	same	same
12	Reduce O&M Effort	Operating and Maintenance Effort (High/Medium/Low)	Medium	Low
13	Reduce Site Impacts	Impacts to Clam Midden (High/Medium/Low)	same	same
14	Increase Self Sufficiency	Increase in Self Sufficiency (High/Medium/Low)	Medium	Low
15	Safety	Safety Risk (High/Medium/Low)	same	same

Energy Efficient Housing Recommendation

Due to the benefits of health, home longevity and long term operating cost savings, the KFN should pursue negotiations with INAC to support any extra cost associated with construction of energy efficient housing.

Efficient Housing Next Steps

1. Apply for funding from BC Ministry of Energy Mines and Petroleum Resources ($3000 per house that meets Energuide 80 level of energy performance plus $500 per house with high efficiency furnace
2. Develop design guidelines
3. Incorporate energy efficiency features into house design and construction

2.2.3 Housing Design Guidelines

The following housing design guidelines were developed based on results of the community survey, discussions during community meetings, and recommendations from the consultants to meet long term community objectives:

General

1. Housing type and size – All single family houses, single story, approximately 1000 ft^2 per house, depending on size of owner's current house. House sizes will have to be kept as small as possible to reduce construction costs.
2. View – Every house should have a view of the ocean if possible.
3. Privacy –The community has agreed to a minimum 23ft separation between houses for visual and noise separation. Less than this requires consultation with the community.
4. Accessibility - Wheelchair accessible interior design recommended for all units, and external wheelchair access required for some units.
5. Interaction - Covered front porches desired to accommodate community interaction.

Durability

1. Large Overhangs – Minimum 2 ft all sides, preferably 4 ft each side plus covered porches.
2. Rain screen cladding – ¾" vertical strapping forming drainage cavity between the moisture barrier (building paper or Tyvek) and the cladding. Rainscreen cladding is required by new BC Building Code about to be released and the new National Building Code.
3. Foundations – Either insulated slab on grade or insulated concrete strip foundation. No pier support foundations with open crawl spaces due to concerns with moisture. If a concrete strip foundation is used then the floor of the crawl space should be covered with a thin slab of concrete over a polyethylene sheet to keep moisture out of crawl space. The crawl space should be insulated on its walls and below the concrete slab and heated (no insulation under the wood floor) to keep it dry.
4. Drainage – Footing drains and free draining fill around foundations. Grading sloped away from houses.

Indoor Air Quality

1. Continuous ventilation to reduce moisture build-up in houses – Continuous exhaust from bathrooms, and fresh air supply to bedrooms and other occupied areas of houses. If the houses have forced air furnaces the furnace ductwork and fan can be used to supply fresh air. A heat recovery ventilator should be incorporated into the continuous ventilation system (See Energy Efficiency)
2. Hard flooring preferred to carpet (carpet traps dirt).
3. Low VOC paints and cabinet glues.
4. Mold resistant drywall.
5. Use of local wood products for interior trim etc.

Energy Performance

1. Energy performance of each house to meet "Energuide 80" level of performance according to Natural Resource Canada's energy performance rating system.
2. Insulation levels – 2x6 wall construction with R22 batt insulation, R40 attic insulation.
3. Furnaces or boilers – Space heating propane furnaces or boilers to be condensing type with a minimum efficiency of AFUE 90%.
4. Windows – Double pane vinyl windows with "low e" coating and argon fill.
5. Heat recovery ventilation – Heat recovery ventilator (HRV) recovers heat from continuous exhaust from bathrooms and kitchen (but not the range hood), and heats continuous incoming fresh air to bedrooms and other occupied areas of houses. If the houses have forced air furnaces the HRV system can use the furnace ductwork and fan to supply fresh air. If not, then a separate ventilation system of ductwork is required.
6. Air tight construction to reduce air leakage through the building envelope.
7. Energy Star appliances.
8. Compact fluorescent lighting.

Roofing and Cladding

1. Roofing – Sloped roofs with cedar shingles or shakes. Cedar shingles and shakes are available to the community at a reduced cost, and its look is preferred because it is a traditional construction material.
2. Cladding – Cedar siding. Cedar siding is available to the community at a reduced cost, and its look is preferred because it is a traditional construction material. Horizontal lapped cedar siding is recommended for ease of attachment to the vertical rainscreen strapping.

Water Efficiency

1. Low flow toilets – Maximum 6 L/flush. Dual flush toilets preferred (3.3L/flush and 6L/flush)
2. Consider rainwater barrels at each house for irrigation of landscaping and gardens.

Fire protection

1. All new buildings should have sprinkler systems for fire protection.

2.2.4 Sample Floor Plans

Basic floor plan options and perspective views of houses have been developed based on community objectives and design guidelines to initiate discussion and thought regarding home construction. The goal is to provide information that will assist the community in articulating their vision of a home to an architect or designer. This individual will then be able to assist the community in moving to construction.

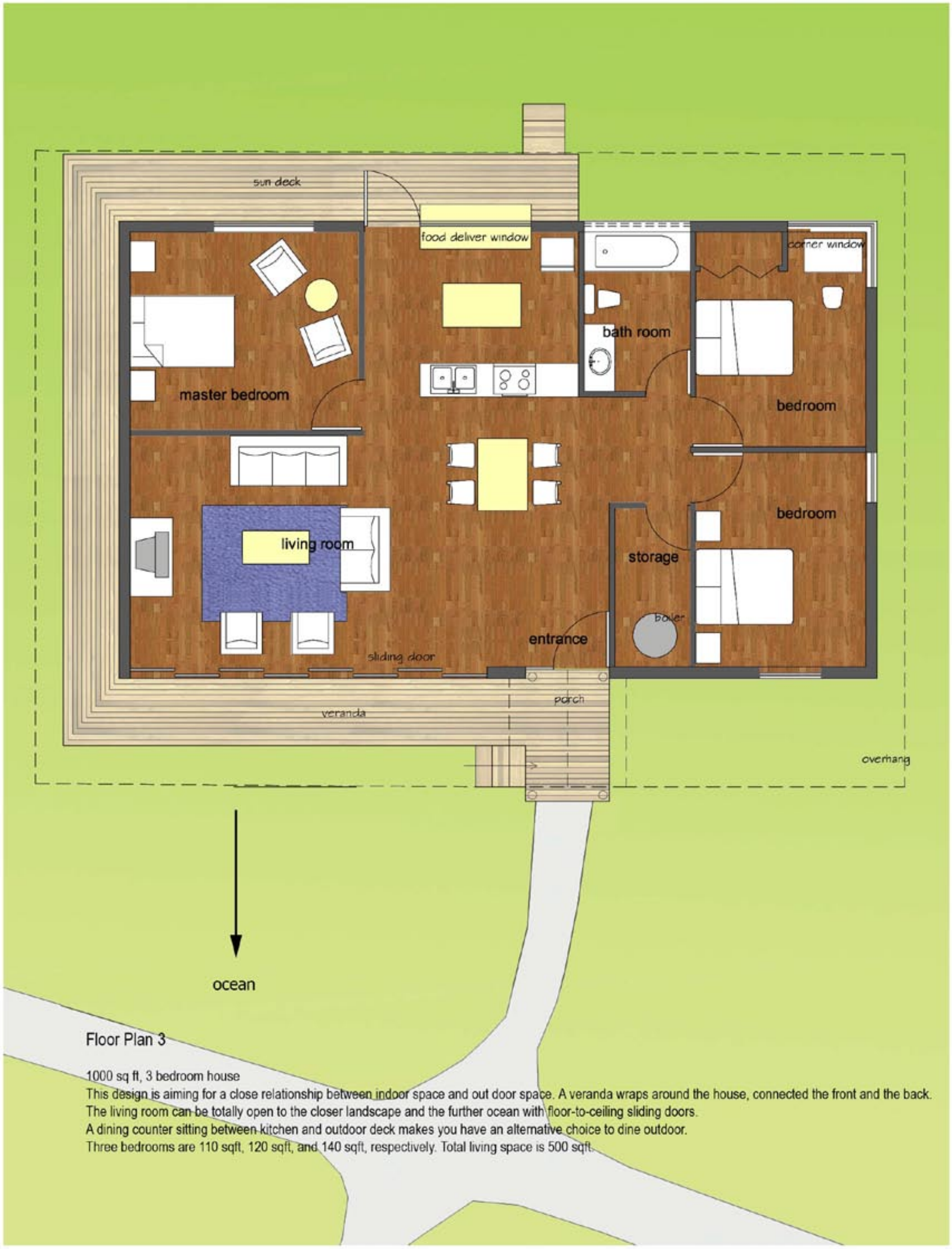
The following four sample floor plan layouts have been developed:

1. 800 sq ft 2 bedroom home, designed for spacious private space
2. 800 sq ft 2 bedroom home, designed for spacious living space
3. 1000 sq ft 3 bedroom home, with a close relationship between indoor space and outdoor space
4. 1000 sq ft 3 bedroom home with split living/private space

Floor Plan 1

800 sq ft, 2 bedroom house
This design is aiming for spacious private space. Two bedrooms are located at the back, guest bedroom 160 sqft, and the master one 190 sqft. Kitchen, dining and living space, 320 sqft, is set within a long stretch so that residents can enjoy the smoothness moving through the whole living area. A long, horizontal bay window lights up the living space and frames a panorama view of the ocean.


sun deck
sliding door
corner window
master bedroom
bedroom
bath room
boiler
storage
kitchen
living room
bay window
ramp
porch
overhang
ocean
Floor Plan 2
800 sq ft, 2 bedroom house
This design is aiming for spacious living space. Kitchen, dining and living space, 385 sqft, is set within almost a square.
There is more fleibility for residents to arrange their furniture.
Two bedrooms are located at the back, guest bedroom 120 sqft, and the master one 175 sqft.
Bay window extends the living space to the landscape and frames the ocean view ahend.



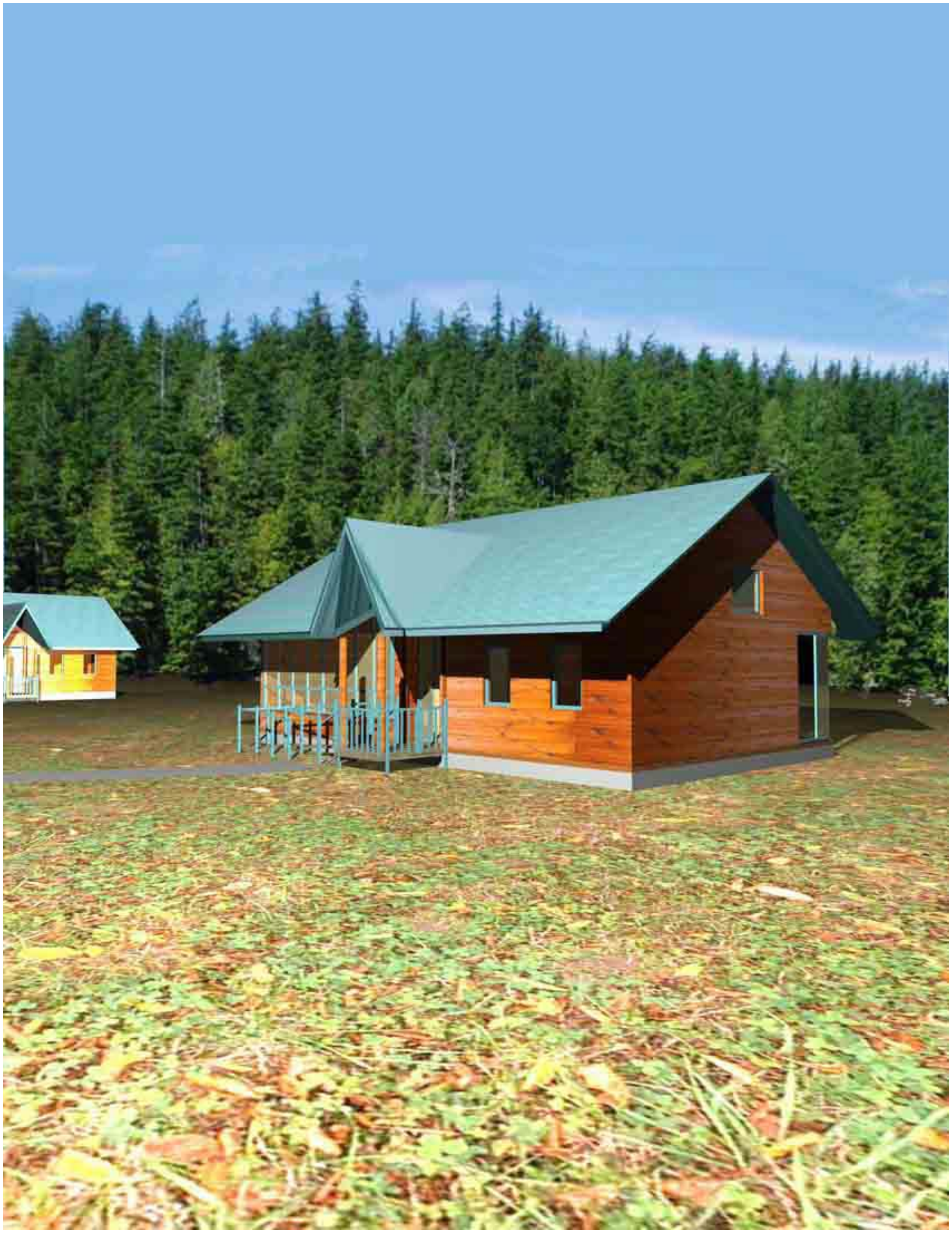
Floor Plan 3

1000 sq ft, 3 bedroom house
This design is aiming for a close relationship between indoor space and out door space. A veranda wraps around the house, connected the front and the back.
The living room can be totally open to the closer landscape and the further ocean with floor-to-ceiling sliding doors.
A dining counter sitting between kitchen and outdoor deck makes you have an alternative choice to dine outdoor.
Three bedrooms are 110 sqft, 120 sqft, and 140 sqft, respectively. Total living space is 500 sqft.

Floor Plan 4

1000 sq ft, 3 bedroom house
A straightforward design, with living space on the left and private space on the right.
Spacious kitchen, dining and living space, 570 sqft, is set all the way from front to the back. Residents have great flexibility to arrange their home.
A dining counter sitting between kitchen and outdoor deck makes you have an alternative choice to dine outdoor.
Three bedrooms, slightly compact, are 95 sqft, 95 sqft, and 130 sqft, respectively.

2.2.5 Sample Housing Perspectives



2.3 Next Steps – Housing

Community Choices

Figure 3 below outlines the next steps required by the community to complete the construction of new houses, broken down by building construction method.

The community has partially completed the first steps:

- At a community meeting on October 5, 2006, the community decided that they are not interested in Option #1, prefabricated trailers similar to the five recently set up on site as emergency housing. They are open to exploring further any of the other three options.
- This document contains an initial set of design guidelines which can be used to aid a designer.
- The community is currently working on developing their housing policy to decide who will get what type and size of house, and where they fit in terms of priority for new housing.
- They are also in the process of discussing options for obtaining funding for the additional construction costs over INAC contributions, either through individual mortgages, community based mortgages, or securing additional funding from INAC or outside sources.
- An RFP for hiring an architect is underway. The KFN will have to pay for design services, or an application for funding will have to be made to INAC. The architect or designer should then design the buildings, assist the KFN to apply for building permits, and oversee housing construction.

Figure 3: Housing Next Steps

Decide on Option 1, 2, 3 or 4

Option 1- Trailers	**Option 2 – On site with outside labour**	**Option 3 – On site with local labour**	**Option 4: Combination Pre-man. and On Site Construction**
Develop housing policy	Develop housing policy	Develop housing policy	Develop housing policy
	Develop design guidelines	Develop design guidelines	Develop design guidelines
Funding strategy & INAC approval and support (Mortgages, CMHC?, etc.)	Funding strategy & INAC approval and support Mortgages, CMHC?, etc.)	Funding strategy & INAC approval and support (Mortgages C, CMHC?, etc.)	Funding strategy & INAC approval and support (Mortgages, CMHC?, etc.)
Chose design from different manufacturers	Hire architect or designer	Hire architect or designer	Hire architect or designer
Hire project manager (eg Jaques Whitford or KWL)	Chose design tender/ versus design build		Chose design tender versus design build
	Tender		Tender
Construction	Construction	Construction	Construction

3. Energy Infrastructure

3.1 Current Status – Energy Infrastructure

The KFN have secured partial funding to construct 26 new houses and are planning to replace all existing houses. The long-term plan also includes a number of new commercial buildings including a new administration/ recreation center /healthcare building, a restaurant, a gift shop/ museum building, and a bed and breakfast. With the new community plan they have a great opportunity to develop a new system of energy infrastructure that costs less to operate and has lower impact on the environment. The new land use plan developed by the community only allows for the (re)construction of 17 houses in the existing village. As a result, a new subdivision up the hill is required to accommodate the remaining 9 houses in the short term, with room for expansion to a maximum of 40 houses in the long term. Any new energy infrastructure must be designed to accommodate both the existing village site and this new subdivision.

Electricity Generation and Distribution
The community is served electricity by a community-operated electrical power system. The system consists of a diesel genset powerhouse with three 75 kW diesel electric generator sets and an automatic paralleling control panel.

All three generators are at the end of their useful life and require replacement or major overhaul. Harry Baxter, P.Eng. completed a report dated June, 2003 entitled "Project Brief and Management Plan for Immediate Major Generator Repairs and Preliminary Design for Subsequent Equipment Replacement in the Diesel-Electric Powerhouse Serving Gwa-yas-dums I.R. #1, B.B.". In this report he notes that the electric system was installed in 1996, with two of the three generators installed in the previous powerhouse, and that the logged hours and review of equipment indicate that all generator sets are nearing the end of their useful life, and only one unit was operational at the time. He also noted in the report that components of the control system were damaged and required repair and recalibration.

In a meeting with Kerr Wood Leidal Associates in March 2006, the engineering firm that designed the original electrical generation and distribution system confirmed that all generators are at the end of their useful life and indicated that one generator was not repairable because significant parts had been removed. They also indicated that the Village's generator maintenance staff reports that typical electrical average demand is between 45-50kW and that a second generator has not automatically come on line to accommodate a demand load larger than the capacity of a single generator set (automatic set points are between 75kW and 80kW). The maintenance employee has been on staff for approximately 2 years. In addition the engineer noted that during the February 24, 2006 site visit, 47kW was the peak demand, the community population was 8 on that date, and the café was not open. This amounts to a very high demand per person.

Village electrical loads include power supply to each residence and community building, as well as community infrastructure including street lighting and the existing well pumps. Many of the residences and community buildings use electric baseboard heaters for space heating. Typical electricity use in each house includes incandescent lighting, a refrigerator, freezer, washer, electric dryer, and plug loads such as microwaves, stereos, televisions, other entertainment equipment, kitchen appliances, etc.

The distribution system is a high voltage single phase distribution system with power poles and above ground transformers and power lines throughout the village site. The number and location of above ground power lines are unattractive and community members have requested that power lines be buried if possible.

Kerr Wood Leidal Associates is in the process of replacing all three 75 kW diesel generators with three new 100 kW air cooled diesel generators as part of the project to install a water treatment plant for the community. Replacement of the diesel generators was required to provide sufficient reliable power for the water treatment plant.

The size of the generators were increased from 75 kW each to 100 kW each to meet the increased power requirements of the water treatment equipment and to allow for reserve capacity for housing expansion up to a maximum foreseeable number of 40 houses. At the encouragement of EcoPlan International, the feasibility of adding heat recovery to the new diesel gensets was reviewed. However, it was determined by Kerr Wood Leidal that modifying the design to water cooled with heat recovery was a process that would create an unacceptable delay in the design and installation of the water treatment plant.

Table 4 projects anticipated electrical requirements based on: known loads such as the street lights, water treatment process and well pumps, as well as unknown loads such as residential and facility building averages. Electrical load projections include that required for the present community with a new water treatment plant, a short term projection with 26 new houses, and a ten year projection with 40 new houses. Projections assume that electric baseboard heating will not be used for space heating.

Table 4: Current and Projected Electricity Loads

Facility Load Type	Connected (kW)	Coincident (kW)	Average (kW)
Water Well Pumps (3 x 2 HP)	5.6	2.7	1.4
Water Treatment Facility	30	20	15
Street Lights (0.3 kW each) ▪ 8 existing ▪ 8 existing + 2 (water treatment building) ▪ 8 existing + 2 (water treatment building) + 4 future	2.4 3.0 4.2	2.4 3.0 4.2	1.2 1.5 2.4
Generator Building	6.5	4.5	1.8
Community Wash House	10	3	1.5
Band Office	3	2	1
Café	25	19	9
Community Hall	10	5	2
Long House	10	5	2
Residential Homes (3 kW each) ▪ 17 - existing ▪ 26 - short term projection ▪ 40 - 10 year projection	51 78 120	51 78 120	25.5 39 60

Scenarios	Connected Load (kW)	Demand Capacity (kW)	Consumption Average (kW)
Existing plus water treatment process; 17 residences, community facilities plus water treatment process	153.5	114.6	60.4
Short Term Projection; 26 residences, community facilities and water treatment process	180.5	142.2	74.2
10 Year Projection; 40 residences, community facilities and water treatment process	222.5	185.4	96.1

Source – Kerr Wood Leidal Associates, Interim Water Treatment Facility, Draft Preliminary Design Report, May 2006

Space Heating
Residential and communal buildings within the community are currently heated with either electric baseboard heaters, low efficiency heating oil stoves, wood stoves, or the heat from propane kitchen ranges.

Approximately 5 out of 17 occupied houses use oil stoves. A large oil tank in the center of the community is filled from a barge at the dock through an underground pipe. Oil tanks on the outside of houses are filled by transferring oil from the central tank into a mobile oil tank and then pumping oil from the mobile tank into house tanks. Environmental damage from oil spills are a concern for the community.

Many of the buildings are poorly heated. The big house has no source of heating and the community hall does not have heating in most of its spaces. Some houses are reported to have no heating except for the heat from propane kitchen ranges. Wood is collected for wood stoves from the forest and clearcuts on the island on an as needed basis.

The cost of diesel fuel for the diesel gensets, heating oil, and propane are all currently paid for by INAC.

Hot Water Heating and Appliances
Hot water heating is primarily provided by electric water heaters at each house, plus at the band office, community center and health center.

Many houses have propane stoves with 20 lb propane tanks on the outside of houses. The propane tanks are transported to the dock where they are refilled by a propane truck on a barge.

The remainder of appliances in most houses are electric. A typical list of electric appliances and plug loads includes:

- Electric clothes dryer and washer
- Electric refrigerator and freezer
- Electric kitchen stove (many propane)
- Microwave
- TV
- Stereo
- Approximately 16 – 60 watt incandescent lights per house

Current Energy Costs
Energy costs for the year 2005 are shown in Table 4 below. As shown the majority of expenditures went towards the purchase of diesel oil for electricity generation. Assuming typical diesel genset efficiency of 30% and current diesel costs, the cost of producing electricity on the island is approximately $0.38 per kWhr, or approximately six times the price of electricity charged to BC Hydro customers on Vancouver Island.

Table 5: 2005 Energy Expenditures

Fuel Type	Expenditure
Fuel – Diesel	$120,840
Fuel – Propane	$7,022
Fuel - Stove Oil	$11,107
Generator Service and Materials	$8,500
Total	**$147,469**

Maintenance
Operation and maintenance of the diesel gensets and other energy related systems is carried out by a community member who is paid for 3hrs per day, seven days per week.

3.2 Options – Energy Infrastructure

3.2.1 Overview

The community has three basic community energy system options available to consider, plus several optional systems that could be added on to provide benefits to any of the three main systems. It is important to note that INAC is currently paying all costs for energy including diesel fuel for gensets, oil for wood stoves, and propane for appliances, INAC has indicated that cost savings from improved energy efficiency could be negotiated to flow back to the community.

Option # 1: Existing Oil Stoves and Electric Baseboard Heat
This is a scenario looking at the expansion of the existing system to include new houses. It is relatively inexpensive and inefficient. This option is not practical from an operating cost perspective and is presented mainly for comparison purposes for more efficient options. The new diesel gensets are not being designed to meet electrical load requirements of electric baseboard heating required for planned community expansion.

Option # 2: A Propane Grid
A propane grid is a relatively efficient and low maintenance option that is common in BC in rural or remote areas. Although this option has a higher capital cost than Option #1, this would be paid back in energy cost savings in approximately 4 years. Once the system is paid off, there is potential for energy costs saving of ~ $40,000 per year compared to Option #1. INAC has indicated that these costs savings may be able to flow back to the community. There have been concerns expressed by community residents regarding fire and explosion risk, however a propane grid installed and maintained by qualified personnel would likely pose a lower risk than the current situation, where each house has individual propane bottles for appliances that are regularly disconnected and transported to the barge for refilling.

Option # 3: District Heating System
A district heating system is the most innovative and energy efficient option available, but also the most complex. This option has a higher capital cost than Option #1 or 2, and would be paid back in energy cost savings in approximately 5 years. Once the system is paid off, there is potential for energy costs saving of ~ $84,000 per year compared to Option #1, which INAC has indicated may be able to flow back to the community.

Because of this system's complexity in design and maintenance, it will require additional time to design and implement. There is an increased risk of maintenance related problems over time if the system is not properly operated and maintained.

One of the main advantages of a district heat system is the ability to incorporate any number of different heating sources, with different fuel types, and to incorporate "free" sources of heat such as waste heat from the diesel generator exhaust or solar energy, or wood waste. This allows the potential of a more efficient system while improving energy security due to the ability to use different fuel or energy supplies.

There are many options for sources of heat supplied to district heating systems and four are profiled in this package: a) Central Propane Boiler, b) Central Wood Pellet Boiler, c)

Cogeneration and Central Propane Boiler, d) "Energy Cabin" Wood Pellet Boiler with Solar Hot Water.

Add On Options: Wood Stoves (Option #4), Solar Hot Water (Option #5) and Wind (Option #6)
Wood Stoves, solar hot water heaters, and a wind generator are all practical options that could be added to any of the above options to reduce energy costs and improve self sufficiency. Wood stoves in particular would improve self-reliance in the event of a system failure due to the abundant supply of local wood resources.

Other Options Considered
A number of other energy options were considered. However they were deemed impractical for the community and therefore not explored in detail. These included:

1. Micro hydro – deemed not practical because there are no rivers or streams with year round flow within several kilometers of the village. The stream to the south of the existing village has very low flow even in the winter. One possibility that could still be explored is the potential for micro hydro at the Wakeman Sound reserve, where a larger river exists. It was not explored because the community has no plans for development at this site at the present time.
2. Ocean source or ground source heat pumps – This option was initially included in the list of options, however upon initial analysis it was determined that the return on investment was very poor due to the high cost of electricity from the diesel gensets. This type of technology can have a good return on investment in locations served by the main electricity grid, where current electricity prices are approximately $0.06 per kWhr compared to approximately $0.38 per kWhr from the diesel gensets.
3. Tidal energy – A review of tidal energy potential from BC Hydro studies shows a fairly good potential for tidal energy from current flowing past Gilford Island into Knight Inlet. Unfortunately it is not practical at this time because the distance to supply electricity to the grid is too far, and tidal generation technology is not yet developed sufficiently to be commercially viable. The development of tidal based electricity generation with the sale of electricity should be explored by the community in the future, particularly once it has been developed at other nearby locations.

Option # 1 - Existing Oil Stoves and Electric Baseboard Heat

Description:

- Electric baseboard heaters providing space heat using electricity generated by diesel gensets
- Inefficient oil stoves with oil tanks outside houses
- Small propane tanks at each house for appliances
- Analysis assumes 50% of new buildings heated with oil furnaces and 50% heated with electricity

Pros:

- Minimal capital cost

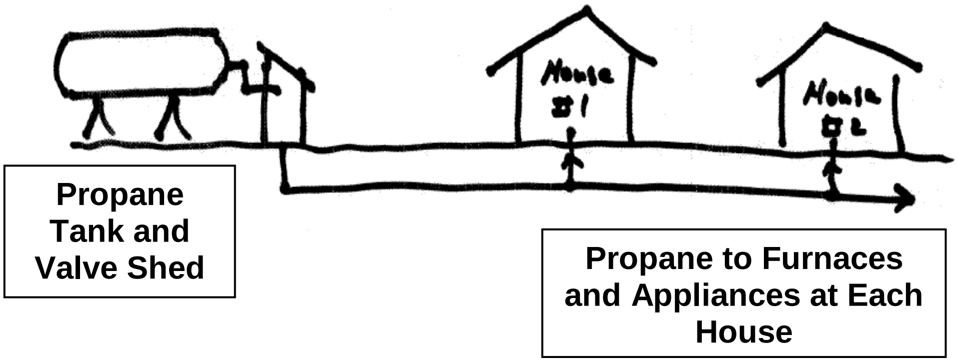
Cons:

- Very high energy costs - very inefficient production of electric heat using diesel generators, and high cost of heating oil.
- Environmental – possible oil spills from manual filling of tanks and transfer from central oil storage, increased air pollution
- High Maintenance – manual filling of oil tanks at each house, propane tanks transported to barge for filling
- Aesthetic – central oil storage tank must be moved so that it is not in the center of the community

Example:

- Current Situation at Gilford Island, oil tanks (left), electric baseboard heater (right)

Option # 2 - Propane Grid



Description:

- Underground propane pipes supply propane to propane furnaces and appliances in each building
- 5,000 gal propane tank & small valve shed located on a pad beside current genset building

Pros:

- Reduced energy costs – high efficiency propane furnaces are more efficient than electric or oil heat. Propane supply charges reduced for central filling of one tank
- Low maintenance – annual maintenance provided by superior propane
- Safety – hard piped propane system is safer than individual tanks being refilled at each house
- Fast speed of construction

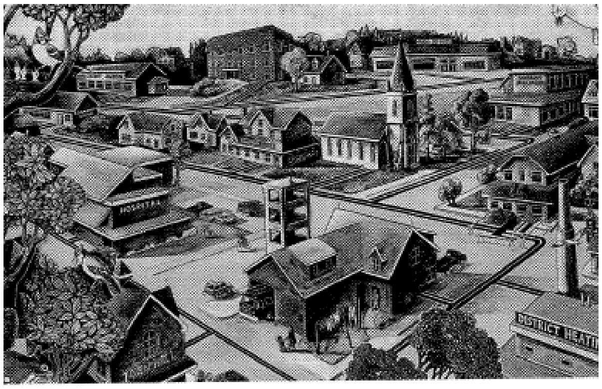
Cons:

- Increased capital cost compared to Option #1

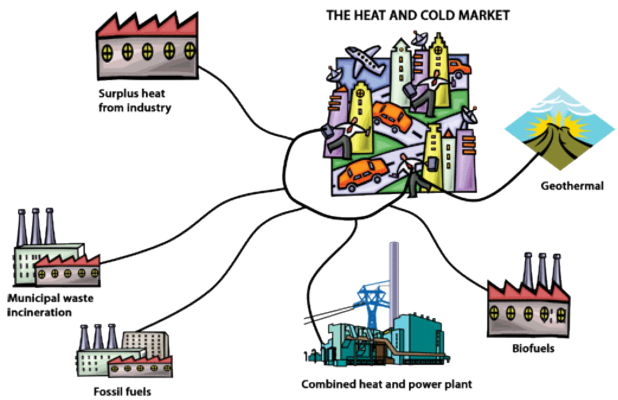
Example:

- Big White Ski Hill (Upper Photo), Lakeview subdivision (Lower Photo), Samahquam Nation Baptiste-Smith Community

Option # 3 - District Heating



District heat distribution network in a mid-sized community. (Illustration by P. John Burden, for the Prince Edward Island Department of Economy, Development and Tourism.)



Description:

- Underground hot water pipes supply hot water to buildings for space heating and domestic hot water use
- The hot water can provide space heating in buildings with in floor radiant heat, or hot water baseboards, or forced are furnaces.
- Central district heating plant produces hot water using:
    - central propane boiler, or
    - wood pellet boiler
- Other low cost energy sources can be added to district heating system to reduce energy costs including:
    - Waste heat recovery from diesel gensets (Cogeneration)
    - Solar hot water heating

Option # 3A - District Heating with Central Propane Boiler

Description:

- Underground hot water pipes supply hot water to buildings for space heating and domestic hot water use
- District heating plant produces hot water using central propane boiler

Pros:

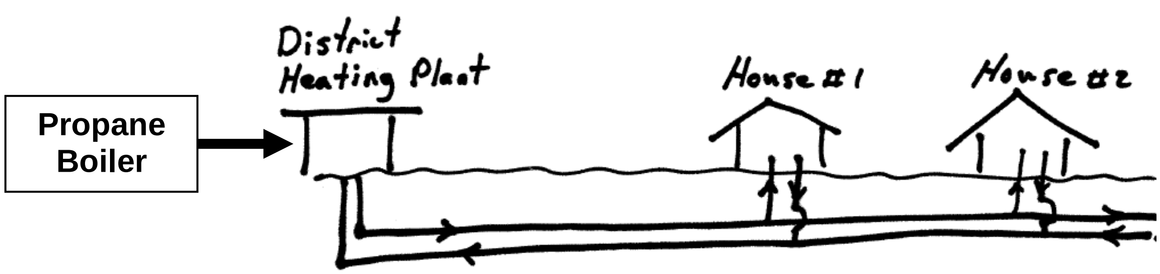
- Reduced energy costs (Same as propane grid) – high efficiency central propane boiler. Propane supply charges reduced for central filling of one tank.
- Energy Flexibility – can switch to other fuel types to generate heat, and use in combination with solar and waste heat.
- Job creation – system will require monitoring and maintenance
- One central heating plant rather than individual furnaces and water heaters at each house (maintenance)

Cons:

- Increased capital cost compared to Option #1 and 2
- Higher maintenance – boiler operation and hot water grid requires monitoring and maintenance
- Propane tanks at each house for appliances require manual refilling unless a propane grid is also constructed
- Slower speed of construction – design and construction will take longer than propane grid. If houses are built before district heating system is ready they will require temporary boilers

Examples:

- North Vancouver lower Lonsdale district heating system



Option # 3B - District Heating with Central Wood Pellet Boiler

Description:

- Underground hot water pipes supply hot water to buildings for space heating and domestic hot water use
- **District heating plant produces hot water using central wood pellet boiler**

Pros:

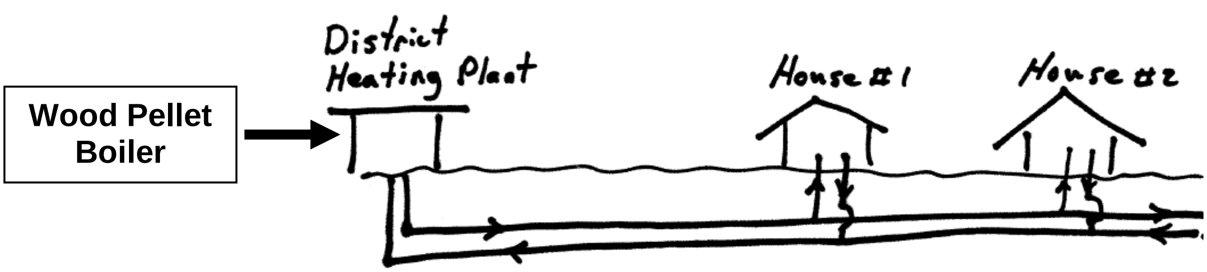
- **Reduced energy costs (Lower than 1, 2, & 3A) – wood pellet costs are lower than propane.**
- Energy Flexibility – can switch to other fuel types to generate heat, and use is combination with solar and waste heat.
- Job creation – system will require monitoring and maintenance

Cons:

- Increased capital cost compared to Option #1 and 2.
- **Higher maintenance – Wood pellet supply and boiler operation and hot water grid requires monitoring and maintenance**
- Propane tanks at each house for appliances require manual refilling unless a propane grid is also constructed
- Slower speed of construction – design and construction will take longer than propane grid. If houses are built before district heating system is ready they will require temporary boilers

Examples:

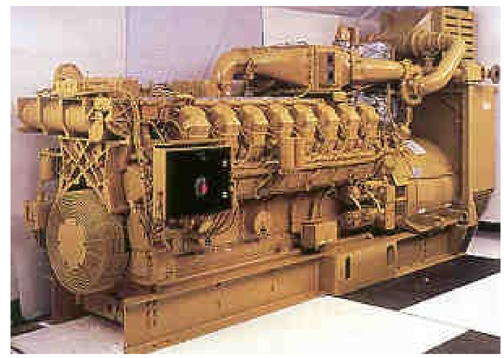
- Oujé-Bougoumou (Quebec), Charlottetown (PEI), Green Acres Family Housing (Vermont)



Option # 3C - District Heating with Cogeneration and Central Propane Boiler

Description:

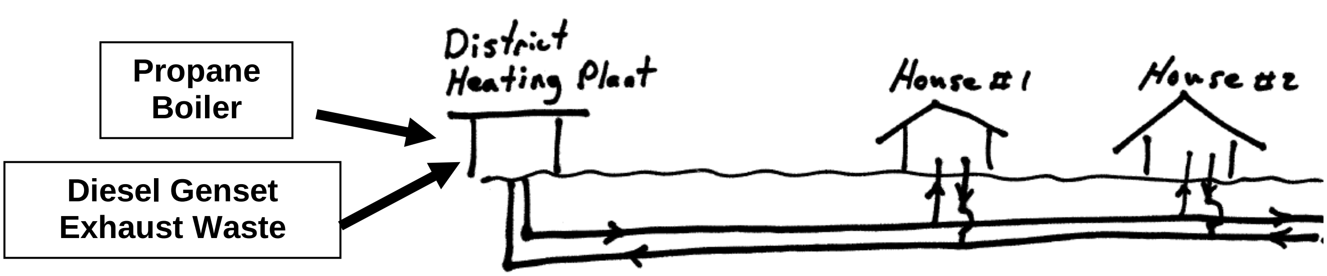
- Underground hot water pipes supply hot water to buildings for space heating and domestic hot water use
- District heating plant produces hot water using central propane boiler
- **Cogeneration – waste heat recovery on diesel genset exhaust provides free heating to district heating grid**



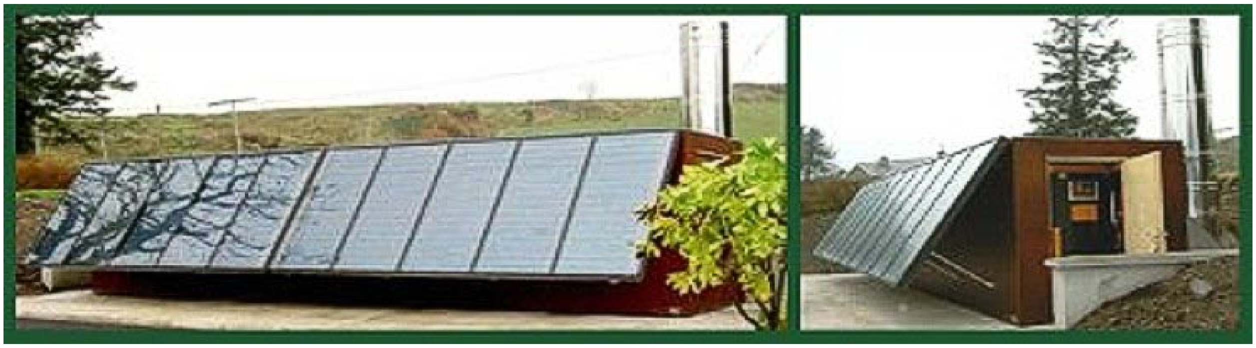
Pros:
- **Reduced energy costs (Lower than 1, 2, & 3A, 3B) – free waste heat from genset exhaust.**
- Energy Flexibility – Can switch to other fuel types to generate heat, and use is combination with solar and waste heat.
- Job creation – System will require monitoring and maintenance

Cons:
- **Increased capital cost compared to Option #1, 2, 3A, and 3B.**
- **Higher maintenance – Cogen system and boiler operation and hot water grid requires monitoring and maintenance**
- Propane tanks at each house for appliances require manual refilling unless a propane grid is also constructed
- Slower speed of construction – design and construction will take longer than propane grid. If houses are built before district heating system is ready they will require temporary boilers.
- Existing diesel gensets are being replaced with air cooled gensets as part of the water treatment system upgrade – these have a much less potential for heat recovery than water cooled gensets.

Examples:
- Nitnat Fish Hatchery, Vancouver Island



Option # 3D - District Heating with "Energy Cabin" Wood Pellet Boiler with Solar Hot Water



Description:

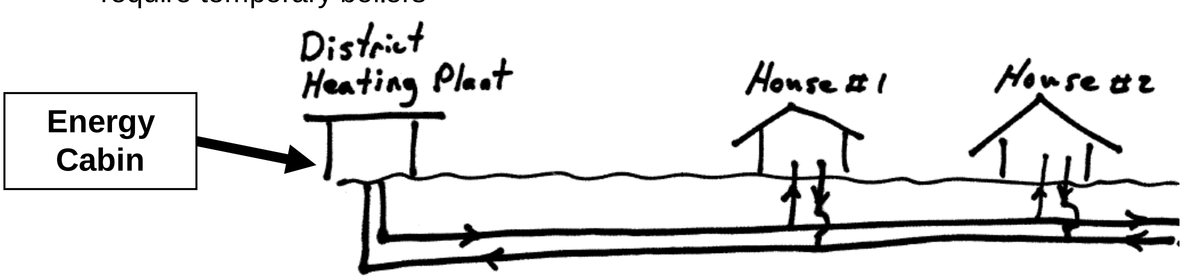
- Underground hot water pipes supply hot water to buildings for space heating and domestic hot water use
- **District heating plant produces hot water using "Energy Cabin" – self contained wood pellet boiler and solar hot water heating panels**
- **First American Scientific Corporation has indicated that they may be interested in installing system and operating it and selling heat to the community**

Pros:

- **Reduced energy costs (Lower than 1, 2, & 3A, 3B) – free solar heat (To be determined).**
- **No capital or maintenance costs – system is installed and maintained by seller**
- Energy Flexibility – can switch to other fuel types to generate heat, and use is combination with solar and waste heat.
- Job creation – system will require monitoring and maintenance

Cons:

- Propane tanks at each house for appliances require manual refilling unless a propane grid is also constructed
- Slower speed of construction – design and construction will take longer than propane grid. If houses are built before district heating system is ready they will require temporary boilers



Option # 4 - Wood Stove Heating

Description:

- Wood stoves in each building to provide space heating

Pros:

- Reduced energy costs (lower than 1,2, 3A, 3B, 3C, or 3D) assuming wood is harvested locally
- Low capital cost
- Increased self sufficiency and energy security – independent of outside fuel supply and mechanical system failure
- Job creation opportunity for cutting and selling wood to community

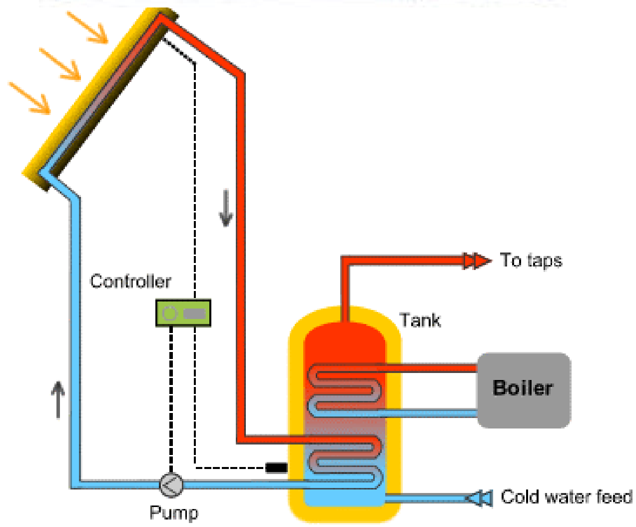
Cons:

- Increase effort required for operation and maintenance
- Limited heat distribution in large buildings
- Local air pollution

Option # 5 - Solar Hot Water Heating

Description:

- Individual solar panels on south facing sloped roofs are used to preheat domestic hot water in each house. Water is circulated in the system only when the temperature of the solar panels is high enough to heat water. "Drain back" system eliminates problems with freezing.
- Or, centralized solar hot water heating array that heats hot water in the district heating system



Pros:

- Reduced energy costs
- Increased self reliance
- Portrays and environmental image which would attract tourism

Cons:

- Increased capital cost
- Increased maintenance

Examples:

- Chanterelle Inn, Nova Scotia,
- Vancouver International Airport,
- numerous single family houses in BC

Option # 6 - Wind Turbine

Description:

- A wind turbine could be installed on top of the 1,000 ft mountain directly above the community, and connected to the diesel gensets as a wind diesel hybrid system
- Electricity produced by the wind generator would offset diesel genset produced electricity

Case Study - Rankin Inlet, Nunavut Source: CMHC

- **Technology**
  - ✓ *One 50 kW wind turbine*
  - ✓ *Installed in September 2000*
  - ✓ *Connected to diesel grid*
- **Results**
  - ✓ *Generates 189,000 kWh per year*
  - ✓ *Displaces over 50,000 litres of diesel per year*
  - ✓ *Greenhouse gas (GHG) emission reductions of 150 tonnes per year*
- **Costs**
  - ✓ *Capital cost: $300,000*
  - ✓ *Maintenance: $10,000 per year*

A 50 kW turbine, Atlantic Orient Corporation

Pros:

- Reduced energy costs for electricity production.
- Increase diesel genset life
- Reduced local air pollution
- Portrays and environmental image which would attract tourism

Cons:

- Increased capital cost.
- Increased operation and maintenance requirements.
- The top of the mountain is outside the reserve and a wind generation license would have to be obtained from the province

Examples:

- Ranken Inlet Wind Diesel Hybrid

Table 6: Energy Infrastructure Decision Matrix

	Objective	Measurement	Option 1	Option 2	Option 3A	Option 3B	Option 3C	Option 3D	Option 4	Option 5	Option 6
1	Reduced Capital Cost	System Cost ($) (Based on new community plan with 26 houses)	$0	$150,000	$390,725	$437,000	$424,475	$0	$52,000	$65,000	$350,000
2	Reduce O&M costs	Annual Energy and Maintenance Costs	$127,859	$89,712	$91,837	$44,128	$59,495	?	$32,590		
		Annual Energy and Maintenance Cost Savings ($/year)	$0	$38,147	$36,022	$83,731	$68,364	?	$95,269	$5,625	$55,000
		Simple Payback Compared to Option 1 (Years)		3.9	10.8	5.2	6.2	?	0.5	11.6	6.4
3	Create Employment Opportunities	# Full time band member jobs (Job years)	0.1	0.1	0.5	0.5	0.5	0.5	2	0.1	0.1
4	Reduce Risk (Certainty)	Risk of completing construction on time and on budget (High/medium/low)	Low	Low	Med	Medium	Med	Med	Med	Med	Med
5	Fast Speed of Construction	Infrastructure Construction Time	Fast	Medium	Slow	Slow	Slow	Slow	Fast	med	Slow
6	Increased Durability	House Life Expectancy (Years)	same	same	same	same	same	same	same	same	same
7	Increase Energy Efficiency	Ability to incorporate energy efficient design (Yes/No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
8	Increase Energy Security	Increase fuel options and or self sufficiency (Yes/No)	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
9	Improve Indoor Environmental Quality	Ability to incorporate an improved ventilation system and improved design to avoid moisture problems (Yes/No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
10	Reduce Water Consumption	Ability to incorporate low flow water fixtures (Yes/No)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
11	Ease of Remote On-Site Construction	Prefabricated components	same	same	same	same	same	same	same	same	same
12	Reduce O&M Effort	Operating and Maintenance Effort (High/Medium/Low)	High	Low	High	High	High	High	High	High	High
13	Reduce Site Impacts	Impacts to Clam Midden, soil, water (High/Medium/Low)	High	Medium	Medium	Medium	Medium	Medium	Med/Low	Low	Low
14	Increase Self Sufficiency	Increase in Self Sufficiency (High/Medium/Low)	Low	Low	Low	High	Low	High	High	High	High
15	Safety	Safety Risk (High/Medium/Low)	Med High	Medium	Med High	Med High	Med High	M High	Med High	Med High	Med High

3.3 Next Steps – Energy Infrastructure

Community Choices

The community was presented with all of the previous options and through community meeting they have chosen the propane grid as their preferred option for delivering energy to the community for heating buildings, hot water heaters, and for appliances such as kitchen ranges and dryers. The following steps are required to implement this option.

1. Obtain an updated proposal from Superior Propane for design and construction of the propane grid. Superior Propane is the local propane supplier that delivers propane to the village. They have provided an estimate for installing a propane grid and providing maintenance to the system based on early versions of the community plan. They have been requested to provide more detailed cost estimated based on the final version of the land use plan including plans for future expansion.
2. Procure INAC Funding.
3. Integrate energy infrastructure with housing e.g. Match space heating type with energy system, size energy system capacity based on design and energy efficiency of housing.
4. Obtain competitive bids for design and construction.
5. Undertake construction.
6. Integrate solar, wind generation, and wood stove options into village.

4. Water

4.1 Current Status – Water

A new water treatment plant is currently under design by Kerr Wood Leidal Associates (KWL), and is scheduled to be installed and operating by the end of December 2006. Full funding for the project is being provided by INAC.

Existing System

The existing water supply system was installed in 1996 to 1997. The water system consists of three 150 mm diameter deep bedrock wells, a well control building, a 170,000 L bolted steel tank reservoir, and a piping distribution system. From the well control building, water is pumped to the water reservoir and then back to the village. Spray aeration is used at the reservoir to remove hydrogen sulphide.

The reservoir is designed to provide pressurization and storage for fire protection and for water delivery to buildings. The reservoir serves four fire hydrants located within the existing village. Storage is based on a 200 person design horizon and 270 L per person per day demand. The highest service elevation recommended is 18m geodetic, which means that development of a new subdivision up the hill would require either a new higher storage reservoir, or a booster pump to provide pressurization for fire protection and building water use.

Since 1999 the community has not used water from the groundwater well system for drinking or cooking due to aesthetic and health concerns. They have been supplied with bottled water which comes into the community by boat on a once a month basis.

Well PW86-1 is no longer used because it has produced water with hydrogen sulphide odours throughout its service life. The other two wells, PW 95-1 and PW 95-2 have produced water with unacceptably high salinity levels, from salt water intrusion due to their close proximity to the ocean and over-pumping from design levels.

No disinfection or other water treatment is used, and was not required for this type of system in the past, however disinfection is now required for all public water supply systems. Water from the various wells has historically had problems exceeding allowable limits for dissolved solids, turbidity, chloride, iron, manganese, or sodium.

Records of recent year water use from the log at the water control building (shown in table below) indicate an average total water use of the between 450 and 530 litres per person per day based on a population of 29 people. Total water use per day in 2005 was 15.5 cubic meters per day, which is 44% of the maximum allowable wastewater discharge under the current sewage disposal permit which allows 35m^3/day. The water system operator indicated that large amounts of water have been used to flush the water reservoir, distribution pipes, and water treatment distribution system. Therefore, the per capita water consumption is actually much less than this.

Table 7: Per Capita Water Consumption

Year	Total Water Use Per Year (Litres)	Liters/Person/Day
2004	4,724,003	450
2005	5,654,416	530

New Water Treatment Plant
In 2005 KWL evaluated the feasibility of four different water treatment systems including: 1) adding chlorination; 2) a new well plus chlorination; 3) reverse osmosis treatment plus chlorination; and 4) existing system with bottled water.

KWL recommended option 3, utilizing a reverse osmosis treatment system to remove contaminants and chlorination to disinfect the water. This option was accepted by the community and INAC has agreed to fund the project.

The new water treatment plant is being designed to accommodate water use for 200 people based on 270 litres per person per day. The new water treatment plant will consist of a treatment building, settling pond, and includes upgrading of the existing diesel gensets to meet the three phase power requirements of the new treatment plant. Three independent pilot treatment plants incorporating different pre treatment and treatment technologies are being incorporated into the treatment building in order evaluate their effectiveness. Operation and maintenance of the facility will be undertaken by an outside firm, EPCOR Water Services. The water treatment system will produce chemical backwash and waste water flows that will be sent to a settling pond, and then discharged to the sewage outflow.

The estimated project cost for the new water treatment system, including engineering, construction, monitoring, and operation and maintenance for the first year is $3,224,000 ($111,000 per person based on current population), and ongoing operation and maintenance costs are estimated at $282,000 per year.

4.2 Options – Water

Water Conservation
Water conservation technology should be incorporated into the design of new houses and community buildings to reduce the cost of operating the water treatment plant and to avoid exceeding the capacity of the existing wastewater disposal permit due to increased numbers of people living in the community. The following measures should be adopted which will reduce typical home water consumption by at least 50%

Water Efficiency:

1. Low flow toilets – Maximum 6 L/flush instead of standard 13 L/flush. Dual flush toilets preferred (3.3L/flush and 6L/flush). New low flow toilets actually reduce the incidence of clogging, rather than increase it as typically assumed.
2. Use low flow shower heads – Shower heads rated at 1.5 GPM with an excellent spray pattern are readily available to replace standard 2.5 GPM showerheads.
3. Specify 0.5 GPM aerators on bathroom water faucets instead of standard 2.2 GPM flowrates. No one will notice the lower flow rate.
4. Consider rainwater barrels at each house for irrigation of landscaping and gardens.

Water Treatment Operator Employment
Operation and maintenance of the new water treatment plant will be undertaken by an outside contractor using certified operators. A community member could be trained to become certified at operation of the water treatment plant.

Rainwater Collection
The village is located in a region with a very high rate of annual rainfall and throughout the history of the village the community has relied upon surface or rainwater collection for their water supply. Older community members talk about using "Cedar Water" from a seasonal creek at the north end of the village and a surface water collection system above the center of the village. This collection system consisted of a weir in a seasonal stream and cedar storage tank but was removed in 1996. Rainwater or surface collection was not evaluated as an option in the water supply feasibility study completed by KWL in 2005.

While rainwater collection is not practical for the entire community because construction of the new water treatment system has been funded and is underway, there still could be opportunities to use rainwater collection for outlying buildings such as the tourist buildings and bungalows at "Buddy Bay", or on new houses to offset water use through the water treatment plant, possibly reducing operating costs for the plant. Options include:

1. Incorporating rainwater collection into the design of new buildings in the tourist area – the future bungalows, information center, kayak shelter, or tourist center. Rainwater collection systems should be designed and constructed according to the "Guide for Regulating the Installation of Rainwater Harvesting Systems – Potable and Non Potable Uses".
2. Incorporating rainwater roof collection and cisterns into new houses for non potable uses such as toilet flushing or irrigation.

4.3 Next Steps – Water

Community Choices

1. Incorporate water conservation technology into new building design.
2. Designate a community member as water system operator to provide assistance to the EPCOR certified operator and aim to certify the community member.
3. Incorporate rainwater collection into tourist buildings, or rain barrels on new houses, for irrigation and potentially for toilet flushing.

5. Wastewater

5.1 Current Status – Wastewater

The current wastewater disposal system for houses and community buildings was constructed in 1990. It consists of individual 750 Gallon septic tanks, and distribution via the community owned sewer system within the village to the outfall at the south end of the village. The outfall is a 100mm HDP pipe with its terminus approximately 25m below the surface and 440m in length into Retreat Passage waters. A dosing siphon that is used to deliver sewage through the outfall at low tide is located at the south end of the village. During all site visits by the planning consultants, a strong sewage odour was observed around the dosing chamber, and community members complain about the smell of sewage in the area. A broken sewage pipe near the siphon pump that has apparently been repaired may have been contributing to the odour.

According to Dave Johnson, who currently has the responsibility for maintaining the wastewater system, the septic tanks were pumped out in 2005 for the first time in 15 years. He indicates that the system is working well, and other than the odour problem, does not require any upgrade or modification.

Kerr Wood Leidal, who originally designed the system, indicates that the system is working well, has enough excess capacity to accommodate future expansion to 40 households, and has a good remaining life expectancy.

5.2 Options – Wastewater

Odour Control
Kerr Wood Leidal indicates that the foul odour observed around the siphon pump may be from air escaping due to a broken or loose cap on the dosing chamber. If that is not a problem and the odour is escaping through the vent, then they suggest either adding a carbon filter to the vent to remove odor from air escaping through the vent, or extending the vent inlet to a location far from occupied areas.

Wastewater Treatment for New Subdivision
As part of the pre-design work for the new subdivision, Kerr Wood Leidal is reviewing whether or not the wastewater system needs upgrading to meet current requirements for sewage treatment systems that are more stringent than were in place when the system was installed in 1990. The village has a waste discharge permit for 35 cubic meters per day, which should be sufficient to meet future expansion needs, even with the increase in discharge from the water treatment plant. New houses should be constructed with low flow toilets, showers, and faucets to ensure that this maximum capacity is not exceeded.

5.3 Next Steps – Wastewater

Community Choices

1. Design new houses with low flow toilets, showers, and faucets to reduce the amount of wastewater flow going to the water treatment plant and avoid the need to increase the discharge flowrate allowed under the current wastewater discharge permit.

2. Investigate the source of odour at the dosing chamber and repair (repair broken or loose cap on the dosing chamber, or add a carbon filter to the vent to remove odor from air escaping through the vent, or extending the vent inlet to a location far from occupied areas.
3. Design expansion of water treatment system to the new subdivision (underway by Kerr Wood Leidal)

6. Fire Protection

6.1 Current Status – Fire Protection

Fire protection to the village is provided by the four fire hydrants, fire fighting equipment, and community members. There is currently no fire pump in the village. Therefore, it may be difficult to draw the design fire flow from hydrants using just fire hoses. Building sprinkler systems has been recommended by previous consultants however, they have not been installed in any of the existing buildings.

6.2 Options – Fire Protection

New Buildings
All new buildings should be constructed with fire sprinklers. The water supply system for the existing village site is designed to be able to supply water to buildings equipped with sprinkler systems.

New Subdivision
The existing water reservoir is designed to provide pressurization and storage for fire protection and for water delivery to buildings. The reservoir serves four fire hydrants located within the existing village. The highest service elevation recommended is 18m geodetic, which means that development of a new subdivision up the hill would require either a new higher storage reservoir, or a booster pump to provide pressurization for fire protection and building water use.

6.3 Next Steps – Fire Protection

Community Choices

1. Incorporate sprinklers into new houses and other buildings.
2. Investigate the purchase of fire fighting equipment.

7. Solid Waste

7.1 Current Status – Solid Waste

In the recent past the community used a landfill up the hill southeast of the village to dispose of solid waste. It is no longer being used and all solid waste is currently being removed from the landfill and disposed of at the 7-Mile Landfill in the Mt Waddington Regional District.

The community currently transports all solid waste to Alert Bay for disposal. The system consists of 12 plastic garbage bins with wheels (garbage totes) that are located throughout the village. Once per week the totes are wheeled to the dock, loaded on a seiner, and transported to Alert Bay. From there the garbage is transported to the 7-Mile landfill north of Port McNeil.

They are currently shipping approximately 4 totes/ week of garbage out of the village. The boat picks up the garbage once per week at a cost of approximately $400 per trip. The cost to dispose of the garbage is $12.50 per tote (or $50/week).

7.2 Options – Solid Waste

Option 1 - Recycling
Alert Bay has a very good recycling program that should be used by the village to reduce solid waste disposal costs and negative environmental impacts. They accept glass, plastics, metals, and paper. There is no charge for recycling that comes to the municipal dock in Alert Bay, except a small charge for moving it from the dock to the recycling center.

The four totes per week of garbage could likely be reduced to one tote per week of garbage plus three totes per week of free recycling, resulting in a cost savings of approximately $38 per week, or $2,000 per year. More importantly it would result in a 75% reduction of waste going to the landfill and the negative environmental impacts associated with its transportation and disposal.

Option 2 - Recycling Plus Reduced Trips
If recycling was implemented and the number of barge trips to transport solid waste to Alert Bay was reduced to one every two weeks from once per week, the cost savings would be approximately $238 per week, or $12,375 per year.

Alert Bay also has a service to recycle washers and dryers (which are sent to Vancouver) and they are working on developing a Reuse Center.

Option 3 - Coordinate Transportation with Bottled Water Drop Off
Another option to reduce transportation costs associated with barging of the totes to Alert Bay is to coordinate garbage transportation with the transportation of bottled water into the community. This is currently happening on a once per month basis but will terminate when the new water treatment plant is up and running. The cost savings associated with a reduction of one trip per month is approximately $4800 per year.

Option 4 - Composting
On site composting is another option, however community members have concerns about attracting animals to the village. Site composting could probably be done in a secure storage facility far removed from the village.

7.3 Next Steps – Solid Waste

Community Choices

1) Develop a recycling system. Talk to the recycling coordinator out of Alert Bay, John Jollisse, Tel 604-974-2211 to arrange for recycling. Set up new recycling totes or dedicate existing totes to recycling
2) Consider reducing garbage barge trips to Alert Bay from once per week to once every two weeks. A secure storage location could easily be constructed for garbage if it is not picked up every week.
3) Coordinate water delivery with garbage disposal trips.
4) Consider developing a composting facility

8. Conclusions

This report examined options to address the physical needs of the community as they relate to housing, energy, and infrastructure systems such as water, wastewater, and solid waste. Options were examined that best meet the long-term objectives of the community, as well as addressing the need for immediate short-term physical repairs or replacements relating to housing, energy, water, sewer, and solid waste management. In summary, the following list highlights the main findings of the study:

Housing Construction Methods

- Four methods of construction were evaluated for their benefits and drawbacks, including pre-manufactured trailers, on site construction with community labour, construction on site with outside labour, and construction combining partially pre-manufactured components with on site construction.
- Based on the current construction climate in BC, new houses are estimated to cost between $100,000 and $175,000 per 1000 sq ft house depending on how they are designed and the method used for construction. The KFN have secured funding of approximately $90,000 per house from INAC to build 26 replacement and new homes at Gwa-yas-dums Village, and will be contributing approximately $20,000 per house themselves.
- KFN have reviewed this analysis and decided to engage the services of an architect or home designer to help facilitate the development of construction drawings and the construction tendering process based on these construction methods.

Housing Design Guidelines

- Housing design guidelines that incorporate both community values and technical recommendations have been developed around building type, durability, indoor air quality, energy performance, roofing and cladding, water efficiency and fire protection.
- Sample floor plans and housing perspectives have also been completed to initiate thinking and discussion as a transition step to engaging the services of an architect. In October, the community agreed to move forward with engaging the services of an architect or designer and to oversee the transition to implementation. This architect should also assist the community in developing architectural designs and specifications for the other buildings (commercial, administrative, health, recreation) identified in the site plan.
- Energy efficient housing design was explored as part of the housing analysis and overall physical development plan. The costs and benefits of housing designed to an energy performance level of “Energuide 80” were evaluated. Energy efficient housing would have significant operating cost savings of up to $100 per year per house, with the additional benefits of improved indoor air quality and building longevity/ durability if heat recovery ventilation is incorporated into the designs. Based on the long-term cost savings and other benefits of energy efficient housing

design, EcoPlan recommends that INAC support the extra costs associated with the construction of energy efficient housing to the “Energuide 80” level of performance.

- Water efficient housing design was explored and is recommended to be incorporated into the design of new buildings. This would reduce the operating cost of the new water treatment plant and enable community expansion without the need to increase the allowable discharge with the current wastewater discharge permit.

Community Energy

- An analysis of over 10 long-term community energy options was developed and evaluated by the community. A total of 15 community-based criteria, including costs, maintenance requirements, ease of construction, safety, and environmental impacts, among others were used to evaluate options.
- Based on this analysis, KFN chose as their preferred system, a propane grid system in conjunction with the upgraded electrical gensets.
- Capital costs and long-term operating cost savings were critical criteria in choosing the system.
- The propane grid is expected to save approximately $38,000 per year in energy costs compared to the current system of electric and oil space heating and hot water heating. Initial estimates for capital costs are approximately $150,000 and will take approximately four years to recover this initial expenditure relative to the current energy system.
- KFN should consider implementing other alternative energy options explored such as solar hot water systems, a wind turbine on top of the mountain above the village, and wood stoves or wood pellet boilers. These options would reduce operating costs and environmental impacts, including increased energy security and self sufficiency.

Water

- The water in Gwa-yas-dums is not potable and is one of the most pressing concerns facing the community. KFN, working with Kerr Wood Leidal Consulting Engineers, are in the process of implementing a reverse osmosis and chlorination system of water treatment to address this crisis. The implementation of this project is scheduled for installation of the pilot treatment facility in the fall of 2006.
- Water conservation methods incorporated into the new building design guidelines should be implemented to reduce the operating costs for water treatment, and reduce wastewater flows and the size of the expanded wastewater treatment system.
- There is an opportunity to capture a local employment opportunity resulting from the need for a certified water treatment system operator.

Wastewater

- The current waste water disposal system is meeting the needs of the existing houses with the exception of strong sewage odour from the dosing chamber. The community should investigate this source of odour at the dosing chamber and repair (repair broken or loose cap on the dosing chamber, or add a carbon filter to the vent to remove odor from air escaping through the vent, or extending the vent inlet to a location far from occupied areas).

- The new subdivision will require expansion of the water treatment system. This may result in the need to upgrade the system to meet current requirements for sewage treatment systems that are more stringent than were in place when the system was installed in 1990. This process is currently being completed by KWL. All new buildings should be designed to reduce water consumption as much as possible to reduce the size and cost of expanding the wastewater disposal system.

Fire Protection

- The current water supply system is designed to provide fire protection flow rates. However, the community does not have fire pumps for fire fighting. All new buildings should be constructed with sprinklers and the community should acquire fire pumps for fire fighting. The new subdivision will require construction of either a new water reservoir above the height of the new subdivision, or a booster pump from the existing reservoir, to provide fire protection.

Solid Waste

- The community currently transports all solid waste to Alert Bay for disposal. A recycling program that uses the existing recycling facilities in Alert Bay could be implemented to reduce the cost and environmental impacts of solid waste disposal. The community could consider reducing solid waste barge trips to Alert Bay and implement an animal proof composting system on Gilford Island to reduce transportation and disposal costs.