An Investigation Into The Social, Ecological, and Economic Factors To Conisder When Planning Sustainble Housing

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ABSTRACT

Outlined in this report are the findings of the social, ecological, and economic factors that should be considered when implementing sustainable housing as requested upon by the University of British Columbia's (UBC) Farm. A triple bottom line analysis of the social, ecological, and economic factors that should be considered when implementing sustainable housing is performed on three different sustainable developments.

The important social factors when considering sustainable housing are creating social spaces, encouraging diversity, and educating people on sustainability. Key ecological criteria are reduction of green house gases, reduction of energy and water consumption, waste management, and use of recyclable and rapidly renewable building materials. Economic factors which should be considered are reduction of living costs, use of energy efficient appliances, in-residence energy monitoring devices, per-unit utility billing, and a biomass facility for providing heat and hot water.

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LIST OF ABBREVIATIONS

Abbreviation	Definition
CSLP	Craik Sustainable Living Project
DSG	Dockside Green
EVI	Ecovillage at Ithaca
GHG	Green House Gas Emissions
LEED	Leadership in Energy and Environmental Design
PVC	Polyvinyl Chloride
UBC	University of British Columbia
UV	Ultraviolet

1.0 INTRODUCTION

This report was requested by The UBC Farm to conclude on social, ecological, and economic factors to be considered for their proposed Sustainability College. To perform this analysis, case studies on existing sustainable housing options were performed using a triple bottom line assessment of the social, ecological, and economic factors correlations. The UBC Farm requires a Sustainability College that will provide an accommodation for faculty members and students of the farm. The Sustainability College is designed to host around 75-100 people. In addition, the Sustainable College is required to be integrated into the landscape with emphasis on minimizing the ecological footprint of the building.

Three individual case studies are performed on different sustainable housing options which include Craik Sustainable Living Project (CSLP), EcoVillage at Ithaca (EVI) and Dockside Green (DSG). A triple bottom line assessment is performed to analyze the social, ecological and economic aspects of each case study. Upon the assessments, the factors and standards that need to be considered for the Sustainable College are reflected and concluded. In addition, possible housing style and technologies are recommended to satisfy the factors and standards.

2.0 CASE STUDIES

1.1 Introduction

The following three case studies, Craik Sustainable Living Project (CSLP), Ecovillage at Ithaca (EVI), and Dockside Greens (DSG) were chosen because they are believed to be the most relevant and beneficial to the planning of the UBC Farm Sustainability College. The first case study CSLP was chosen because of its simple, affordable, and rural sustainability characteristics. The second study EVI was chosen for its vast and detailed information on the development, and its rural location. The final case study DSG was selected for its location, high-level of sustainability measures, and its bordering of an urban city.

1.2 Craik Sustainable Living Project

The Craik Sustainable Living Project which consists of an eco-centre and eco-village. It was created as a combined effort by the Town and Rural Municipality of Craik to create a sustainable living environment. The project is located in south central Saskatchewan (Craik sustainable living project, 2009). The eco-centre opened in July of 2004 and is used as a multipurpose facility. It features energy efficient building design, innovative heating and cooling systems complete with renewable energy systems(Craik sustainable living project, 2009).

The idea of creating a sustainable eco-village was first proposed by Dr. Lynn Oliphant in 2001. The central goal of CSLP is to create a sustainable living community and inspire other communities to join the eco-community concept. Craig Sustainable Living Project has won many awards and recognitions. The founder of CSLP, Dr. Oliphant was awarded the Canadian Geographic, Canadian Environment Award in 2005 for his contributions in creating a sustainable environment in the Town of Craik (Community Awards Network, 2005). One of the reasons for the success of CSLP is their 5 year plan which spans from 2003 to 2008. More than 75% of their planned goals were achieved as planned (Craik sustainable living project, 2009). The detailed timeline for planning is attached in Appendix A. Figure 1 below shows a picture of the CLSP eco-center.

Figure 1 - Craik Sustainable Living Project Eco-Center

1.3 Ecovillage at Ithaca

EcoVillage at Ithaca is located in the Finger Lake region of upstate New York, only a few miles away from the city of Ithaca and Cornell University (Walker). EVI currently has two cohousing neighborhoods, FROG and SONG, including 15 duplex houses with 160 residents. In addition, a third neighborhood TREE is currently in the planning stage. Located on 175 acres of land, EVI is adjacent to two community supported agricultural (CSA) farms. These farms provide local organic food to EVI residents and over a thousand other people in Ithaca during the growing season. EVI is built for educational purposes "to promote experiential learning about ways of meeting human needs for shelter, food, energy, livelihood and social connectedness that are aligned with the long term health and viability of Earth and all its inhabitant" (Walker).

The planning of EVI began in 1991 by Joan Bokaer and Liz Walker. During 1992-1993, they fundraised $400,000 and purchased the land. By 1995, the road, sewer, water and pond were built, and construction finished in fall of 1997. The detailed timeline for construction and planning is attached in Appendix B. In Figure 2 below a picture of the Ecovillage at Ithaca may be seen.

Figure 2 - Ecovillage at Ithaca

2.4 Dockside Green

Dockside Green is a 15 acre harbour front community located in Victoria British Columbia containing 1.3 million square feet of residential, office, retail and commercial building (Overview, 2012). It is home to an estimated 2,500 people divided between three neighborhoods (Hunter, 2010). The site was originally an abandoned dockyard owned by the City of Victoria, who sold it to developers under the condition that the development achieves a minimum standard of Silver from the Leadership in Energy and Environmental Design (LEED). (Ling, Thomas, & Hamilton, 2007). The development of the community is based off of a triple bottom line assessment and has received a LEED certification level of platinum, the highest achievable level for sustainability (Lucey). Some of the major sustainability measures incorporated by DSG include a biomass gasification facility that provides heating and hot water for the entire community, an on-site sewage treatment plant, and a wastewater treatment plant (Lucey). A picture of a DSG residency is seen in Figure 3.

Figure 3 - Dockside Green Residents

3.0 TRIPLE BOTTOM LINE ASSESMENT

3.1 Introduction

A triple bottom line assessment on the three case studies will be conducted in the preceding sections on the social, ecological, and economic factors considered by these sustainable housing developments. The social aspect looks at the people interactions, and beneficiaries towards the community. For the ecological factors, sustainable environmental measures, environmental impact and carbon footprint are key components considered. Economically the profitability of the community and sustainable measurements implemented are looked at.

3.2 Social

3.2.1 Craik Sustainable Living Project

Craik Sustainable Living Project incorporates community and social development by focusing on creating a vibrant living space for the community. CSLP eco-centre is easily accessible, situated near Highway #11, one of the busiest highways in Saskatchewan. The eco-centre is adjacent to the Craik Regional Park approximately midway between major centres of Regina and Saskatoon (Craik sustainable living project, 2009).

The CSLP eco-centre promotes opportunities for social interactions among the community by providing facilities such as the gold club house, meeting rooms, restaurants, and lounge and gift shops. The Craik and District Golf Course is a well-known nine-hole golf course in Saskatchewan which organizes golf tournaments for golf enthusiasts from around the world once every several months (Craik and district golf course, 2004). Such tournaments promote and educate the cause of the community. The eco-centre provides meeting rooms which can be combined to create a larger multi-functional space used for special occasions such as birthday parties and family gatherings.

3.2.2 Ecovillage at Ithaca

Creating a harmonious social space is one of the EVI's main goals. The FROG and SONG neighborhoods are designed to inspire social interactions. The buildings are clustered around a pedestrian courtyard, with recreational spaces and office areas (Kirby, 2003). Pedestrian-only streets and community amenities allow more social relations between the communities as people walk from place to place. There are also two common houses where EVI residents share common dinners several times a week (Walker). The village residents are given the opportunity to volunteer about 2-3 hours per week on outdoor maintenance and operation management. EVI hosts seasonal festivals such as concerts and talent shows.

A Study completed revealed that EVI residents have more diverse personalities and life experiences (Kirby, 2003). The majority of EVI residents move to the community because of social motivations, which are emphasized in EVI's design and planning process. As Kirby concludes, "Introducing outside facilitators to open channels of communication led to significant improvement in the ability of Ecovillage residents to listen to each other and to respond appropriately."

3.2.3 Dockside Green

DSG promotes a community of varying ethnicities, income levels, and ages. Health safety of the people is a concern and each building provides 100% fresh air from central or individual heat recovery ventilators, and in the construction phase of the project only low or non-volatile compounds were used (Our Triple Bottom Line...). The developers ensure the viability of their sustainability features through yearly building inspections from an independent commissioning agent. DSG provides the ability for connectedness between residents with pedestrian and cycling trails such as the north/south greenway, fitness centre, sustainability centre, and a first nation's totem pole (Dockside Green Annual Sustainability Report, 2011). A sense of safety to the community is established through walk-up townhouses, improvements to local roads to slow down traffic, and pedestrian crosswalks to connect community trails. The integration of residential, commercial, office and retail space provides people with walk able access to simple amenities. This stimulates social interaction through the ability for residents to frequently cross paths during every day life, creating more opportunities for casual conversations to begin. The plant facilities are integrated into the landscape to create more of an aesthetic appearance to the community.

The on-site wastewater treatment facility caused concern among residents about the health of the facility; however, this was addressed through signs informing people of where treated water was being used (Lucey).

3.3 Ecological

3.3.1 Craik Sustainable Living Project

Ecological efficiency is a major concern of CSLP and they have put it at the forefront in the design of the eco-centre and eco-village. The main focus during the design and construction of the eco-centre was the energy efficiency of the building. This requirement was fulfilled by renewable sources (Craik sustainable living project, 2009). Recycled materials were used instead of conventional building materials to reduce the carbon footprint of the building.

The exterior walls are made of durum wheat straw bales which are available locally and provide an insulation value of R-40 and R-50 cellulose for the ceiling. The windows are made of fibreglass instead of PVC as fibreglass strands are not affected by ultraviolet rays (UV) rays, pro-longing their lifespan (Sunlight/UV Test Data, 2005). The masonry oven is made of bricks which provide a large amount of thermal mass. The bricks used, were recycled from a demolished Craik school (Craik sustainable living project, 2009). Passive solar design allows natural light into the building. No floor coverings were used because floor covering may interfere with the floor's ability to absorb sunlight and radiate into the building. When passive solar radiation is an insufficient source of heat for the building, an in floor radiant heat system is used to warm the floor. Radiant heat systems are more efficient than forced air heating because they eliminate duct losses, and the spread allergens in the building (Stetiu, 1999).

Fresh air building is supplied to the building during the summer season using five earth tubes buried beneath the ground. Earth tubes distribute cooled air throughout the building. In winter, cold air is drawn through the earth tubes, warmed and distributed inside the building (Craik sustainable living project, 2009). Rain water is treated in-house by using a biological water treatment system. Rain water is filtered through sand, charcoal and fine sediment before being exposed to UV radiation to kill remaining pathogens. Drinking water will then undergo reverse osmosis in-house (Craik sustainable living project, 2009). Sewage is deposited into storage bins in the basement where the liquid waste is pumped into separate storage tanks and solid waste is composted by an automated misting system (Craik sustainable living project, 2009). Periodic addition of wood and red wiggler worm is essential for the composting process. The building reduces the need for new building materials by using recycled ones, is a more efficient way of transferring heat, and obtaining water reducing the carbon footprint.

3.3.2 Ecovillage at Ithaca

On average, EVI residents use 40% less energy than other middle class U.S. households (EcoVillage at Ithaca Offers Sustainable Living in a Community Setting). To achieve energy efficiency, EVI has adopted a low-tech approach using energy efficient options such as low-flow toilets and radiant floor heating. In the SONG neighborhood, a variety of green building approaches are also employed, including passive solar design, solar hot water, super-insulated roofs, straw bale insulation, rainwater collection, etc. A co-housing design allows sharing of heating systems, thereby enhancing heat maintenance. The full construction specifications are given in Table 1.

Table 1 - Construction Specifications for EVI

(http://www.greenbuildingadvisor.com/sites/default/files/EcoVillage%20table.jpg)

	First Residents Group (FROG)	Second Neighborhood Group (SONG)
Foundation	Crawlspace (walls and slab floors insulated with 2 inches of rigid foam)	Eco-Block insulated concrete forms
Walls	2x6 walls with 2x2 interior strapping; cellulose insulation	6-inch Thermapan SIPs; alternate construction methods must be R-26 minimum
Windows	Accurate Dorwin triple-pane	Andersen double-pane low-e argon
Attic insulation	R-40 cellulose	R-50 cellulose
Heating system	Vaillant 83% AFUE 200,000 Btuh natural gas cast-iron boilers.	Munchkin 92% AFUE natural gas condensing boilers from Heat Transfer Products
Heat distribution	Fan/coil units and hot-air ductwork, with some hydronic baseboard under windows	Basement radiant slabs with hydronic baseboard elsewhere
Domestic hot water	Each unit has a 20- or 30-gallon indirect water heater warmed by boiler water	Each unit has an indirect water heater
Ventilation	Exhaust fans in bathrooms; fresh air intake connected to return air ductwork	Exhaust-only ventilation using a Panasonic fan on a 24-hour timer; available alternate is the RenewAire energy recovery ventilator
Air leakage	2.0 to 2.5 ac/h at 50 Pascals	Varies

The ecological footprint per person in EVI as of 2002 is 10.5 acres or 44% of U.S. ecological footprint in 2010. The water usage in EVI is 1000 gallons per person per month, which is equivalent to 29% of the water consumption for a typical New York state resident. A detailed comparison is demonstrated in Figure 4.

Frog Neighborhood: 30 Homes	U.S. Single Family homes
Range: 900 sq ft to 1709 sq ft Avg = 1,228 sq ft Avg with common house facilities = 1,345 sq ft (=60% of US avg)	Range: 5%<1,200; >50%>2,000 Avg = 2,230 sq ft in the year 2002 (in 1950 it was 983)
Space per person = 504 sq ft	Space per person in 2002: 864 sq ft for new construction, 670 for existing stock (in 1950 it was 292 sq ft)
Avg energy consumption in BTU: 1997—2002 (natural gas and electricity combined)	Avg energy consumption in BTU: 2001 in Northeast Region of US
69 million per household (=65%) 50 thousand per sq ft (=83%) 25 thousand per resident (=62.5%)	105.9 million per household 60 thousand per sq ft 40 thousand per resident
Water use = 1,000 gallons per person per month in 1998-2002 (=29%)	Water use in New York State = 3,400 gallons per person per month
Electricity use 1999-2000 = 138 kWh per month (=59%)	Electricity use in Northeast U.S. = 232 kWh per month
Ecological footprint per person in 2002 = 10.5 acres (=44%)	U.S. ecological footprint = 24 acres (9.7 ha) in 2010

Figure 4 - Figure 1 Energy Consumption Comparison between EVI and US Middle Class Family (Franke, 2011)

In addition to technology, the energy consumption habits of the residents also reduce the ecological impact. For example, the common dinners that happen three times weekly only involves 1-2 shopping trips and uses 1-2 stoves instead of 30 stoves. The Friday night evening videos in common houses results in a slight reduction in electricity use.

3.3.3 Dockside Green

Dockside green has its an on-site wastewater plant that reuses rain water, for applications such as toilet flushing, landscape irrigation, green roof watering, and maintenance of the ecologically supporting stream/pond. The water reduction measurements used at DSG include:

- Dual-Flush Toilets,
- 5.7 L/min (1.5 gpm) shower heads,
- 3.4 L/min (0.9 gpm) kitchen faucets,

- Waterless urinals (in public restrooms)
- Dishwashers that use only 21.8 L per load, and
- Washing machines with regular cycles between 18.1 and 40.7 L per load (Lucey).

The re-use of water by the facility saves approximately 113 million litres in drinking water per year (Integrated Resource Recovery Case Study: Dockside Green Mixed Use Development , 2009). The buildings at DSG are designed to use 45 to 55% less energy than the Canadian National Energy Code which reduces the community's overall GHG emissions by about 259 tonnes. Some of the energy saving measures used is:

- Energy Star Efficient Appliances
- Fluorescent lighting
- LED lighting in corridors,
- Occupancy Sensors,
- Solar lighting in landscape areas, and
- Smart design to allow for an abundance of daylight into the home.

DSG uses Energy Star appliances, and a comparison against standard appliances may be seen in Table 2.

Table 2 - Comparison of Standard and Energy Efficient Appliances (Dockside Green Annual Sustainability Report, 2011)

Appliance	Standard	Dockside Green
Dishwasher	623 kWh/year/appliance	377 kWh/year/appliance
Refrigerator	527 kWh/year/appliance	476 kWh/year/appliance
Stove/Range	750 kWh/year/appliance	545 kWh/year/appliance
Clothes Washer	876 kWh/year/appliance	145 kWh/year/appliance
Clothes Dryer	909 kWh/year/appliance	340 kWh/year/appliance
Total per suite	3,685 kWh/year/appliance	1,883 kWh/year/appliance

Individual meters are integrated into each suite, providing the resident with information on hot and cold water use, heating bills, and electricity usage. Showing residents of their real time energy costs has shown up to a 20% reduction in energy savings (Our Triple Bottom Line...). DSG's water use compared to conventional design can be seen in Table 3.

Table 3 - Water Usage Standards

Appliance	Standard	Dockside Design
Shower Heads	9.5 L/minute	4.7 L/minute
Lavatories	8.3 L/minute	1.9 L/minute
Kitchen	8.3 L/minute	3.4 L/minute
Toilets	6.0 L	6.0/3.0 L
Urinals	1.0 G	0.0 G

Water-efficient appliances and treated water save approximately 70 million gallons of water per year. Water-efficient appliances alone save approximately 39.2 gallons of water per year (Dockside Green Annual Sustainability Report, 2011).

The community has its own biomass facility which is used to generate heat to the community and is a key component in DSG's ability to be a carbon neutral development (Moresco, 2009). Locally sources wood waste fuels the biomass plant which provides an estimated 75% of the developments energy needs. An outline of the carbon foot print of the plant may be seen in Table 4.

Table 4 - System Performance of Biomass Facility (Dockside Green Biomass Gasification System)

Annual Thermal Capacity (NG Equivalent)	74,000 MMBtu/yr
Avoided CO_2 Emissions	3,460 tonnes/yr
Voided CO_2 Emissions (Car Equivalent)	850 cars/yr
Wood Fuel Trucks Required	60-100 trucks/yr @60% capacity
Ash Production (recycled as compost)	220 tonnes/yr @60% capacity

The buildings are designed using passive design, meaning they use building orientation to maximize the energy performance of the building. The following are notable features of passive design:

- Averages of R17 wall insulation and R22 roof insulation
- Low E double-glazed windows provide a cool atmosphere in the summer and warm atmosphere in the winter resulting in increased indoor comfort and less energy consumption

- Most south-facing and west-facing windows are equipped with moisturized exterior sun shades to provide shade during the summer months
- LED lights are used in corridors and compact fluorescents are used in suites and common areas that save energy and maintenance costs
- Heat recovery technology captures the heat from ventilated air being exhausted to pre-warm incoming heat
- A four-pipe fan coil system is used with two of the pipes designated for domestic hot water and cold water supply system. This provides some free cooling to the retail spaces (Dockside Green Annual Sustainability Report, 2011).

The eco-footprint of DSG was reduced through the use of rapidly renewable natural materials such as:

- Bamboo flooring and cabinet doors
- Wheat board substrates in cabinets
- Wool carpets
- Cork flooring and paneling in lobby areas

and recycled environmentally products:

- Fly ash
- Interface carpet tile
- Rebar with recycled steel
- Aluminum windows and railings with recycled content
- Terrazzo with post-customer recycled glass
- Recovered concreted crushed and used on-site
- Cork flooring made from left over wine cork (Dockside Green Annual Sustainability Report, 2011).

All paints and other materials used are low or non-volatile organic compounds.

3.4 Economic

3.4.1 Craik Sustainable Living Project

Craik Sustainable Living Project strives to be economically efficient. CSLP established a plan to allow residents to build their own homes in Craik eco-village by selling land for $1 and giving residents the freedom to build their own houses provided that they build their house to be sustainable. Studying the plan done by a resident building a 612 square foot round straw bale house in the eco-village, cost an approximated $18,000 for materials alone (Craik sustainable living project, 2009). The resident was able to buy straw from a nearby farm in Craik for a much lower price, thereby reducing the overall cost of building materials. The plumbing and septic tank cost approximately $4,500. The effort of supporting sustainable energy and reducing cost of maintaining the Craik eco-centre was made possible with the installation of 3kW photovoltaic cells and obtaining electricity from a nearby 10kW wind turbine (Tuepah & Rehnby, 2011).

3.4.2 Ecovillage at Ithaca

The cost of a house at EVI ranges from $133,000 for 650 sqft to $225,000 for 1100 sqft (Walker). New houses and apartments in the TREE neighborhood range from $80,000 for 450 sqft to $235,000 for 1440 sqft. This comes out slightly below the area median at approximately $200 per sqft. The reduced energy consumption comes out to approximately 40%, saving residents $15 on utility bills per month.

Solar panels used by EVI cost approximately $270,000 and can offset energy consumption by 50 to 60%.

3.4.3 Dockside Green

In comparison to normal mix-use developments, the projected costs of a sustainable community similar to DSG are projected to be 1 to 1.5% higher (Community Energy Case Studies). The operating cost for a two-bedroom unit is an estimated $215 per year, with smaller units paying less than this. The residency provides a 33% savings in comparison to standardized Victoria housing (Lucey). Water conservation techniques used at DSG include low-flow appliances, sinks, and toilets, and in-residence water meters. These conservation techniques have helped reduce water consumption by an estimated 56%, reducing capital and operating costs of their water treatment plant by approximately 50%. DSG has its own on-site sewage treatment plant, which saves residents an estimated $600 to $700 per year. The sewage treatment plan cost a total of

$3 million (Steve). The on-site water waste treatment facility had a total cost of approximately $4 million and provides over $81,000 per year in saved water costs for the entire development (Integrated Resource Recovery Case Study: Dockside Green Mixed Use Development , 2009). Each residency is monitored and pays for their own usage of hot and cold water, heat and electricity (Dockside Green Annual Sustainability Report, 2011). Compared to the Canadian National Building Code, this model saves 50 to 52% in energy costs. The on-site biomass facility provides heating and hot water to the development producing annual savings of $400,000 to $600,000 every year (Dockside Green Biomass Gasification System). The ash production produced by the plant may be sold as compost to local landscaping companies (Dockside Green Biomass Gasification System). The total cost of the biomass facility is $7 million (Moresco, 2009). Table 5 outlines the cost and savings of the major sustainability facilities implemented at DSG.

Table 5 - Major Sustainability Facilities Implemented at DSG

Description	Cost	Savings
On-site Waste Water Treatment Facility	$4 Million	$81,000 per year
Biomass Facility	$7 Million	$400,000 - $600,000 per year
Sewage Treatment Facility	$3 Million	$600 - $700 per year/resident

4.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the triple bottom line assessment performed on the case studies in this report, the UBC Farm should focus its social factor on implementing opportunities for faculty and students to engage in frequent social interactions, multiculturalism, and education of sustainable features incorporated. For the ecological factor, the Sustainability College should emphasize on green house gas reduction, energy consumption and water consumption, integrate waste management techniques, and use recyclable and rapidly renewable building materials. Economically the Sustainability College should look at reducing living costs by implementing energy efficient appliances to reduce maintenance expenses, in-residence energy monitoring devices and per-unit energy billing to deter abuse of energy, and a biomass facility for heating and hot water.

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APPENDICES

APPENDIX A – CLSP Five Year Planning (2003-2008)

Year One - April 2003 to April 2004

- Plan and begin construction of multi-purpose Eco-centre. (Done)
- Begin educational seminars/workshops and educational programming for local residents (children, youth, adults) on climate change, renewable energy options, and other sustainable living alternatives. (Done)
- Establish community steering committee to oversee development of entire Craik Sustainable Living Project. (Done)
- Explore wide variety of funding opportunities to ensure completion of all phases of the project in a timely and quality manner. (Done)
- Explore conversion of golf course to a "green" biocide free, ecologically sensitive course. (Done)

Year Two - 2004 to 2005

- Finish construction of the Eco-centre. (Done)
- Begin landscaping and plantings of demonstration gardens around the Eco-centre. (Done)
- Lease restaurant and management of the meeting rooms. (Done)
- Begin official tours of the Eco-centre. (Done)
- Advertise for residents of a new sustainable housing development or ecovillage and begin meetings and planning for the development. (Done)
- Develop a plan to convert the current sewage lagoon into a more sustainable waste management option. (Preliminary study presented to CSLP steering committee in January, 2005)
- Secure funding to develop a new waste management system and begin construction. (electronic waste collection program was initiated in October 2006 but discontinued; community composting program initiated 2009)
- Construct sustainable solar/wind power system to supply entire demonstration area, beginning with the Eco-centre. (Fundraising was established in 2005, and a small output, demonstration wind generator was installed in 2007; Currently not functioning.)

Year Three - 2005 to 2006

- Begin retrofitting of existing buildings in R.M. and Town. (Done)
- Electricity usage audit was completed on the Town and R.M. of Craik adminstrative building, maintenance shop, fire hall, community hall, Craik Town Hall and Opera House, community rink and water plant. Reports were submitted to the appropriate boards. (Done)
- Exterior roofing material made from recycled auto tires has been installed on the Craik Town Hall and Opera House. (Done)
- Energy efficient lighting has been installed in the community rink. (Done)
- A tankless water heater has been installed in the Town and R.M. of Craik administration building. (Done)
- New residents for ecovillage and development of their house and land development plans confirmed.
- Four separate plans confirmed with Eco-Village committee as of October, 2006.
- Development of outlet for local produce and other goods and crafts.
- Solar Garden gift shop markets assorted goods and crafts.

Year Four - 2006 to 2007

- Expand workshop offerings to general public.
- Begin construction of houses and work areas in demonstration community. (The 9 available lots have been sold. Development has begun on several of these. New lots are being developed.)
- First annual solar fair weekend - major focus on the Craik initiative with booths and demonstrations of alternative sustainable technologies by local and outside companies. (First annual Solar Fair was held in June, 2007.)

Year Five - 2007 to 2008

- Complete construction of major buildings in the demonstration community and begin day-long tours/workshops.

- Exploration of other compatible activities such as dinner theatre, concerts, art shows, seminars.
- Full scale production and marketing of meat, produce and other products from demonstration community.
- Construction of ecologically sound marina.

APPENDIX B – HISTORY OF EVI (in brief)

- 1990-1991 Joan Bokaer develops vision for an "ecovillage" while on the Global Walk for a Liveable World, an environmental walk across U.S which included Liz Walker.
- June, 1991 Week long "Envisioning Retreat" takes place in Ithaca. This retreat jump-starts the formation of an EcoVillage organization. Joan Bokaer and Liz Walker serve as co-directors.
- Sept, 1991 At EVI Gathering of 60 people in Ithaca, land-search group reports on their work, and group agrees to purchase current parcel of land. Joan and Liz begin fundraising for $400,000 in gifts and loans.
- Jan., 1992 EVI receives non-profit status from IRS, holds First Annual Meeting: bylaws are adopted, Board of Directors is elected.
- March, 1992 First meeting of EcoVillage residents group takes place with 50 people attending.
- June 23, 1992 Land Closing on 176 acres. Westhaven Farm?

- Summer '93 First resident group, or "FROG" hires Jerry and Claudia Weisburd as development consultants. First harvest of Jen and John Bokaer-Smith's organic CSA farm, which leases 3 acres from EVI.
- Summer-Fall '95 Final Site Plan approval for FROG granted July 18, after 11 months of Town Planning Board meetings. Labor Day ground-breaking ceremony attracts 200 people. Road, sewer, water and pond built.
- Spring '96 EVI sets aside 55 acres for a permanent conservation easement administered by the Finger Lakes Land Trust, in response to a request from Bill and Mary Webber who forgave their $130,000 loan for the land.
- Fall '96 First families move into FROG in October. FROG suffers major construction fire on Nov. 16. Eight homes and the Common House are burned to the ground, and six other homes are damaged. Joan Bokaer retires from her role as co-director. Second neighborhood group begins to form under the guidance of Liz Walker.
- Summer-Fall '97 Completion of FROG. Common House opened in August for first time.
- 1998 EVI named a finalist for the World Habitat Award (one of five in developed nations).

- 1999 SONG hires Rod Lambert and Liz Walker as co-development managers. Katie Creeger leases 5 acres of EVI land to start an organic berry farm.
- 2000 EVI secures low-interest $100,000 loan from Equity Trust Fund in October, to help SONG build infrastructure.
- 2001 Mike Carpenter is hired as SONG construction manager. SONG receives final Town approvals. Groundbreaking on the infrastructure for SONG begins.
- 2002 EcoVillage doubles in size! Verse I , the first fourteen homes of SONG are completed and residents move in. Verse II, the next sixteen homes are started. EVI becomes the first cohousing group in the country to construct two neighborhoods. EVI forms partnership with Ithaca College Environmental Studies Department, which together receive a three-year National Science Foundation grant.
- 2003 This year stands out as the year we became a village. SONG homes are completed. An intensive Common House design process starts, with the CH slated to be built in

1 / 2History of EVI (in brief!)

2005. The "Debt-Free in 2003"campaign is a success, and the mortgages on the land are completely paid off. Educational work takes off, with two Ithaca College courses taught by EVI residents (continued every year since then), and mini-grants given out to IC faculty and EVI residents.

- 2004 Educational work on sustainability really takes off, with the collaboration of IC/EVI/and Cooperative Extension to launch "Sustainable Tompkins County". Ithaca College holds its first "Sustainability Summit" and makes a major commitment to sustainability.

Gaia Education

, a project of the Global EcoVillage Network, forms at Findhorn, Scotland, to develop a world-wide ecovillage design curriculum. Liz Walker serves on the founding board of directors.

- 2005 EcoVillage at Ithaca: Pioneering a Sustainable Culture is published by New Society Publishers. Design Charette with architect Greg Ramsey takes place for Master Site Plan, after multiple village-wide Big Picture Forums are held and Guidelines for Development are revised. Ground-breaking for SoNG CH.
- 2006 First year of education workshop program led by Liz Walker and Elan Shapiro (based on Gaia Education training). Partnership with Ithaca College is adopted by I.C. as permanent part of their budget.

Kestrel's Perch Berry Farm opens,

as first U-Pick, organic, berry farm CSA in country.

Song CH completed

- 2007 Root cellar constructed, designed by Ithaca College Students and built by EVI residents. Passive solar bus shelter completed. Goals for Development approved to guide planning process for future development. $25,000 grant received from a local foundation to explore creating an EcoVillage Education Center.

TREE (third neighborhood) begins to meet

, aiming for small, affordable and accessible homes.

- 2008 Big Picture committee introduces new Site Design process, which includes potential designs from residents. Green designer Steve Bauman is hired to help complete the process. Cornell President David Skorton speaks at a fundraising dinner at EVI for the Institute for Sustainable Agriculture (part of the EVI Ed. Center). EcoVillage Center for Sustainability Education feasibility study completed.

APPENDIX C – Other Sustainable Housing Options

The Low Impact Woodland Home in Wales was not chosen to perform a TBL on because it did not provide enough information to perform a proper TBL analysis on and it was a single-housing unit. A picture of the home may be seen below in Figure 1Figure 5.

Figure 5 - A Low Impact Woodland Home

O.U.R. Ecovillage was a runner-up; however it lacked detailed information that would allow for a proper TBL analysis to be performed. In Figure 6 below, a picture of the Ecovillage may be seen.

Figure 6 - O.U.R. Ecovillage