EXHIBIT G

Escanaba Township

DRAFT Groundwater/Surface Water Protections for Solar Farm Development and Operation – Ordinance Format

January 26, 2020

1. Purpose and Background
    a. The residents of Escanaba Township depend exclusively on groundwater from domestic supply wells for a safe drinking water supply. The purpose of this section is for managing potential risks to groundwater used for water supply in Escanaba Township that could result from utility-scale solar farm development and operation
    b. The natural setting of Escanaba Township creates susceptibility of surficial contamination reaching shallow limestone bedrock aquifer and impacting supply wells in that aquifer zone.
    c. Two areas of known groundwater bacterial contamination exist in Escanaba Township referred to as Carroll's Corners and Flat Rock. These areas have special water well construction requirements by the Public Health, Delta and Menominee (PHDM) Counties Environmental Services Division that requires all new wells to be properly constructed into a deeper aquifer formation to avoid surficially contaminated groundwater.
    d. Utility-scale solar farms by design and operation do not use groundwater or hazardous substances that pose known risks to groundwater quality.
    e. Construction of photovoltaic (PV) panel support structures require pile foundations in soil or shallow bedrock that need to be built and maintained in a manner that does not increase risk of surface water entering shallow bedrock.

2. Water Resources Protection From Utility-Scale Solar Farm Development and Operation
    a. Surface Water Protection –
        i. PV support structures shall not be built or installed in inland lakes, ponds, streams, or wetlands to avoid the potential of directly connecting surface water into subsurface geological formations during construction or operation.
    b. Groundwater Protection –
        i. PV support structures (piles or other foundations) may be installed into unconsolidated soils or shallow bedrock (limestone located above the local "Blue Shale" stratigraphic horizon) using the following techniques:
            1. Piles or foundations terminating in unconsolidated soils above bedrock: Piles or foundations terminating in unconsolidated soils may be drilled or driven with standard construction techniques. Bentonite grout or dry bentonite pellets or chips shall be placed at the surface around piles while driving or installing helical piles with drive heads. Final grade of the surface seal shall be away from the pile.
            2. Piles or foundations installed in shallow bedrock shall be installed with grout seals from the base of the pile to ground surface.

Grouting materials shall comply with standards of the Michigan Well Construction Code and Michigan Building Code. Final grade of the surface seal shall be away from the pile

a. PV support piles or structures that are removed shall include grouting of any abandonment hole with grout materials that comply with standards of the Michigan Well Construction Code.

c. Storm water management
    i. Storm water in PV support structure areas shall be managed in such a way that does not create surface pooling of water around support foundation structures at the ground surface.
    ii. Infiltration basins for storm water management shall not be constructed in PV areas unless specific constructing features are designed and approved by the Township

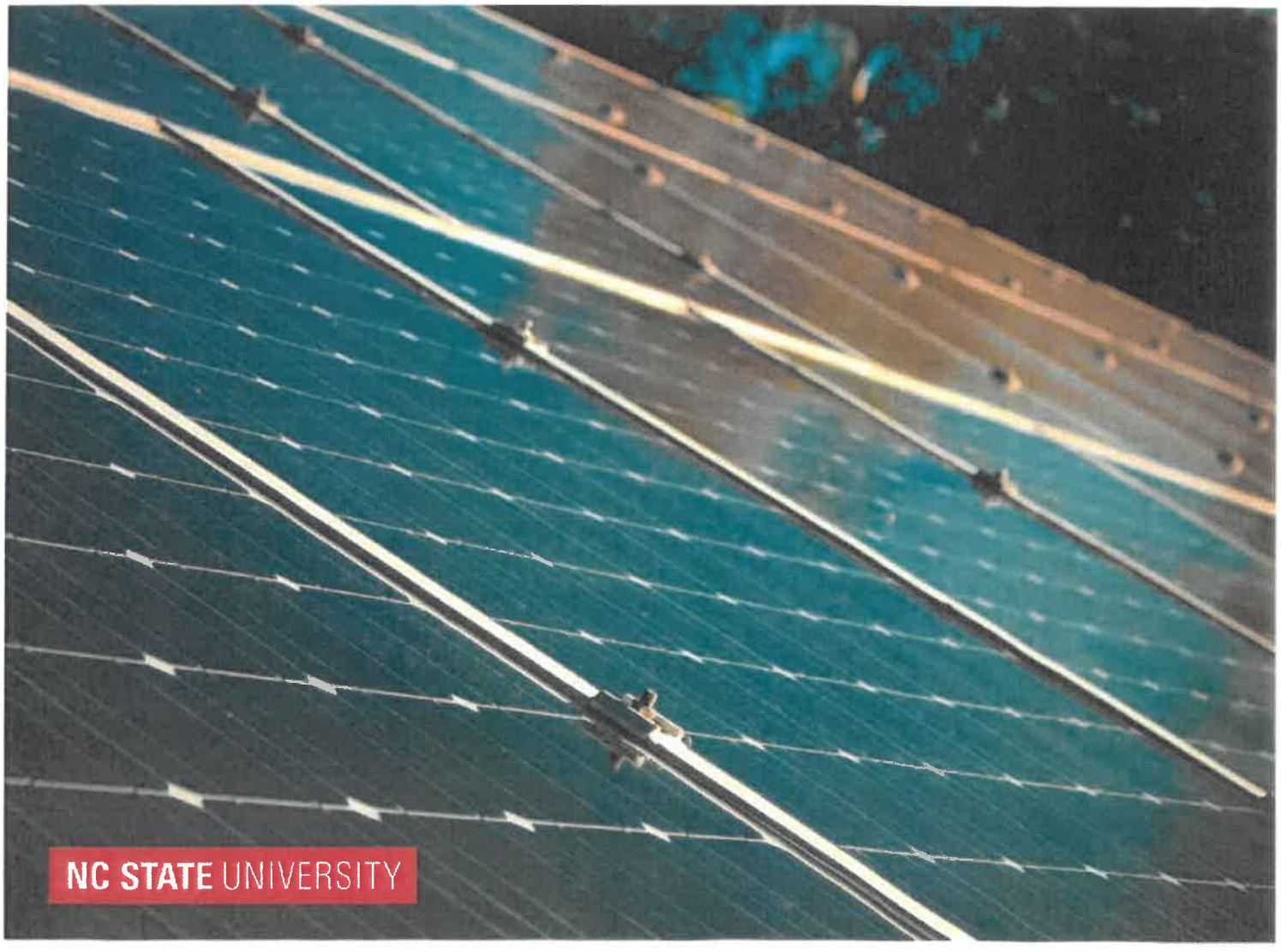
3. Areas of Known Groundwater Contamination
    a. Baseline Site conditions
        i. Two areas of known bacterial contamination in shallow groundwater are known in Escanaba Township defined as the Carroll's Corners area and the Flat Rock area.
            1. These areas are mapped in the Escanaba Township Draft Master Plan dated September 27, 2018
            2. These areas have special water well construction requirements imposed by PHDM
    b. PV development or operations within these two areas shall maintain a minimum horizontal isolation distance of 100 feet from operating water wells within these two areas. The isolation distance will protect from any inadvertent penetrate into residual agricultural or domestic waste sources in surface soils in the PV construction areas.
    c. New water wells constructed in this area shall be located outside of a minimum of 100 feet from PV structures and foundations.

EXHIBIT H

NC CLEAN ENERGY
TECHNOLOGY CENTER

Health and Safety Impacts of Solar Photovoltaics

MAY 2017



NC CLEAN ENERGY TECHNOLOGY CENTER

NC STATE UNIVERSITY

Health and Safety Impacts of Solar Photovoltaics

The increasing presence of utility-scale solar photovoltaic (PV) systems (sometimes referred to as solar farms) is a rather new development in North Carolina's landscape. Due to the new and unknown nature of this technology, it is natural for communities near such developments to be concerned about health and safety impacts. Unfortunately, the quick emergence of utility-scale solar has cultivated fertile grounds for myths and half-truths about the health impacts of this technology, which can lead to unnecessary fear and conflict.

Photovoltaic (PV) technologies and solar inverters are not known to pose any significant health dangers to their neighbors. The most important dangers posed are increased highway traffic during the relative short construction period and dangers posed to trespassers of contact with high voltage equipment. This latter risk is mitigated by signage and the security measures that industry uses to deter trespassing. As will be discussed in more detail below, risks of site contamination are much less than for most other industrial uses because PV technologies employ few toxic chemicals and those used are used in very small quantities. Due to the reduction in the pollution from fossil-fuel-fired electric generators, the overall impact of solar development on human health is overwhelmingly positive. This pollution reduction results from a partial replacement of fossil-fuel fired generation by emission-free PV-generated electricity, which reduces harmful sulfur dioxide (SO_2), nitrogen oxides (NO_x), and fine particulate matter ($PM_{2.5}$). Analysis from the National Renewable Energy Laboratory and the Lawrence Berkeley National Laboratory, both affiliates of the U.S. Department of Energy, estimates the health-related air quality benefits to the southeast region from solar PV generators to be worth 8.0 ¢ per kilowatt-hour of solar generation..[1] This is in addition to the value of the electricity and suggests that the air quality benefits of solar are worth more than the electricity itself.

Even though we have only recently seen large-scale installation of PV technologies, the technology and its potential impacts have been studied since the 1950s. A combination of this solar-specific research and general scientific research has led to the scientific community having a good understanding of the science behind potential health and safety impacts of solar energy. This paper utilizes the latest scientific literature and knowledge of solar practices in N.C. to address the health and safety risks associated with solar PV technology. These risks are extremely small, far less than those associated with common activities such as driving a car, and vastly outweighed by health benefits of the generation of clean electricity.

This paper addresses the potential health and safety impacts of solar PV development in North Carolina, organized into the following four categories:

(1) Hazardous Materials
(2) Electromagnetic Fields (EMF)
(3) Electric Shock and Arc Flash
(4) Fire Safety

1. Hazardous Materials

One of the more common concerns towards solar is that the panels (referred to as "modules" in the solar industry) consist of toxic materials that endanger public health. However, as shown in this section, solar energy systems may contain small amounts of toxic materials, but these materials do not endanger public health. To understand potential toxic hazards coming from a solar project, one must understand system installation, materials used, the panel end-of-life protocols, and system operation. This section will examine these aspects of a solar farm and the potential for toxicity impacts in the following subsections:

1.1 Project Installation/Construction

The system installation, or construction, process does not require toxic chemicals or processes. The site is mechanically cleared of large vegetation, fences are constructed, and the land is surveyed to layout exact installation locations. Trenches for underground wiring are dug and support posts are driven into the ground. The solar panels are bolted to steel and aluminum support structures and wired together. Inverter pads are installed, and an inverter and transformer are installed on each pad. Once everything is connected, the system is tested, and only then turned on.

Figure 1: Utility-scale solar facility (5 MW_{AC}) located in Catawba County. Source: Strata Solar

1.2 System Components

1.2.1 Solar Panels: Construction and Durability

Solar PV panels typically consist of glass, polymer, aluminum, copper, and semiconductor materials that can be recovered and recycled at the end of their useful life.[2] Today there are two PV technologies used in PV panels at utility-scale solar facilities, silicon, and thin film. As of 2016, all thin film used in North Carolina solar facilities are cadmium telluride (CdTe) panels from the US manufacturer First Solar, but there are other thin film PV panels available on the market, such as Solar Frontier's CIGS panels. Crystalline silicon technology consists of silicon wafers which are made into cells and assembled into panels, thin film technologies consist of thin layers of semiconductor material deposited onto glass, polymer or metal substrates. While there are differences in the components and manufacturing processes of these two types of solar technologies, many aspects of their PV panel construction are very similar. Specifics about each type of PV chemistry as it relates to toxicity are covered in subsections a, b, and c in section 1.2.2; on crystalline silicon, cadmium telluride, and CIS/CIGS respectively. The rest of this section applies equally to both silicon and thin film panels.

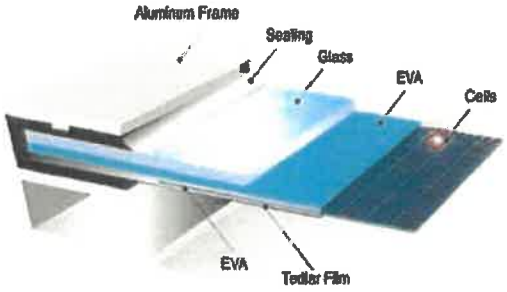


Figure 2: Components of crystalline silicon panels. The vast majority of silicon panels consist of a glass sheet on the topside with an aluminum frame providing structural support. Image Source: www.riteksolar.com.tw

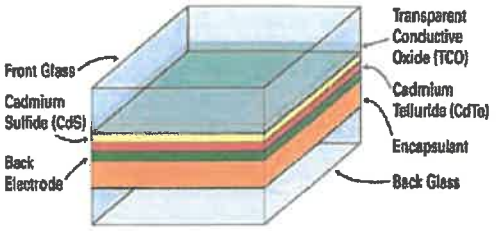


Figure 3: Layers of a common frameless thin-film panel (CdTe). Many thin film panels are frameless, including the most common thin-film panels, First Solar's CdTe. Frameless panels have protective glass on both the front and back of the panel. Layer thicknesses not to scale. Image Source: www.homepower.com

To provide decades of corrosion-free operation, PV cells in PV panels are encapsulated from air and moisture between two layers of plastic. The encapsulation layers are protected on the top with a layer of tempered glass and on the backside with a polymer sheet. Frameless modules include a protective layer of glass on the rear of the panel, which may also be tempered. The plastic ethylene-vinyl acetate (EVA) commonly provides the cell encapsulation. For decades, this same material has been used between layers of tempered glass to give car windshields and hurricane windows their great strength. In the same way that a car windshield cracks but stays intact, the EVA layers in PV panels keep broken panels intact (see Figure 4). Thus, a damaged module does not generally create small pieces of debris; instead, it largely remains together as one piece.

Figure 4: The mangled PV panels in this picture illustrate the nature of broken solar panels; the glass cracks but the panel is still in one piece. Image Source: http://img.alibaba.com/photo/115259576/broken_solar_panel.jpg

PV panels constructed with the same basic components as modern panels have been installed across the globe for well over thirty years..[3] The long-term durability and performance demonstrated over these decades, as well as the results of accelerated lifetime testing, helped lead to an industry-standard 25-year power production warranty for PV panels. These power warranties warrant a PV panel to produce at least 80% of their original nameplate production after 25 years of use. A recent SolarCity and DNV GL study reported that today's quality PV panels should be expected to reliably and efficiently produce power for thirty-five years..[4]

Local building codes require all structures, including ground mounted solar arrays, to be engineered to withstand anticipated wind speeds, as defined by the local wind speed requirements. Many racking products are available in versions engineered for wind speeds of up to 150 miles per hour, which is significantly higher than the wind speed requirement anywhere in North Carolina. The strength of PV mounting structures were demonstrated during Hurricane Sandy in 2012 and again during Hurricane Matthew in 2016. During Hurricane Sandy, the many large-scale solar facilities in New Jersey and New York at that time suffered only minor damage..[5] In the fall of 2016, the US and Caribbean experienced destructive winds and torrential rains from Hurricane Matthew, yet one leading solar tracker manufacturer reported that their numerous systems in the impacted area received zero damage from wind or flooding..[6]

In the event of a catastrophic event capable of damaging solar equipment, such as a tornado, the system will almost certainly have property insurance that will cover the cost to cleanup and repair the project. It is in the best interest of the system owner to protect their investment against such risks. It is also in their interest to get the project repaired and producing full power as soon as possible. Therefore, the investment in adequate insurance is a wise business practice for the system owner. For the same

reasons, adequate insurance coverage is also generally a requirement of the bank or firm providing financing for the project.

1.2.2 Photovoltaic (PV) Technologies

a. Crystalline Silicon

This subsection explores the toxicity of silicon-based PV panels and concludes that they do not pose a material risk of toxicity to public health and safety. Modern crystalline silicon PV panels, which account for over 90% of solar PV panels installed today, are, more or less, a commodity product. The overwhelming majority of panels installed in North Carolina are crystalline silicon panels that are informally classified as Tier I panels. Tier I panels are from well-respected manufacturers that have a good chance of being able to honor warranty claims. Tier I panels are understood to be of high quality, with predictable performance, durability, and content. Well over 80% (by weight) of the content of a PV panel is the tempered glass front and the aluminum frame, both of which are common building materials. Most of the remaining portion are common plastics, including polyethylene terephthalate in the backsheet, EVA encapsulation of the PV cells, polyphenyl ether in the junction box, and polyethylene insulation on the wire leads. The active, working components of the system are the silicon photovoltaic cells, the small electrical leads connecting them together, and to the wires coming out of the back of the panel. The electricity generating and conducting components makeup less than 5% of the weight of most panels. The PV cell itself is nearly 100% silicon, and silicon is the second most common element in the Earth's crust. The silicon for PV cells is obtained by high-temperature processing of quartz sand (SiO_2) that removes its oxygen molecules. The refined silicon is converted to a PV cell by adding extremely small amounts of boron and phosphorus, both of which are common and of very low toxicity.

The other minor components of the PV cell are also generally benign; however, some contain lead, which is a human toxicant that is particularly harmful to young children. The minor components include an extremely thin antireflective coating (silicon nitride or titanium dioxide), a thin layer of aluminum on the rear, and thin strips of silver alloy that are screen-printed on the front and rear of cell.[7] In order for the front and rear electrodes to make effective electrical contact with the proper layer of the PV cell, other materials (called glass frit) are mixed with the silver alloy and then heated to etch the metals into the cell. This glass frit historically contains a small amount of lead (Pb) in the form of lead oxide. The 60 or 72 PV cells in a PV panel are connected by soldering thin solder-covered copper tabs from the back of one cell to the front of the next cell. Traditionally a tin-based solder containing some lead (Pb) is used, but some manufacturers have switched to lead-free solder. The glass frit and/or the solder may contain trace amounts of other metals, potentially including some with human toxicity such as cadmium. However, testing to simulate the potential for leaching from broken panels, which is discussed in more detail below, did not find a potential toxicity threat from these trace elements. Therefore, the tiny amount of lead in the grass frit and the solder is the only part of silicon PV panels with a potential to create a negative health impact. However, as described below, the very limited amount of lead involved and its strong physical and chemical attachment to other components of the PV panel means that even in worst-case scenarios the health hazard it poses is insignificant.

As with many electronic industries, the solder in silicon PV panels has historically been a lead-based solder, often 36% lead, due to the superior properties of such solder. However, recent advances in lead-free solders have spurred a trend among PV panel manufacturers to reduce or remove the lead in their panels. According to the 2015 Solar Scorecard from the Silicon Valley Toxics Coalition, a group that tracks environmental responsibility of photovoltaic panel manufacturers, fourteen companies (increased from twelve companies in 2014) manufacture PV panels certified to meet the European Restriction of

Hazardous Substances (RoHS) standard. This means that the amount of cadmium and lead in the panels they manufacture fall below the RoHS thresholds, which are set by the European Union and serve as the world's de facto standard for hazardous substances in manufactured goods..[8] The Restriction of Hazardous Substances (RoHS) standard requires that the maximum concentration found in any homogenous material in a produce is less than 0.01% cadmium and less than 0.10% lead, therefore, any solder can be no more than 0.10% lead..[9]

While some manufacturers are producing PV panels that meet the RoHS standard, there is no requirement that they do so because the RoHS Directive explicitly states that the directive does not apply to photovoltaic panels..[10] The justification for this is provided in item 17 of the current RoHS Directive: "The development of renewable forms of energy is one of the Union's key objectives, and the contribution made by renewable energy sources to environmental and climate objectives is crucial. Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources (4) recalls that there should be coherence between those objectives and other Union environmental legislation. Consequently, this Directive should not prevent the development of renewable energy technologies that have no negative impact on health and the environment and that are sustainable and economically viable."

The use of lead is common in our modern economy. However, only about 0.5% of the annual lead consumption in the U.S. is for electronic solder for all uses; PV solder makes up only a tiny portion of this 0.5%. Close to 90% of lead consumption in the US is in batteries, which do not encapsulate the pounds of lead contained in each typical automotive battery. This puts the lead in batteries at great risk of leaching into the environment. Estimates for the lead in a single PV panel with lead-based solder range from 1.6 to 24 grams of lead, with 13g (less than half of an ounce) per panel seen most often in the literature..[11] At 13 g/panel.[12], each panel contains one-half of the lead in a typical 12-gauge shotgun shell.. This amount equates to roughly 1/750th of the lead in a single car battery. In a panel, it is all durably encapsulated from air or water for the full life of the panel..[14]

As indicated by their 20 to 30-year power warranty, PV modules are designed for a long service life, generally over 25 years. For a panel to comply with its 25-year power warranty, its internal components, including lead, must be sealed from any moisture. Otherwise, they would corrode and the panel's output would fall below power warranty levels. Thus, the lead in operating PV modules is not at risk of release to the environment during their service lifetime. In extreme experiments, researchers have shown that lead can leach from crushed or pulverized panels..[15, .16] However, more real-world tests designed to represent typical trash compaction that are used to classify waste as hazardous or non-hazardous show no danger from leaching..[17, .18] For more information about PV panel end-of-life, see the Panel Disposal section.

As illustrated throughout this section, silicon-based PV panels do not pose a material threat to public health and safety. The only aspect of the panels with potential toxicity concerns is the very small amount of lead in some panels. However, any lead in a panel is well sealed from environmental exposure for the operating lifetime of the solar panel and thus not at risk of release into the environment.

b. Cadmium Telluride (CdTe) PV Panels

This subsection examines the components of a cadmium telluride (CdTe) PV panel. Research demonstrates that they pose negligible toxicity risk to public health and safety while significantly reducing the public's exposure to cadmium by reducing coal emissions. As of mid-2016, a few hundred MWs of

cadmium telluride (CdTe) panels, all manufactured by the U.S. company First Solar, have been installed in North Carolina.

Questions about the potential health and environmental impacts from the use of this PV technology are related to the concern that these panels contain cadmium, a toxic heavy metal. However, scientific studies have shown that cadmium telluride differs from cadmium due to its high chemical and thermal stability..[19] Research has shown that the tiny amount of cadmium in these panels does not pose a health or safety risk..[20] Further, there are very compelling reasons to welcome its adoption due to reductions in unhealthy pollution associated with burning coal. Every GWh of electricity generated by burning coal produces about 4 grams of cadmium air emissions..[21] Even though North Carolina produces a significant fraction of our electricity from coal, electricity from solar offsets much more natural gas than coal due to natural gas plants being able to adjust their rate of production more easily and quickly. If solar electricity offsets 90% natural gas and 10% coal, each 5-megawatt (5 MW_{AC}, which is generally 7 MW_{DC}) CdTe solar facility in North Carolina keeps about 157 grams, or about a third of a pound, of cadmium *out of* our environment..[22, 23]

Cadmium is toxic, but all the approximately 7 grams of cadmium in one CdTe panel is in the form of a chemical compound cadmium telluride, .[24] which has 1/100th the toxicity of free cadmium..[25]. Cadmium telluride is a very stable compound that is non-volatile and non-soluble in water. Even in the case of a fire, research shows that less than 0.1% of the cadmium is released when a CdTe panel is exposed to fire. The fire melts the glass and encapsulates over 99.9% of the cadmium in the molten glass..[27]

It is important to understand the source of the cadmium used to manufacture CdTe PV panels. The cadmium is a byproduct of zinc and lead refining. The element is collected from emissions and waste streams during the production of these metals and combined with tellurium to create the CdTe used in PV panels. If the cadmium were not collected for use in the PV panels or other products, it would otherwise either be stockpiled for future use, cemented and buried, or disposed of..[28] Nearly all the cadmium in old or broken panels can be recycled which can eventually serve as the primary source of cadmium for new PV panels..[29]

Similar to silicon-based PV panels, CdTe panels are constructed of a tempered glass front, one instead of two clear plastic encapsulation layers, and a rear heat strengthened glass backing (together >98% by weight). The final product is built to withstand exposure to the elements without significant damage for over 25 years. While not representative of damage that may occur in the field or even at a landfill, laboratory evidence has illustrated that when panels are ground into a fine powder, very acidic water is able to leach portions of the cadmium and tellurium,.[30] similar to the process used to recycle CdTe panels. Like many silicon-based panels, CdTe panels are reported (as far back ask 1998.[31]) to pass the EPA's Toxic Characteristic Leaching Procedure (TCLP) test, which tests the potential for crushed panels in a landfill to leach hazardous substances into groundwater..[32] Passing this test means that they are classified as non-hazardous waste and can be deposited in landfills..[33],.[34] For more information about PV panel end-of-life, see the Panel Disposal section.

There is also concern of environmental impact resulting from potential catastrophic events involving CdTe PV panels. An analysis of worst-case scenarios for environmental impact from CdTe PV panels, including earthquakes, fires, and floods, was conducted by the University of Tokyo in 2013. After reviewing the extensive international body of research on CdTe PV technology, their report concluded, "Even in the worst-case scenarios, it is unlikely that the Cd concentrations in air and sea water will exceed the environmental regulation values.".[35] In a worst-case scenario of damaged panels abandoned on the ground, insignificant amounts of cadmium will leach from the panels. This is because this scenario is

much less conducive (larger module pieces, less acidity) to leaching than the conditions of the EPA's TCLP test used to simulate landfill conditions, which CdTe panels pass..[36]

First Solar, a U.S. company, and the only significant supplier of CdTe panels, has a robust panel take-back and recycling program that has been operating commercially since 2005..[37] The company states that it is "committed to providing a commercially attractive recycling solution for photovoltaic (PV) power plant and module owners to help them meet their module (end of life) EOL obligation simply, cost-effectively and responsibly." First Solar global recycling services to their customers to collect and recycle panels once they reach the end of productive life whether due to age or damage. These recycling service agreements are structured to be financially attractive to both First Solar and the solar panel owner. For First Solar, the contract provides the company with an affordable source of raw materials needed for new panels and presumably a diminished risk of undesired release of Cd. The contract also benefits the solar panel owner by allowing them to avoid tipping fees at a waste disposal site. The legal contract helps provide peace of mind by ensuring compliance by both parties when considering the continuing trend of rising disposal costs and increasing regulatory requirements.

c. CIS/CIGS and other PV technologies

Copper indium gallium selenide PV technology, often referred to as CIGS, is the second most common type of thin-film PV panel but a distant second behind CdTe. CIGS cells are composed of a thin layer of copper, indium, gallium, and selenium on a glass or plastic backing. None of these elements are very toxic, although selenium is a regulated metal under the Federal Resource Conservation and Recovery Act (RCRA)..[38] The cells often also have an extremely thin layer of cadmium sulfide that contains a tiny amount of cadmium, which is toxic. The promise of high efficiency CIGS panels drove heavy investment in this technology in the past. However, researchers have struggled to transfer high efficiency success in the lab to low-cost full-scale panels in the field..[39] Recently, a CIGS manufacturer based in Japan, Solar Frontier, has achieved some market success with a rigid, glass-faced CIGS module that competes with silicon panels. Solar Frontier produces the majority of CIS panels on the market today..[40] Notably, these panels are RoHS compliant,.[41] thus meeting the rigorous toxicity standard adopted by the European Union even thought this directive exempts PV panels. The authors are unaware of any completed or proposed utility-scale system in North Carolina using CIS/CIGS panels.

1.2.3 Panel End-of-Life Management

Concerns about the volume, disposal, toxicity, and recycling of PV panels are addressed in this subsection. To put the volume of PV waste into perspective, consider that by 2050, when PV systems installed in 2020 will reach the end of their lives, it is estimated that the global annual PV panel waste tonnage will be 10% of the 2014 global e-waste tonnage..[42] In the U.S., end-of-life disposal of solar products is governed by the Federal Resource Conservation and Recovery Act (RCRA), as well as state policies in some situations. RCRA separates waste into hazardous (not accepted at ordinary landfill) and solid waste (generally accepted at ordinary landfill) based on a series of rules. According to RCRA, the way to determine if a PV panel is classified as hazardous waste is the Toxic Characteristic Leaching Procedure (TCLP) test. This EPA test is designed to simulate landfill disposal and determine the risk of hazardous substances leaching out of the landfill..[43,44,45] Multiple sources report that most modern PV panels (both crystalline silicon and cadmium telluride) pass the TCLP test..[46,47] Some studies found that some older (1990s) crystalline silicon panels, and perhaps some newer crystalline silicon panels (specifics are not given about vintage of panels tested), do not pass the lead (Pb) leachate limits in the TCLP test..[48, 49]

The test begins with the crushing of a panel into centimeter-sized pieces. The pieces are then mixed in an acid bath. After tumbling for eighteen hours, the fluid is tested for forty hazardous substances that all must be below specific threshold levels to pass the test. Research comparing TCLP conditions to conditions of damaged panels in the field found that simulated landfill conditions provide overly conservative estimates of leaching for field-damaged panels..[50] Additionally, research in Japan has found no detectable Cd leaching from cracked CdTe panels when exposed to simulated acid rain..[51]

Although modern panels can generally be landfilled, they can also be recycled. Even though recent waste volume has not been adequate to support significant PV-specific recycling infrastructure, the existing recycling industry in North Carolina reports that it recycles much of the current small volume of broken PV panels. In an informal survey conducted by the NC Clean Energy Technology Center survey in early 2016, seven of the eight large active North Carolina utility-scale solar developers surveyed reported that they send damaged panels back to the manufacturer and/or to a local recycler. Only one developer reported sending damaged panels to the landfill.

The developers reported at that time that they are usually paid a small amount per panel by local recycling firms. In early 2017, a PV developer reported that a local recycler was charging a small fee per panel to recycle damaged PV panels. The local recycling firm known to authors to accept PV panels described their current PV panel recycling practice as of early 2016 as removing the aluminum frame for local recycling and removing the wire leads for local copper recycling. The remainder of the panel is sent to a facility for processing the non-metallic portions of crushed vehicles, referred to as "fluff" in the recycling industry..[52] This processing within existing general recycling plants allows for significant material recovery of major components, including glass which is 80% of the module weight, but at lower yields than PV-specific recycling plants. Notably almost half of the material value in a PV panel is in the few grams of silver contained in almost every PV panel produced today. In the long-term, dedicated PV panel recycling plants can increase treatment capacities and maximize revenues resulting in better output quality and the ability to recover a greater fraction of the useful materials..[53] PV-specific panel recycling technologies have been researched and implemented to some extent for the past decade, and have been shown to be able to recover over 95% of PV material (semiconductor) and over 90% of the glass in a PV panel..[54]

A look at global PV recycling trends hints at the future possibilities of the practice in our country. Europe installed MW-scale volumes of PV years before the U.S. In 2007, a public-private partnership between the European Union and the solar industry set up a voluntary collection and recycling system called PV CYCLE. This arrangement was later made mandatory under the EU's WEEE directive, a program for waste electrical and electronic equipment..[55] Its member companies (PV panel producers) fully finance the association. This makes it possible for end-users to return the member companies' defective panels for recycling at any of the over 300 collection points around Europe without added costs. Additionally, PV CYCLE will pick up batches of 40 or more used panels at no cost to the user. This arrangement has been very successful, collecting and recycling over 13,000 tons by the end of 2015..[56]

In 2012, the WEEE Directive added the end-of-life collection and recycling of PV panels to its scope..[57] This directive is based on the principle of extended-producer-responsibility. It has a global impact because producers that want to sell into the EU market are legally responsible for end-of-life management. Starting in 2018, this directive targets that 85% of PV products "put in the market" in Europe are recovered and 80% is prepared for reuse and recycling.

The success of the PV panel collection and recycling practices in Europe provides promise for the future of recycling in the U.S. In mid-2016, the US Solar Energy Industry Association (SEIA) announced that they are starting a national solar panel recycling program with the guidance and support of many

leading PV panel producers..[58] The program will aggregate the services offered by recycling vendors and PV manufacturers, which will make it easier for consumers to select a cost-effective and environmentally responsible end-of-life management solution for their PV products. According to SEIA, they are planning the program in an effort to make the entire industry landfill-free. In addition to the national recycling network program, the program will provide a portal for system owners and consumers with information on how to responsibly recycle their PV systems.

While a cautious approach toward the potential for negative environmental and/or health impacts from retired PV panels is fully warranted, this section has shown that the positive health impacts of reduced emissions from fossil fuel combustion from PV systems more than outweighs any potential risk. Testing shows that silicon and CdTe panels are both safe to dispose of in landfills, and are also safe in worst case conditions of abandonment or damage in a disaster. Additionally, analysis by local engineers has found that the current salvage value of the equipment in a utility scale PV facility generally exceeds general contractor estimates for the cost to remove the entire PV system..[59, 60, 61]

1.2.4 Non-Panel System Components (racking, wiring, inverter, transformer)

While previous toxicity subsections discussed PV panels, this subsection describes the non-panel components of utility-scale PV systems and investigates any potential public health and safety concerns. The most significant non-panel component of a ground-mounted PV system is the mounting structure of the rows of panels, commonly referred to as "racking". The vertical post portion of the racking is galvanized steel and the remaining above-ground racking components are either galvanized steel or aluminum, which are both extremely common and benign building materials. The inverters that make the solar generated electricity ready to send to the grid have weather-proof steel enclosures that protect the working components from the elements. The only fluids that they might contain are associated with their cooling systems, which are not unlike the cooling system in a computer. Many inverters today are RoHS compliant.

The electrical transformers (to boost the inverter output voltage to the voltage of the utility connection point) do contain a liquid cooling oil. However, the fluid used for that function is either a non-toxic mineral oil or a biodegradable non-toxic vegetable oil, such as BIOTEMP from ABB. These vegetable transformer oils have the additional advantage of being much less flammable than traditional mineral oils. Significant health hazards are associated with old transformers containing cooling oil with toxic PCBs. Transfers with PCB-containing oil were common before PCBs were outlawed in the U.S. in 1979. PCBs still exist in older transformers in the field across the country.

Other than a few utility research sites, there are no batteries on- or off-site associated with utility-scale solar energy facilities in North Carolina, avoiding any potential health or safety concerns related to battery technologies. However, as battery technologies continue to improve and prices continue to decline we are likely to start seeing some batteries at solar facilities. Lithium ion batteries currently dominate the world utility-scale battery market, which are not very toxic. No non-panel system components were found to pose any health or environmental dangers.

1.4 Operations and Maintenance – Panel Washing and Vegetation Control

Throughout the eastern U.S., the climate provides frequent and heavy enough rain to keep panels adequately clean. This dependable weather pattern eliminates the need to wash the panels on a regular basis. Some system owners may choose to wash panels as often as once a year to increase production, but most in N.C. do not regularly wash any PV panels. Dirt build up over time may justify panel washing a few times over the panels' lifetime; however, nothing more than soap and water are required for this activity.

The maintenance of ground-mounted PV facilities requires that vegetation be kept low, both for aesthetics and to avoid shading of the PV panels. Several approaches are used to maintain vegetation at NC solar facilities, including planting of limited-height species, mowing, weed-eating, herbicides, and grazing livestock (sheep). The following descriptions of vegetation maintenance practices are based on interviews with several solar developers as well as with three maintenance firms that together are contracted to maintain well over 100 of the solar facilities in N.C. The majority of solar facilities in North Carolina maintain vegetation primarily by mowing. Each row of panels has a single row of supports, allowing sickle mowers to mow under the panels. The sites usually require mowing about once a month during the growing season. Some sites employ sheep to graze the site, which greatly reduces the human effort required to maintain the vegetation and produces high quality lamb meat..[62]

In addition to mowing and weed eating, solar facilities often use some herbicides. Solar facilities generally do not spray herbicides over the entire acreage; rather they apply them only in strategic locations such as at the base of the perimeter fence, around exterior vegetative buffer, on interior dirt roads, and near the panel support posts. Also unlike many row crop operations, solar facilities generally use only general use herbicides, which are available over the counter, as opposed to restricted use herbicides commonly used in commercial agriculture that require a special restricted use license. The herbicides used at solar facilities are primarily 2-4-D and glyphosate (Round-up®), which are two of the most common herbicides used in lawns, parks, and agriculture across the country. One maintenance firm that was interviewed sprays the grass with a class of herbicide known as a growth regulator in order to slow the growth of grass so that mowing is only required twice a year. Growth regulators are commonly used on highway roadsides and golf courses for the same purpose. A commercial pesticide applicator license is required for anyone other than the landowner to apply herbicides, which helps ensure that all applicators are adequately educated about proper herbicide use and application. The license must be renewed annually and requires passing of a certification exam appropriate to the area in which the applicator wishes to work. Based on the limited data available, it appears that solar facilities in N.C. generally use significantly less herbicides per acre than most commercial agriculture or lawn maintenance services.

2. Electromagnetic Fields (EMF)

PV systems do not emit any material during their operation; however, they do generate electromagnetic fields (EMF), sometimes referred to as radiation. EMF produced by electricity is non-ionizing radiation, meaning the radiation has enough energy to move atoms in a molecule around (experienced as heat), but not enough energy to remove electrons from an atom or molecule (ionize) or to damage DNA. As shown below, modern humans are all exposed to EMF throughout our daily lives without negative health impact. Someone outside of the fenced perimeter of a solar facility is not exposed to significant EMF from the solar facility. Therefore, there is no negative health impact from the EMF

produced in a solar farm. The following paragraphs provide some additional background and detail to support this conclusion.

Since the 1970s, some have expressed concern over potential health consequences of EMF from electricity, but no studies have ever shown this EMF to cause health problems..[63] These concerns are based on some epidemiological studies that found a slight increase in childhood leukemia associated with average exposure to residential power-frequency magnetic fields above 0.3 to 0.4 μT (microteslas) (equal to 3.0 to 4.0 mG (milligauss)). μT and mG are both units used to measure magnetic field strength. For comparison, the average exposure for people in the U.S. is one mG or 0.1 μT, with about 1% of the population with an average exposure in excess of 0.4 μT (or 4 mG)..[64] These epidemiological studies, which found an association but not a causal relationship, led the World Health Organization's International Agency for Research on Cancer (IARC) to classify ELF magnetic fields as "possibly carcinogenic to humans". Coffee also has this classification. This classification means there is limited evidence but not enough evidence to designate as either a "probable carcinogen" or "human carcinogen". Overall, there is very little concern that ELF EMF damages public health. The only concern that does exist is for long-term exposure above 0.4 μT (4 mG) that may have some connection to increased cases of childhood leukemia. In 1997, the National Academies of Science were directed by Congress to examine this concern and concluded:

> "Based on a comprehensive evaluation of published studies relating to the effects of power-frequency electric and magnetic fields on cells, tissues, and organisms (including humans), the conclusion of the committee is that the current body of evidence does not show that exposure to these fields presents a human-health hazard. Specifically, no conclusive and consistent evidence shows that exposures to residential electric and magnetic fields produce cancer, adverse neurobehavioral effects, or reproductive and developmental effects.".[65]

There are two aspects to electromagnetic fields, an electric field and a magnetic field. The electric field is generated by voltage and the magnetic field is generated by electric current, i.e., moving electrons. A task group of scientific experts convened by the World Health Organization (WHO) in 2005 concluded that there were no substantive health issues related to *electric* fields (0 to 100,000 Hz) at levels generally encountered by members of the public..[66] The relatively low voltages in a solar facility and the fact that electric fields are easily shielded (i.e., blocked) by common materials, such as plastic, metal, or soil means that there is no concern of negative health impacts from the electric fields generated by a solar facility. Thus, the remainder of this section addresses magnetic fields. Magnetic fields are not shielded by most common materials and thus can easily pass through them. Both types of fields are strongest close to the source of electric generation and weaken quickly with distance from the source.

The direct current (DC) electricity produced by PV panels produce stationary (0 Hz) electric and magnetic fields. Because of minimal concern about potential risks of stationary fields, little scientific research has examined stationary fields' impact on human health..[67] In even the largest PV facilities, the DC voltages and currents are not very high. One can illustrate the weakness of the EMF generated by a PV panel by placing a compass on an operating solar panel and observing that the needle still points north.

While the electricity throughout the majority of a solar site is DC electricity, the inverters convert this DC electricity to alternating current (AC) electricity matching the 60 Hz frequency of the grid. Therefore, the inverters and the wires delivering this power to the grid are producing non-stationary EMF, known as extremely low frequency (ELF) EMF, normally oscillating with a frequency of 60 Hz. This frequency is at the low-energy end of the electromagnetic spectrum. Therefore, it has less energy than

other commonly encountered types of non-ionizing radiation like radio waves, infrared radiation, and visible light.

The wide use of electricity results in background levels of ELF EMFs in nearly all locations where people spend time – homes, workplaces, schools, cars, the supermarket, etc. A person's average exposure depends upon the sources they encounter, how close they are to them, and the amount of time they spend there..[68] As stated above, the average exposure to magnetic fields in the U.S. is estimated to be around one mG or 0.1 μT, but can vary considerably depending on a person's exposure to EMF from electrical devices and wiring..[69] At times we are often exposed to much higher ELF magnetic fields, for example when standing three feet from a refrigerator the ELF magnetic field is 6 mG and when standing three feet from a microwave oven the field is about 50 mG..[70] The strength of these fields diminish quickly with distance from the source, but when surrounded by electricity in our homes and other buildings moving away from one source moves you closer to another. However, unless you are inside of the fence at a utility-scale solar facility or electrical substation it is impossible to get very close to the EMF sources. Because of this, EMF levels at the fence of electrical substations containing high voltages and currents are considered "generally negligible"..[71], .[72]

The strength of ELF-EMF present at the perimeter of a solar facility or near a PV system in a commercial or residential building is significantly lower than the typical American's average EMF exposure..[73],[74] Researchers in Massachusetts measured magnetic fields at PV projects and found the magnetic fields dropped to very low levels of 0.5 mG or less, and in many cases to less than background levels (0.2 mG), at distances of no more than nine feet from the residential inverters and 150 feet from the utility-scale inverters..[75] Even when measured within a few feet of the utility-scale inverter, the ELF magnetic fields were well below the International Commission on Non-Ionizing Radiation Protection's recommended magnetic field level exposure limit for the general public of 2,000 mG..[76] It is typical that utility scale designs locate large inverters central to the PV panels that feed them because this minimizes the length of wire required and shields neighbors from the sound of the inverter's cooling fans. Thus, it is rare for a large PV inverter to be within 150 feet of the project's security fence.

Anyone relying on a medical device such as pacemaker or other implanted device to maintain proper heart rhythm may have concern about the potential for a solar project to interfere with the operation of his or her device. However, there is no reason for concern because the EMF outside of the solar facility's fence is less than 1/1000 of the level at which manufacturers test for ELF EMF interference, which is 1,000 mG..[77] Manufacturers of potentially affected implanted devices often provide advice on electromagnetic interference that includes avoiding letting the implanted device get too close to certain sources of fields such as some household appliances, some walkie-talkies, and similar transmitting devices. Some manufacturers' literature does not mention high-voltage power lines, some say that exposure in public areas should not give interference, and some advise not spending extended periods of time close to power lines..[78]

3. Electric Shock and Arc Flash Hazards

There is a real danger of electric shock to anyone entering any of the electrical cabinets such as combiner boxes, disconnect switches, inverters, or transformers; or otherwise coming in contact with voltages over 50 Volts..[79] Another electrical hazard is an arc flash, which is an explosion of energy that can occur in a short circuit situation. This explosive release of energy causes a flash of heat and a shockwave, both of which can cause serious injury or death. Properly trained and equipped technicians and electricians know how to safely install, test, and repair PV systems, but there is always some risk of

injury when hazardous voltages and/or currents are present. Untrained individuals should not attempt to inspect, test, or repair any aspect of a PV system due to the potential for injury or death due to electric shock and arc flash, The National Electric Code (NEC) requires appropriate levels of warning signs on all electrical components based on the level of danger determined by the voltages and current potentials. The national electric code also requires the site to be secured from unauthorized visitors with either a six-foot chain link fence with three strands of barbed wire or an eight-foot fence, both with adequate hazard warning signs.

4. Fire Safety

The possibility of fires resulting from or intensified by PV systems may trigger concern among the general public as well as among firefighters. However, concern over solar fire hazards should be limited because only a small portion of materials in the panels are flammable, and those components cannot self-support a significant fire. Flammable components of PV panels include the thin layers of polymer encapsulates surrounding the PV cells, polymer backsheets (framed panels only), plastic junction boxes on rear of panel, and insulation on wiring. The rest of the panel is composed of non-flammable components, notably including one or two layers of protective glass that make up over three quarters of the panel's weight.

Heat from a small flame is not adequate to ignite a PV panel, but heat from a more intense fire or energy from an electrical fault can ignite a PV panel..[80] One real-world example of this occurred during July 2015 in an arid area of California. Three acres of grass under a thin film PV facility burned without igniting the panels mounted on fixed-tilt racks just above the grass..[81] While it is possible for electrical faults in PV systems on homes or commercial buildings to start a fire, this is extremely rare..[82] Improving understanding of the PV-specific risks, safer system designs, and updated fire-related codes and standards will continue to reduce the risk of fire caused by PV systems.

PV systems on buildings can affect firefighters in two primary ways, 1) impact their methods of fighting the fire, and 2) pose safety hazard to the firefighters. One of the most important techniques that firefighters use to suppress fire is ventilation of a building's roof. This technique allows superheated toxic gases to quickly exit the building. By doing so, the firefighters gain easier and safer access to the building, Ventilation of the roof also makes the challenge of putting out the fire easier. However, the placement of rooftop PV panels may interfere with ventilating the roof by limiting access to desired venting locations.

New solar-specific building code requirements are working to minimize these concerns. Also, the latest National Electric Code has added requirements that make it easier for first responders to safely and effectively turn off a PV system. Concern for firefighting a building with PV can be reduced with proper fire fighter training, system design, and installation. Numerous organizations have studied fire fighter safety related to PV. Many organizations have published valuable guides and training programs. Some notable examples are listed below.

- The International Association of Fire Fighters (IAFF) and International Renewable Energy Council (IREC) partnered to create an online training course that is far beyond the PowerPoint click-and-view model. The self-paced online course, "Solar PV Safety for Fire Fighters," features rich video content and simulated environments so fire fighters can practice the knowledge they've learned. www.iaff.org/pvsafetytraining
- Photovoltaic Systems and the Fire Code: Office of NC Fire Marshal
- Fire Service Training, Underwriter's Laboratory

- Firefighter Safety and Response for Solar Power Systems, National Fire Protection Research Foundation
- Bridging the Gap: Fire Safety & Green Buildings, National Association of State Fire Marshalls
- Guidelines for Fire Safety Elements of Solar Photovoltaic Systems, Orange County Fire Chiefs Association
- Solar Photovoltaic Installation Guidelines, California Department of Forestry & Fire Protection, Office of the State Fire Marshall
- PV Safety & Firefighting, Matthew Paiss, Homepower Magazine
- PV Safety and Code Development: Matthew Paiss, Cooperative Research Network

Summary

The purpose of this paper is to address and alleviate concerns of public health and safety for utility-scale solar PV projects. Concerns of public health and safety were divided and discussed in the four following sections: (1) Toxicity, (2) Electromagnetic Fields, (3) Electric Shock and Arc Flash, and (4) Fire. In each of these sections, the negative health and safety impacts of utility-scale PV development were shown to be negligible, while the public health and safety benefits of installing these facilities are significant and far outweigh any negative impacts.

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NC CLEAN ENERGY TECHNOLOGY CENTER

EXHIBIT I

Long Range Agricultural Development Plan

for

Delta County Michigan

October 1988

C O N T E N T S

A C K N O W L E D G E M E N T S

This plan was completed through the efforts and resources of the following organizations and agencies:

... Agricultural Sub Committee of the Delta County Planning Commission

... Delta County Planning Commission

... Delta County Office of the Michigan State University Cooperative Extension Service

... Central U.P. Planning and Development District

... Michigan State University Cooperative Extension Service

... Michigan State University Agricultural Experiment Station

... U.S. Soil Conservation Service

... Delta Soil Conservation District

... Delta-Menominee County District Health Department

... Delta County Building and Zoning Department

... Farmers Home Administration - Delta County Office

... Farm Credit Services - Delta County Regional Office

... Michigan Department of Natural Resources - State Land Use Office

... Hiawathaland Michigan Farm Bureau

F O R W A R D

The primary purpose of the Long Range Agricultural Development Plan is to provide an analysis and recommendations to enhance growth of the agricultural sector in Delta County. This plan is the result of over two years work by a group of dedicated citizens interested in maintaining a strong agriculture component in the economic development of Delta County.

The process began with the gathering of data on the natural resource base and socioeconomic factors affecting the area. This included soil, water and forest resources, land ownership patterns, the agricultural infrastructure, agricultural history and trends within the national and world agricultural economy.

Plans to guide development and expand growth are useless unless they are properly implemented. Because of the difficulties normally associated with implementing plans, the format of the Delta County Plan was altered from the usual to include a situational statement, goal and recommendation for each segment of agriculture. This includes those that are county wide in scope and those that affect specific types of agriculture. In addition, a list of supporting agencies and organizations is included in each segment that has the expertise and resources to assist in accomplishing each goal. While this still does not guarantee implementation of the recommendations, the committee feels it will enhance implementation of the plan.

In addition to this document, the Long Range Agricultural Plan also includes a Fruit Site Inventory for the county under a separate cover. The inventory provides geographic and soil information, air drainage and outlines specific areas in the county best suited for fruit and other frost sensitive crops. Copies of the Fruit Site Inventory are available from the Delta County Planning Commission and local agricultural agencies.

A C R O N Y M S

AI -- Artificial Insemination
ASCS -- Agricultural Stabilization and Conservation Service
BdNCC -- Bay de Noc Community College
CUPBDC -- Central Upper Peninsula Business Development Center
CUPPAD -- Central Upper Peninsula Planning and Development District
DCACofC -- Delta County Area Chamber of Commerce
DCRC -- Delta County Road Commission
DMDHD -- Delta Menominee District Health Department
DS-ISD -- Delta Schoolcraft Intermediate School District
EMAT -- Extension Management Assistance Team
EP STA -- Experiment Station
FB -- Farm Bureau
FCS -- Farm Credit Services
FmHA -- Farmers Home Administration
GIS -- Geographic Information Service
MCIA -- Michigan Crop Improvement Association
MDA -- Michigan Department of Agriculture
MDHIA -- Michigan Dairy Herd Improvement Association
MDNR -- Michigan Department of Natural Resources
MDOT -- Michigan Department of Transportation
MFGA - Michigan Fish Growers Association
MFPA - Michigan Fish Producers Association
MSG - Michigan Sea Grant
MSU -- Michigan State University
MSUCES -- Michigan State University Cooperative Extension Service
MSU EXP STA -- Michigan State University Experiment Station
MTU - Michigan Technological University
NCRAC - North Central Regional Aquaculture Center
NMU -- Northern Michigan University
NMUEIC -- Northern Michigan University Economic Initiative Center

PA -- Public Act
SCD -- Soil Conservation District
SCS -- Soil Conservation Service
UP -- Upper Peninsula
UPS -- United Parcel Service
USDA -- United States Department of Agriculture
USFS -- United States Forest Service
Vo AG -- Vocational Agriculture

I HISTORY

The initial exploration of Delta County began when French explorers frequented the Upper Peninsula area searching for furs along its abundant water routes as early as the 17th century. During the next 100 years, missionaries explored the Upper Peninsula hoping to convert the sparsely settled population of Indians; however, it wasn't until the search for minerals and timber in the 1800s that increasing numbers of people settled in the Upper Peninsula.

Attracted by the huge stands of pine and hardwoods, the Delta County area became a center for sawmill activity, timber harvesters and the associated business and retail outlets needed to support this industry. Early records show the first water powered saw mill in the Flat Rock area in 1832.

As the lumbering industry grew, the demand for food and feed for horses and oxen grew. The result was a slow but steady increase in cleared land, first as small gardens and later expanded fields around the initial settlements. As the timber was removed, farmers moved in and the roots of the present agricultural industry were established. The better soils found in much of Delta County proved ideal for growing forage crops and potatoes. The forage crops were utilized to feed livestock and a broad array of meat, milk, eggs, potatoes and other vegetables began to be grown and sold or bartered locally. Eventually, a number of immigrant groups settled and began farming various areas in the county. These included Finnish in the Rock area, Belgians in St. Nicholas, French in Flat Rock, Polish in South Bark River, Swedish in the Rapid River, Stonington area and French and Anglo Saxons in the Garden Peninsula. While most of these communities have become ethnically mixed over the years, there are still a number of descendents from the original families living and farming the area on land originally cleared by their ancestors.

Farm numbers grew rapidly during the late 1800s and first quarter of the 19th century peaking at over 2,000 farms in the late 1920's and early 30's. With the advent of major technological advancements beginning in the 1930's and 40's, farm size began to increase rapidly and farm numbers began to decrease. Since the 1940's, the above trend has continued to increase its pace resulting in farms of much larger size but fewer in number mirroring the national and world trends in agricultural production.

This overall trend changing to large, more efficient, highly specialized farm units has either directly or indirectly resulted in one other major change: the entrance into the agricultural sector of part time farm operators whose major employment and income is generated off the farm. In these cases, the farms can be either small (10-40 acres or can be as large as several hundred acres) and farm more land and generate more farm income than "large" farms of only 10-15 years ago. The key difference is that the operation is part time and less than 50 percent of family income is generated on the farm.

It is the committees' feeling that the trend to larger "super" farms and part time farms will continue and in fact, be the rule in the future. This is a major premise in developing a Long Range Agricultural Plan.

II SOIL, WATER AND FOREST RESOURCES

Delta County is located in the South central region of the Upper Peninsula and is bordered by Marquette and Alger Counties on the North; Menominee County on the West and South; Schoolcraft County on the East and Big and Little Bays de Noc of Lake Michigan on the East and South, providing the county the longest shoreline of any county in Michigan. Over 80 percent of the land in the county is wooded with the average farmer having over 50 percent of the farm in forest land. This results in farm size actually being larger to provide an adequate amount of cleared land for crop production.

A complete intensive soil survey of Delta County was completed in 1967 and published in the early 1970s. The survey is an excellent resource for in-depth interpretation of agricultural, forestry, recreation and engineering capabilities of county soils. The majority of agricultural land in the county is located on the Onaway, Trenary, Emmet and Longrie series. These soils are characterized by good natural fertility, Ph and drainage and relatively level topography as compared to other U.P. agricultural areas. Stoniness varies according to location, but in general, is not a problem except for isolated cases that are easily discernible through the use of soil maps or on-site inspection. These soils also produce excellent timber yields where the primary growth is northern hardwood forest or planted species of softwood conifers.

In the event of potential agricultural expansion, thousands of acres of productive soil types would be available for conversion to agriculture near all of the present farming locations in the county. Water for irrigation is available or can be developed on most farms from streams, surface runoff impoundments, dug ponds or wells. The cost of development will generally increase in the order listed. Because of the soil types present in the county and the availability of water in most areas, the potential for intensive, specialized types of agriculture is enhanced.

Forest resources are an integral part of Delta County farm operations. While this has generally been an under managed segment of the farm, it is one that has great potential for increasing the profitability of the agricultural sector. The recent addition of a forest management trained professional by the Delta County Soil and Water Conservation District, the establishment of a U.P. Tree Improvement Center in Delta

County by Michigan State University and the availability of private and industrial forest consultants create an atmosphere for greatly increased forest management on private lands in the county and consequently increased profits.

Climatic conditions in Delta County are some of the most favorable in the Upper Peninsula. While the extreme northern part of the county has a short growing season of about 80-90 days, the central and southern parts of the county will vary from 100 to over 130 days. Lake influence along Little and Big Bays de Noc offer many micro climate conditions with the southern half of the Garden Peninsula having the longest frost free season (130 days) in the county. The main agricultural areas of the county will usually receive approximately 2,000 degree days base 50 per year permitting a variety of crops to be grown. Annual precipitation is approximately 32-34 inches of water per year of which about 1/3 is in the form of snow. Annual snowfall is one of the lowest in the Upper Peninsula at under 80 inches per year.

III CURRENT LAND USE AND OWNERSHIP PATTERNS

A key factor in determining the future of agriculture in the county is the current land use and land ownership patterns and what changes, if any, are needed to favor agricultural development.

According to the latest census data (1982) average farm size is 258 acres with a range of 5 acres to over 2,000. Currently, a categorized assessment of farm size indicates that 13 percent of the farms are larger than 500 acres, 40 percent of the farms have 180 to 499 acres, 36 percent have 50 to 179 acres, and 11 percent of the farms are under 50 acres in size. The largest farms are located in the major (prime) agricultural areas of St. Nicholas, Cornell, Flat Rock, Bark River and the Garden Peninsula. These large to super large farms can form the basis for expansion and or maintenance of agricultural production in the prime agricultural areas.

In addition, greater numbers of the 100-200 acre size farms exist in the prime areas of the county along with even larger numbers of 40-100 acre agricultural units. The secondary agriculture areas of Rock, North Delta, Rapid River, the Stonington Peninsula and Ensign contain some 200-400 acre units (a few larger) along with a number of smaller farms. Agriculture in the secondary areas has subsided greatly in the past 20 years; however, it appears that the reason is based more on human expectations and goals than soil and water resources. Assuming this premise is true, there remains a potential for revitalizing these areas through more intensive agricultural use.

Land use patterns have reflected the vitality of agriculture in each area. A higher percentage of land in the prime areas is utilized for row crops, cash crops, alfalfa and small grains than is used in the secondary areas. The major portions of land in the secondary areas are in improved and unimproved forage production with lesser amounts of small grains and little row crop or cash crop production. The same phenomenon is found in land utilization. A much higher percentage of land is intensively managed in the prime areas as compared to the secondary regions.

Of prime concern in the secondary locations is the natural conversion of cropland to shrubs and native tree species. If this continues for another 10-15 years, many of the fields will require excessive expense to convert back to agricultural use. This could be a major hurtle to

overcome in the future use of the agricultural soil base in these areas.

Systems must be explored that address the problems of idle or under utilized agricultural lands, consolidation of ownership or other methods of putting together large land units and unplanned residential development or non agricultural usage of prime and speciality farm lands.

A county wide zoning ordinance was established in the 1970's to address the problems of urban sprawl and strip development as it related to agriculture and to identify and protect the prime and good agricultural and forest land in the county. All but four townships were included in the ordinance; however, these four townships designed their township ordinances to mesh with the county ordinance. While the ordinances have put a measure of control over unplanned development, the county and townships need to incorporate some of the new techniques developed in the past 10 years to further protect the soil and water resource base yet provide a positive atmosphere for agricultural development.

IV AGRICULTURAL INFRASTRUCTURE

Often overlooked in the process of developing the agricultural economy is the existing agricultural infrastructure and its pivotal effect on the industry. As U.P. agricultural counties go, Delta County has a well defined and utilized infrastructure, but one that could change drastically in the next 5-10 years due to declining farm numbers and regional farm service centers.

Present infrastructure includes:

FARM SUPPLIES AND EQUIPMENT

- Two full service feed, seed and fertilizer elevators.
- Two farm equipment dealers - new equipment.
- Three farm equipment dealers - used equipment and parts.
- Two forestry and construction equipment dealers.
- Two farm structure contractors.
- Out of county businesses also supply the county with feed, seed, fertilizer and new equipment sales and service.

PROCESSING/MARKETING FACILITIES

- Two livestock slaughtering plants.
- One farmers market.
- Four farmer/processor plants for dry bean handling.
- Twelve farmer/processor for storage and packaging potatoes.
- One apple cider and apple pack processing plant.
- Three farmer small grain seed processing mills.
- Three maple syrup processors.
- One feeder calf sale yard.
- MMPA and AMPI milk marketing cooperative.

FARM SUPPORT SERVICES

- Several petroleum/bottle gas suppliers.
- Three veterinarians in county and four from out of the county that serve the area.
- State of Michigan Department of Agriculture Diagnostic Lab and U.P. Regional Office.
- U.P. Regional FmHA Office.
- U.P. Regional Farm Credit Services Office.
- County ASCS, SCS, FmHA and MSU Cooperative Extension Offices.

Marketing services for milk is handled by two large milk cooperatives

that serve the county and livestock marketing is provided by trucking services that haul livestock to Wisconsin livestock sales. An annual feeder calf sale is held in Rapid River and private livestock buyers also serve the area. Potato and dry bean marketing is generally done through out-of-county brokerage firms or marketing agencies. The majority of potatoes (those not sold locally) go to the Midwest, South and Eastern regions of the U.S. A similar distribution pattern is in place for the dry bean crop; however, on some years the entire crop of red kidney beans is exported to European countries. Corn, small grains, and forages are primarily fed to livestock with excesses marketed in the U.P. and northern Wisconsin and Michigan areas. Hog and sheep marketing systems are also in place but because of lesser numbers transportation to markets require additional coordination and planning. Fruit and vegetable marketing is generally tailored to meet local demands with little product leaving the immediate county area.

Christmas trees are an increasing commodity with a well established marketing system; however, it is much smaller than some other U.P. counties.

The area is generally served by a good road system that is well maintained and kept free of snow even in the most severe winters. All-season roads (US 2, 41 and M-35 - those without seasonal weight restrictions) bisect the county North, South and East, West; however, lack of all season roads to the potato, bean and dairy regions creates special problems of moving potatoes and beans during the March/April spring breakup period. The county is served by three railroads. A number of trucking firms also serve the area including three locally operated lines and several from outside the area. However, since the federal deregulation of transportation, scheduled service to the area has been much less reliable. Air freight and transportation is available from the Delta County Airport and the county is a regional center for UPS. Natural gas is available in all of the major cities plus several rural areas where two pipelines cross the county.

V. FUTURE TRENDS

Probably no segment of the economy has been through more sweeping changes in the past ten years than the agricultural sector. Some of these changes have, and are being caused by national and international socio-economic conditions, others are the result of technological breakthroughs that many experts believe will revolutionize the industry in the next ten to fifteen years. The combination of these factors has placed the agricultural sector in a major restructuring position some leaders believe will have no historical precedent. The fall out of farms and agri-business has increased rapidly in the past three years as a result of this transition. It is precisely this factor that has prompted agricultural leaders in Delta County to look at the consequences of these impending changes and to address the issue of agricultural survival in our area.

Trying to look into and plan for the future is always a risky undertaking and is particularly so when it is done at the county level. We are obviously not in a position to influence the restructuring of agriculture but will definitely be influenced by it. The course of action must be one of what can we do locally to adjust to the restructuring process and still remain competitive.

The basis for our recommendations will be conditioned by the following futuristic trends:

- Most of the problems facing agriculture are controlled outside of the local agricultural sector. World economic growth and agriculture trade policy reform will shape the future of the industry.
- The key to long range financial planning is to keep costs low, be cost effective and be cautious.
- Farm policy change is evolutionary with no extreme changes at any one time expected but the trend is to a more free market system.
- Marketing will be a key factor in success or failure of major agricultural enterprises. Key to success is quality, service, adequate product, and the use of marketing technology.
- Livestock industry is moving from the West to the Midwest. Vertical integration will become more commonplace in this industry as well as other commodities.

- Overall farm size will continue to expand and the trend to "super" farms will accelerate.
- Mid sized full time farms grossing between $70,000 and $150,000 will be under increased financial pressures and will decrease in numbers.
- Part time farms (farms with 50 percent or more of family income generated off the farm) will continue to increase.
- Farm services: equipment, supplies, marketing, etc., will continue to change from a local to regional or larger service area becoming more costly and inconvenient for the small producer.
- Environmental controls for pesticide use, waste management and erosion will become more restrictive.
- Liability protection availability will have a major impact on specific farm enterprises.
- The availability of credit could have far reaching effects on full time agricultural enterprises.
- Comparative advantage will be a major factor in future direction of the agricultural economy.

VI RECOMMENDATIONS AND STRATEGIES FOR DEVELOPMENT

The Agricultural Sub Committee is very much aware of the pitfalls and difficulty of developing a long-range plan and even more important, implementing such a plan on a voluntary basis. However, the committee believes it is a reachable goal and the recommendations that follow are based on this premise.

A. OVERALL/COUNTY

SITUATION: Delta County's agricultural economy is dependant on a well managed natural resource base, including soils, woodlands, and surface and groundwaters. Damage to the natural environment could occur without adequate agricultural planning, resulting in economic losses. Information concerning the relation of land use practices and the effects on groundwater are available, however, this material is not easily assembled for use.

GOAL: To establish a county wide natural resource information system which will support local decision makers on sound land use and agricultural development. To use this information to make decisions which will help lessen the impact of agricultural practices on the environment.

RECOMMENDATIONS: Promote creation of a geographic information system (GIS) within Delta County. A computerized mapping and analysis system of this design should include informational "layers" including: USSCS soil classifications, current land use inventory, hydrological systems, road networks, land ownership, prime agricultural land and user defined elements. The system should permit easy creation and drafting of map layers at any scale. The system must allow display of multiple layers of information, which are referenced to a common geographic location, to support decisions based on the correlation of the user selected criteria.

SUPPORTING AGENCIES AND ORGANIZATIONS: DMDHD, MDNR, SCS, SCD, MSUCES, MSU EXP STA, county and township governments.

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SITUATION: Farm Credit/Financing. The weakening of the national agricultural economy has been felt in Delta County. Decreased prices for agricultural products, eroding values of agricultural assets, increased cost for operations, and higher prices for short term capital investments are a few of the important factors which have contributed to decreased profitability of agricultural operations. A greater proportion of these influences impacting the agricultural economy are from outside the Delta County area.

Sources and availability of financial credit for agricultural ventures have decreased as a result of lower profitability. Qualifications to receive agricultural credit have also increased further tightening the availability of credit.

Delta County has a weak base for sources of agricultural credit. Few local banks or conventional lending institutions are actively engaged with agricultural loans. There seems to be a lack of interest on the part of these institutions in the local agricultural economy and its importance in providing a base for economic development. Farm Credit Services and locally supported Federal loan and cost sharing programs have either tightened lending practices, experienced budget reductions, or both.

The net result is a weakening of our agricultural structure within the county. This has resulted in fewer agri-business people and more acres of idle land directly impacting the local economy negatively.

GOAL: The primary goal is to develop a plan which will strengthen the local agricultural economy and increase the availability of farm credit.

The secondary goal is to educate the general public and business persons. By increasing their knowledge we can increase the local awareness of the magnitude and importance of agriculture to the areas total economy, thus increasing financial institutions participation in agricultural financing.

RECOMMENDATIONS: Develop a total overall budgetary plan targeted specifically to agriculture. This plan should be designed to support, promote, improve, and enhance agriculture throughout Delta County and at a minimum, maintain adequate funding levels for local agriculture supported programs. In addition, the plan should increase support and funding for special events promotion to increase participation of Ag Day and Ag

Awareness at the U.P. State Fair, and Bay Fest, etc... Financial support for booths and free sample products of Delta County products should be included.

- Farmers must continue to improve their skills in projecting cash flow analysis, record keeping and farm management to provide farm credit organizations and institutions more accurate and realistic information.

- Funding for the Chamber of Commerce Agricultural Committee should be reinstated and used directly to enhance agriculture.

- Political support should be obtained to maintain and increase state and federal assistance within the county, and to provide property tax abatement incentives to organizations or individuals donating use of land for agriculture related promotion and research.

SUPPORTING AGENCIES AND ORGANIZATIONS: FHA, FCS, local banks, MSUCES, DCACofC, farm organizations, CUPBDC.

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SITUATION: Planning and Zoning. While the county and townships have been operating under a county-wide zoning ordinance and similar township ordinances that provide agricultural uses a measure of protection, the ordinances need to be amended to provide additional protection to prime and unique farmlands. In addition, there is a need to develop techniques that are feasible in combining or utilizing land units to provide the most efficient use allowing the creation of large competitive units.

GOAL: To provide an atmosphere and the tools needed to create conditions conducive to agricultural resource expansion while protecting land and water resources.

RECOMMENDATION: It is suggested that the County Planning Commission, in cooperation with township planning commissions, initiate revisions in the county and township zoning ordinances that will insure protection of our basic agricultural land and water resources. It is further recommended that the techniques and suggestions outlined in the Michigan Farmland Trust Publication "Planning and Zoning for Farm Land Protection A Community Based Approach" be used as a guide in implementing these revisions. It is also recommended that a special sub committee be established by the County Planning Commission to research ways and means farmers can utilize to consolidate or put together land units large enough to be competitive in today's agricultural arena. Some possibilities include special long term leasing; crop share arrangements; special associations, districts or other means.

SUPPORTING AGENCIES AND ORGANIZATIONS: CUPPAD, MSUCES, SCS, FB, local government, FCS, FmHA.

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SITUATION: Taxation of Farmland - Farmland taxes continue to rise while farm income and actual land values have fallen in recent years. While state programs such as PA116 provide some relief, taxes are too high in relation to the income producing capacity of the land.

GOAL: Establishment of a more equitable farmland tax structure.

RECOMMENDATION: A concentrated effort needs to be undertaken to bring agricultural land tax assessment in line with its income producing capability. This is a long term project that will require additional legislative action on the state level; however, an important step has already been taken with the implementation of PA116 over 10 years ago. New assessment procedures should be tied in with a PA116 type package to assure the land will remain in agriculture and not be used as a loophole to escape taxation while waiting for property values to escalate and then sell for non agricultural purposes.

Every farmer planning to remain in agriculture should seriously evaluate placing their farm in PA116 regardless of local assessment policy. This provides the best protection currently available on low income years and is an effective tool in keeping land in agricultural production.

SUPPORTING AGENCIES AND ORGANIZATIONS: FB, MSUCES, local government, FmHA, FCS.

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SITUATION: Ground and Surface Water Protection - Delta County has some of the best agricultural soils in the Upper Peninsula; however, many are underlaid by fractured limestone bedrock, three to ten feet below the surface. Little research has been conducted about the transfer of manure, fertilizers and pesticides through the soil into surface and ground water reservoirs and what effects different agricultural systems may have on this process.

GOAL: To protect the surface and ground waters of the county for agricultural and personal use.

RECOMMENDATION: Establish a pilot project in the Garden Peninsula or Bark River-Schaffer area to monitor movement of fertilizers, pesticides, etc., through the soil into the surface and ground waters under different agricultural production systems. This should be a cooperative effort between the DNR, MSU, SCS, the County Health Department and local units of government. Emphasis should be on maintaining agricultural production efficiency while protecting the surface and ground waters of the county.

SUPPORTING AGENCIES AND ORGANIZATIONS: Local and state government officials and agencies, MSUCES, MSU EXP STA, MDNR.

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SITUATION: Vocational Agriculture Education - Agricultural education was eliminated from all of our county public schools years ago and has not been reinstated. However, in the past twenty years, other types of vocational education has expanded rapidly in these school systems. The result has been a basic negative attitude in our school systems towards agriculture and consequently a viewpoint that there is little potential for employment in this industry. It is recognized that agriculture has a definite role in the future development of the area; it is an important one that offers as much or more total employment than most of the vocational programs now being offered.

GOAL: Establishment of a county-wide vocational agriculture program.

RECOMMENDATION: Appointment of a special committee of local agricultural, business and civic leaders to investigate the feasibility of reestablishing a county vocational agriculture program. This committee should meet with area school administrators, the Intermediate School District and Bay de Noc Community College as the active providers in a vocational program. A concept similar to that used by other vocational classes where students are bussed to a central location for specific training may be a possibility.

SUPPORTING AGENCIES AND ORGANIZATIONS: MSUCES, FB, DS-ISD, BdNCC, farm organizations, area school districts.

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SITUATION: Wildlife Crop Damage - Crop damage from wildlife such as deer, geese and other species has increased rapidly in the past five years. It is now at the point where in selected areas, certain crops cannot be grown at a profit. The number one problem is deer in the west half of the county followed by geese in the Garden Peninsula. While the local DNR offices have responded positively through the issuance of special kill permits, increased limits and longer seasons, the problem continues to get worse.

GOAL: Reduce damage from deer and other wildlife to farm and forest crops to a level that economic production of these crops can be maintained.

RECOMMENDATION: A state wildlife damage control policy must be initiated to bring crop and forest losses to acceptable levels. Every avenue of control must be explored including longer seasons, special seasons, kill permits, trapping, removal and compensation for crop losses. The establishment of new species in agricultural areas must be evaluated thoroughly for potential crop damage before these species are introduced. Input from local farmers and forest production personnel should be received prior to management decisions being made that adversely affects agriculture and forest production on private lands. Utilization of various types of leases to increase the harvest of wildlife while providing the farmer and forest landowner income should also be considered.

SUPPORTING AGENCIES AND ORGANIZATIONS: MSUCES, MDNR, local governments, farm organizations, state legislators.

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SITUATION: Agri-business Retention - Delta County is presently served by a variety of agri-business firms and a well developed agricultural infrastructure to serve the agricultural community. This system was developed because of the relatively large agriculture industry within 50 miles of Escanaba and consequently the demand for services. The recent restructuring of agriculture nationwide both at the farm and agri-business levels is putting tremendous pressures on the local agricultural industry and could result in a deterioration of the agricultural infrastructure and our overall agricultural base. If this happens, it will become more expensive to operate and our ability to compete will be severely damaged.

GOAL: To maintain and/or expand our farm and agri-business base by maintaining an effective and economically strong infrastructure to serve agriculture now and in the future.

RECOMMENDATION: Development of a blue ribbon committee comprised of representatives of agri-business, farmers, financial institutions, agencies, government and the Chamber of Commerce to develop recommendations and initiate action to protect and expand our agriculture infrastructure.

Assist agri-business firms in evaluation and improvement of their operations to remain competitive - MSU Agri-business EMAT; Bay de Noc Community College and Central U.P. Business Development Center; Northern Michigan Economic Initiative Center and other sources of assistance can be utilized.

Develop an educational awareness program on the importance of agriculture to the local community and the necessity of maintaining and expanding the agricultural sector of the economy.

SUPPORTING AGENCIES AND ORGANIZATIONS: Local government officials, business leaders, MSU, MSUCES, CUPPAD, BdNCC, CUPBDC, NMUEIC, DCACofC.

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SITUATION: Lowering Production Input Costs - Recent studies throughout the United States have provided solid evidence of lower per unit production costs for the very large farmer. A substantial reduction in the cost of inputs such as fertilizer, feed, seed, chemicals, equipment, etc., is realized through volume purchases available to the large producer. This situation provides a strong competitive edge in lowering production costs and increasing income. Delta County farmers must determine ways to cut overall expenses and lower per unit production costs to remain competitive.

GOAL: Reduce costs of inputs through improved purchasing and operating systems.

RECOMMENDATION: Farmers need to give consideration to cooperative buying arrangements for fertilizer, seed, chemicals and other supplies resulting in volume purchasing and consequent reduction of costs comparable to super farm operations.

Consideration of neighborhood or group purchasing, leasing or share arrangements of large equipment such as combines, planters, etc., that are used for only short periods of time on a seasonal basis thus spreading the cost over more acres and reducing per unit costs.

Cooperative harvesting or planting arrangements using equipment already purchased by different farmers but presently used only on the owners farm. A number of these systems are already in use in some parts of the country and in a few instances, are beginning to be utilized locally.

The use of forward contracts, futures, etc., should be considered in purchasing feed, concentrates, etc., in large volumes at reduced prices. Several farmers may have to group together to build sufficient volume to take advantage of this system.

SUPPORTING AGENCIES AND ORGANIZATIONS - Farm groups, MSUCES, FCS, FmHA, local suppliers.

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SITUATION: Marketing - For many types of farmers, the entire farm income may be generated in one or two sales during the year or in other situations over a period of only a few months. Many times the farmers will take what ever the market provides during the normal sale period of the crop or livestock in question and more often than not, receive the bottom end of the market. It is essential that farmers improve their marketing skills to receive the best possible prices for their products.

GOAL: To improve marketing skills to the point where farmers will receive prices in the upper 50% of the market range for comparable quality and quantity.

RECOMMENDATION: Educational, financial and farm service agencies and organizations should combine their efforts to teach marketing techniques to area farmers who market their own products. The use of the futures market, options, forward contracting, quality control and development, and improved transportation systems should be emphasized.

Farmer marketing/learning groups should be organized by type of farming to increase the effectiveness and implementation of information presented.

These same groups could be utilized to assist farmers in improving the quality of the commodity produced to meet the highest demands of the market. It is absolutely imperative that quality be a top priority for all producers of livestock and crops.

Investigate the feasibility of establishing a logo or brand name that identifies the county and region with high quality products. If possible, this would probably be done most effectively at the U.P. level.

SUPPORTING AGENCIES AND ORGANIZATIONS: MSUCES, FCS, FmHA, FB, crop and livestock organizations, CUPBDC.

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SITUATION: Transportation System - An efficient transportation network is necessary to serve the various agricultural businesses in Delta County. During the two months of spring breakup, bean, dairy and potato farmers and forestry interests are restricted in moving their products. Depending on the commodity, less than efficient loads are moved on the highways. The State Department of Transportation has a transportation economic development fund for road projects related to economic development opportunities in agriculture and forestry.

GOAL: To fully develop an efficient system of roads and highways serving forestry and agriculture businesses.

RECOMMENDATIONS: The County Road Commission should continue to prioritize the roads within the county to determine the need for repair and immediate upgrading. The Road Commission should also apply for funds through the Michigan Transportation Economic Development Fund to upgrade the road system serving forestry and agriculture. This should be done in consultation with agriculture and forestry interests to determine priorities.

SUPPORTING AGENCIES AND ORGANIZATIONS: CUPPAD, FB, local units of government, farm and forestry associations.

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SITUATION: Farm Forest Lands - The typical Delta County farm has over 50 percent of its land in forest cover. This varies from swamp species to upland hardwoods; however, most farms have both types. Generally speaking, the forested farm land has not been managed as intensively as the crop and pasture lands and returns have been low. Increased forest management efforts could result in additional farm income on a sustained basis. However, marketing outlets must also be improved to sell the product.

GOAL: To manage the total farm land resource including forest lands to maximize profits.

RECOMMENDATIONS: Farm forestland owners should seek professional forestry assistance to inventory the forest resources, develop a forest management plan and determine a marketing strategy for their property. Farmers, forest industry persons and agency personnel must develop methods of combining or consolidating small volumes of timber harvested by private landowners in a workable system to allow marketing to the major timber companies. The problem of liability and workmen compensation needs to be addressed to allow this to happen.

SUPPORTING AGENCIES AND ORGANIZATIONS: SCD, SCS, MDNR, MSUCES, consulting foresters, USFS, MTU, MSU.

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VII SPECIFIC COUNTY RECOMMENDATIONS BY TYPE OF FARMING

SITUATION: DAIRY FARMING - Traditionally dairying has been and continues to be the major type of farming in Delta County. The county's land and water resource base is ideally suited to the production of forages, small grains and other crops utilized by the dairy cow. In general, dairy farmers have followed the national trend of increasing herd size and increasing production per cow. The trend away from Grade B to Grade A production is accelerating and may eliminate Grade B production systems in the foreseeable future. However, as in most types of farming, the margin of profit for many dairy farmers has decreased and in some cases is negative. It is absolutely imperative that dairy farmers continue to find ways to decrease their cost of production with a goal of remaining competitive with the national industry.

GOAL: To produce milk at a profitable level competitive with national production costs.

RECOMMENDATION: Every farmer who plans to remain in the dairy business should utilize DHIA as an integral part of making management decisions on the farm. It is not enough to be on a DHIA testing program, the records must be used to the fullest extent in managing the herd.

- AI breeding and feeding a balanced ration for production should be a top priority if farms are to remain competitive.
- A preventative herd health program should be in place with the farms' local veterinarian. This will lower overall health costs and improve herd production.
- Reproductive interval should be as near to 365 days as possible. Heifers need to be grown so as to be bred to freshen at 24 months of age.
- Intensive grazing, the use of rumensin and proper feeding of vitamins and minerals will all contribute to faster growing lower cost heifer production.
- Crop production emphasis should be placed on producing high quality alfalfa or other legumes to increase milk production and lower the cost of purchased protein. Corn and grain production should be tied into the utilization of manure produced on the farm. The option of purchasing corn

instead of growing corn needs to be evaluated regularly.
- Intensive grazing management is an option many farmers may find effective in lowering production costs, machinery investment and labor.
- Overall farm business management must be a continuing high priority. Investment in machinery, land, labor and capital must be constantly scrutinized for optimum efficiency and minimum cost.
- Seasonal calving combined with intensive grazing and the individual or shared use of milking facilities may offer future low cost production alternatives for dairy farming.

SUPPORTING AGENCIES AND ORGANIZATIONS: MSUCES, MDHIA, lending institutions, MDA, agri-business sector, MSU EXP STA, AI associations.

SITUATION: BEEF FARMING - Beginning in the 1950's, beef cow calf farming expanded rapidly in Delta County as a result of farmers finding off farm employment and switching from dairy to beef production. This trend continued through the mid 1970's then levelled off at the 3000-3500 cow level through 1980. Since 1980, there has been a rapid decrease in brood cow numbers to about 2000-2200 cows at the present time. There were a number of reasons for the decline but the main reason is low prices and/or negative returns on investment. Presently the downturn in numbers has been halted and it appears an increase in numbers may again take place if prices remain at or near 1987 levels. Delta County land ownership patterns and excellent forage production capacity lends itself well to both the cow calf and backgrounding options. Some changes in management systems are needed but overall, beef cow calf and backgrounding enterprises should remain a viable part of the agricultural economy.

GOAL: To competitively expand the total pounds of beef produced in the county utilizing fully our forage production capacity.

RECOMMENDATIONS: A more professional, business type of attitude needs to be adopted by commercial beef producers (big and small) if they are to remain competitive and profitable. Emphasis needs to be placed on minimum investment for maximum return while producing the kind of product the market demands.

- Beef producers need to consider flexibility and income protection in their marketing plans. Marketing as feeder calves, short yearlings or long yearlings and backgrounding need to be evaluated each season to maximize returns. Use of options contracts and the futures market can also be key elements in protecting income and locking in a profit. Electronic marketing will become more commonplace.
- The use of frost seeding, no-till interseeding and intensive grazing can increase production of pounds of beef per acre over 400 percent above many forms of existing management.
- Creative leasing arrangements need to be considered to utilize idle and under used lands as well as land presently farmed. Size or scale of operation is a major factor in producing suitable returns on investment.
- Outside or venture capital will be necessary to finance larger

operations. In terms of added value, a good case can be made for private investment by local entrepreneurs.

- Commercial cow herds need to design breeding programs to produce calves with predictable carcasses (e.g. yield grade 2, high good 650 lb.)
- Feeder calf and backgrounding will remain the segment of the industry we are most able to compete in.
- Under most forage conditions combinations of beef cattle and sheep can maximize forage utilization and profits.
- Retained ownership of high performance calves needs to be considered by cow calf producers to gain maximum returns.
- Producers need to keep abreast of new technology such as control of sex determination, new combinations of steroid growth implants, genetically engineered vaccines and electronic implants for identification and monitoring of health and physiology.

SUPPORTING AGENCIES AND ORGANIZATIONS: MSUCES, MSU EXP STA, breed and marketing associations, AI associations, local financial institutions and agencies, venture capital group.

SITUATION: SHEEP AND HOG PRODUCTION - Historically, Delta County has had minimal production of sheep and hogs; however, a modest increase has taken place in the past 10 years. While neither of these types of animal agriculture is expected to equal dairying or beef production in the county, there is potential for expansion particularly as part-time operations on small land ownerships and to a lesser degree full time operators. Sheep can be raised with a minimum of capital and little purchased feed resulting in a good profit under normal market conditions. Hogs are much more volatile, but several feeder pig operations and a few farrow to finish enterprises are now operating successfully in the county. The key to success over the long run will be controlling investment and production costs and doing the best job of marketing through the less than ideal marketing infrastructure that exists in the county.

GOAL: To expand sheep and hog production within the parameters of competitiveness and market opportunity in Delta County.

RECOMMENDATIONS: Development of a marketing system that works for part time operators with minimum numbers of animals. This could include pre-scheduled pick up or assembling of animals to provide adequate volume for transportation, marketing agreements with a large co-op such as Equity or Michigan Livestock Exchange, tying into already existing transportation by area or regional large commercial operations, etc.

- Development of a business operational attitude among part time operators to improve quality and quantity of sheep and hogs produced and total farm management skills.
- Implementation of sound breeding, feeding and animal health programs especially for the small and part time operators.
- Plan flock and herd size to correspond with breeding power, facilities, etc. For small and/or part time operators this level should not be below the number of animals one ram or boar can service.

- Concentrate cropping programs on forages for sheep and barley for hogs. Consider purchasing corn or other high energy grains as needed when feasible.
- Pasture farrowing and partial pasture finishing or hogs needs to be considered to expand this industry.

SUPPORTING AGENCIES AND ORGANIZATIONS: MSUCES, MSU EXP STA, agri-business corporations and cooperatives, AI associations, veterinarians, lending institutions, USDA agencies.

SITUATION: POTATO PRODUCTION - Delta County potato growers have a long and successful history of growing, storing and marketing potatoes. Over the years, the national trend of increased acreage and increased yields has also been experienced by Delta County producers. The predominant variety grown in the county is the Russet Burbank and the area competes well with other potato growing regions in the United States. While production costs have increased dramatically in the past 10 years, production per acre has reached a plateau and prices received by the farmer have remained level to marginally lower. The end result has been lower profit margins and increase chances of a negative return. Delta County growers can remain competitive as our location, soil and water resources and climate are extremely favorable for potato production and marketing. However, survival and/or prosperity of the industry will be based primarily on individual management/marketing skills and the ability to upscale the size of management units.

GOAL: To strengthen and expand the potato industry in the county.

RECOMMENDATIONS: Develop practical ways of leasing, renting or purchasing land for expansion to meet future requirements of size of scale.
- Continue to do research and demonstrations on potato varieties; zone tillage; potato stand improvement; insect, disease and weed control; rotations and green manure to increase yields and lower production costs.
- Investigate the possibility of establishing a local processing plant or other means of utilizing off grade and B sized potatoes.
- Evaluate new systems of marketing including expansion of count packaging operations, contracting with processors, combining grading operations and/or handling of potatoes to generate greater variety and volume to serve specific markets. High quality of product is a top priority.
- Develop a Delta County - U.P. logo to aid public identification of quality fresh market potatoes grown in the U.P.
- Evaluate and implement potato harvesting and storage technology to prevent loss of quality during storage and to lengthen storage life.
- Consider refrigerated storage on one or two farms initially to allow marketing of quality potatoes in May and June when prices usually improve.
- Consider "Niche Marketing" to serve specific segments of the market.

This could include seed production of popular as well as minor varieties: gourmet, fresh market potatoes, "Baby Bakers", etc., etc.
- Develop new production systems incorporating higher cash producing crops or livestock to increase dollars generated from land not growing potatoes.
- Consider renting or leasing hunting rights to generate additional income and lower crop losses from deer.
- Development of all season roads to the major potato growing areas is extremely important for the movement of seed and tablestock during March and April.

SUPPORTING AGENCIES AND ORGANIZATIONS: MSUCES, MSU EXP STA, agri-business corporations and field representatives, MCIA, DCRC, NMUEIC, lending institutions, USDA agencies.

SITUATION: DRY BEAN PRODUCTION - Production of dry beans in Delta County goes back to the 1950's when small amounts were grown for the local canning industry. However, the reestablishment of the industry (particularly kidney beans) began in the 1960's on the Garden Peninsula with acreage remaining around 300-400 until the advent of the bean dryer developed by MSU. As a result of this technology plus the introduction of new disease resistant varieties, acreage expanded rapidly in the mid to late 1970's. The Garden Peninsula area produces outstanding quality kidney beans for processing as well as some seed production. It has developed a very positive reputation and these beans now command a premium over some other areas of Michigan. While production is concentrated on the Garden Peninsula suitable growing areas are also available in the Flat Rock and Stonington Peninsula areas. Because of marketing problems during the development of the industry, a local marketing group was formed in the mid 1970's and continues to market beans for the majority of the producers in the county through a broker selected by the group.

GOAL: To competitively expand dry bean production in the county to the maximum feasible on suitable sites.

RECOMMENDATIONS: Develop creative ways of leasing, renting or purchasing suitable acreage to permit economics of scale needed to remain competitive.

- Explore more efficient tillage and other cultural practices to lower production costs per unit while maintaining quality and yields.
- Explore new rotations including new crops and/or livestock that can add value to overall income per acre generated.
- Continue to work on producing the highest quality beans possible to support and improve upon the already good reputation of Garden Peninsula beans. Emphasis should be placed on bean varieties suitable to the area, insect disease and weed control, harvesting and storage technology and marketing standards.
- Investigate group purchasing of supplies and crop inputs to lower overall purchasing costs. Grower needs could be consolidated and bid out to local as well as regional suppliers of chemicals, fertilizer and seed to obtain competitive prices.

- Work through County Road Commission and Michigan Department of Transportation to develop county road 483 into an all season road for year around transportation of agricultural products.
- Study feasibility of irrigation to stabilize and improve yields of kidney beans and other high value crops. Consider development of an irrigation district to develop and distribute adequate supplies of water.
- Work through local equipment dealers to carry a minimum inventory of parts most needed for bean harvesting and planting equipment and/or express order/purchase for major parts and new equipment.
- Study the possibility of more fully utilizing the areas bean processing facilities and/or consolidation of these facilities to lower the per unit costs of processing and overall grower investment per unit processed.

SUPPORTING AGENCIES AND ORGANIZATIONS: SCS, SCD, MSUCES, MSU EXP STA, agri-business suppliers, MCIA, farm equipment dealers, DCRC, MDOT.

SITUATION: FRUIT AND VEGETABLE PRODUCTION - Commercial production of fruits and vegetables have and continue to be a minor but growing segment of Delta County's agricultural industry. A variety of fruits and vegetables are produced including, but not limited to strawberries, raspberries, apples and lesser amounts of other tree fruit; cole crops, vine type crops, asparagus, sweet corn, etc. The county is well suited for the production of cole crops, fruit and short season vegetable production. Almost all of the crop is produced for the local market with the majority of the small fruit being sold as pick-your-own and the tree fruit picked-for-you. Vegetable production is harvested primarily by the farmer with small amounts of pick-your-own. A major vegetable market is the demand for deer feed which by volume far exceeds that sold for human consumption. This has grown each year and the only remaining question is when will supply outstrip demand.

GOAL: To supply the local market with fruit and vegetables throughout the season and to produce and sell to outside markets where it is competitively feasible.

RECOMMENDATIONS: Marketing is the key factor in producing fruits and vegetables in the county. Producers should thoroughly evaluate and secure a market for their products before extensive production is attempted.

- The local Farmers Market has been operating for more than fifty years; however, the location of the market is a major concern and an attempt should be made to find a new site more accessible to the general public on the US 2-41 corridor in Escanaba.
- Establish demonstration/experiment plots on fruit and vegetable production to evaluate varieties, cultural practices and customer acceptance.
- Potential producers need to do a better job of planning prior to production. Particular emphasis needs to be given to proper site selection including soil type, air drainage, availability of water for irrigation and distance to markets.
- Develop a Horticultural Society or similar organization to provide a forum for increased knowledge in production and marketing skills. This may be an area or U.P. wide organization.

- Additional emphasis needs to be placed on producing a quality product. Proper selection of varieties, insect and disease control and providing a good environment for plant growth are essential management practices that must be implemented if the growers are to remain competitive.
- Pick-your-own operators need to provide an experience to the customer as well as a product if demand is to be sustained. This could include but is not limited to, transportation to and from field; providing a children recreation or care area; improved landscaping and operational layout; picnic/rest area; petting zoo, etc.
- Development of an annual festival around one or more of the fruit or vegetable crops produced in the county.

SUPPORTING AGENCIES AND ORGANIZATIONS: MSUCES, MSU EXP STA, SCS, SCD, DCACofC, NMUEIC, area lending institutions.

SITUATION: FORESTRY/FOREST PRODUCTION - Forest lands make up 50 percent or more of the typical farm in Delta County and consist of upland hardwood, swamp conifers and aspen with most farms having varying amounts of hardwood and swamp species. While harvesting timber has always been a part of farming, managing the timber for maximum production has not been a priority for the majority of farmers. Management consisted and continues to be primarily harvesting when a commercial cut is feasible. Traditionally most farmers harvest cedar posts for their own use and poles and sawlogs for on-farm construction; however, overall the farm forestland is the most unmanaged ownership on the farm. The addition of a professional forester on the county Soil Conservation District staff plus cost incentive and educational programs by various agencies are beginning to show results on the farm. However, marketing small volumes of timber is a major problem.

GOAL: To manage farm forestlands as an integral part of the total operation thus providing additional income on a sustained basis from these lands.

RECOMMENDATIONS: Every farm should have a forest management plan developed through the Soil Conservation District and cooperating agencies. This plan will form the basis for future management and marketing decisions.

- Develop an organization to help farmers and other small forest landowners market timber and other forest products. This is the major obstacle to management of small forest lands in the county.
- Lend support to forestry organizations in lowering the cost of obtaining Workmens Compensation and other insurance. Since both are required before most timber can be sold, it is imperative that new ideas be discussed and implemented to allow the small landowner to harvest and sell his/her own timber when adequate coverage is obtained.
- Evaluate hardwood timber stands for maple syrup production. Provide economic data needed to establish maple syrup production for farm and small forestland owners who are interested.
- Limit Christmas tree production to species unique to our area such as balsam-fir, various spruces and other suitable fir varieties. Production

of top quality trees of the species mentioned will be needed to maintain a market. Scotch and other pine species are being grown in great numbers in the South and central areas of the U.S. and prices are expected to fall greatly in the next five years.

- There is great potential to manage native stands of balsam fir and white spruce for Christmas tree production. Under good management, these stands can produce high quality trees in less time than many conventional plantations.
- Conduct public awareness program on the need to manage forestlands for the benefit of timber quality and quantity as well as wildlife, recreation and other uses.

SUPPORTING AGENCIES AND ORGANIZATIONS: SCD, SCS, MSUCES, MDNR, MSU EXP STA, timber and pulp companies, financial institutions, MTU, MSU, CUPPAD.

SITUATION: MINK PRODUCTION - Delta County has a long and successful history of mink ranching beginning decades ago when the main source of mink feed was fish from nearby Lake Michigan. Over the past 25 years, the industry has changed greatly. Because of chemical contamination of Lake Michigan, mink were switched from natural fish based feed to commercial feeds supplemented with animal by-products.

As in other types of agriculture, producer numbers have decreased but individual operations are larger in size. A major shake out of producers came in the late 1960's and early 1970's as a result of low prices. During the past fifteen years, the number of mink ranches have continued to decline but mink produced remained relatively constant at 35-40,000. The industry is now composed of primarily large, commercial, relatively efficient operations. The recent lifting of an embargo on furs produced in the Soviet Union has caused a great deal of concern about the future of this industry in the U.S.; however, producers are unsure as to how much of an effect this will have on the survival of the American industry.

GOAL: To maintain and expand the mink industry in Delta County.

RECOMMENDATIONS: Commercial producers feel the industry should be kept free of any government subsidies, programs, etc.

- Continue to improve mechanization of the industry and other means to improve labor efficiency.
- Improve quality through genetic improvements cultural and management practices.
- Develop local sources of by-products from poultry, fish and livestock to lower production costs.
- Continue to monitor PCB levels in Great Lakes fish in an effort to get fish back into the feed as soon as contamination drops to safe levels. Special attention should be given to whitefish, perch and other species containing less contaminants.

- Continue University and private research but eliminate duplication and extensive repetition. Concentrate the majority of effort on promotion and marketing of U.S. grown mink.

SUPPORTING AGENCIES AND ORGANIZATIONS: Mink production and marketing associations, FB, MSU EXP STA, MSUCES, MSU, feed companies, MDA, USDA, fur processors.

SITUATION: COMMERCIAL FISHING/AQUACULTURE - Delta County has been a center of commercial fishing in Michigan for over 100 years. The industry generates several million dollars annually with much of the product sold in the Midwest and Eastern parts of the United States. Aquaculture is a relatively new industry in Michigan and Delta County. The combination of the commercial fishing industry in the county and aquaculture is essential if aquaculture is to survive and prosper. The areas' commercial fishing infrastructure will be a major benefit in production, harvesting and marketing of locally produced fish. From a marketing standpoint, the combination of higher demand and higher prices make fish and fish products one of the fastest growing segments of the food industry. It is anticipated that this demand will continue to expand and prices will remain strong in the foreseeable future. This provides the basis for major expansion of the industry in Delta County.

GOAL: To maintain the commercial fishing industry and establish a viable aquaculture industry in the county.

RECOMMENDATIONS: Develop retail fish markets with a historical theme to sell fresh fish to the local and tourism market.
- Combine marketing efforts of commercial fishing and aquaculture production to enhance marketing opportunities of both industries.
- Continue research on raising perch commercially and establish a pilot production facility in Escanaba as research deems feasible.
- Establish perch raising sites on local farm ponds and other suitable private waters to provide fish to be grown out for market in commercial facilities.
- Develop a minnow industry also utilizing private ponds in Delta County.
- Develop fee fishing enterprises as opportunities arise.
- Utilize research from the new North Central Regional Aquaculture Center (NCRAC) at Michigan State University.

SUPPORTING AGENCIES AND ORGANIZATIONS: MFPA, MSU, MSUCES,MSG, NCRAC, MFGA, MDA, FB.

SITUATION: SPECIALTY CROPS AND LIVESTOCK - Historically, Delta County has produced a number of specialty crops and livestock. These include but are not limited to bedding plants, flowers, nursery stock, mushrooms, sod, certified seed, evergreen boughs, rabbits, ducks, geese, mink specialty products, etc. While individually these are relatively small enterprises, combined they provide additional income to a number of people. There appears to be potential for expansion of specialty products and services to serve the local, regional and tourist markets. The extent that these types of enterprises can be developed are only limited by the creative ideas of the producer or marketer. The committee feels this is an area where expansion is feasible, especially for the small landowner.

GOAL: To encourage and develop the production and marketing of specialty crops, livestock and services to fill the need of a changing society.

RECOMMENDATIONS: Conduct a survey/study to determine the demand for various specialty products and services existing and/or needed to meet local, regional and tourist needs.
- Inventory small land ownerships (under 100 acres) to determine availability of land resource base that can be used for these types of enterprises.
- Develop and conduct programs to provide needed management skills to operate specific speciality enterprises and market specialty products, services, etc.
- Conduct awareness programs to inform landowners of opportunities that exist in production and marketing of specialty crops and livestock.

SUPPORTING AGENCIES AND ORGANIZATIONS: MSUCES, MSU EXP STA, DCACofC, BdNCC, CUPBDC, NMUEIC.

SITUATION: RESEARCH AND DEMONSTRATION - Conducting research and its implementation through demonstration plots, educational meetings and individual consultation has been one of the major reasons farmers adopt new technology and improve efficiency. It is imperative that farmers continue to receive research based information if they are to remain competitive.

GOAL: Conduct research and demonstration work for crops, livestock and forestry applicable to Delta County on a continuing basis.

RECOMMENDATIONS: Institute a coordinated county approach for research and demonstration work through cooperation and communication with farmers, agencies, organizations, agri-business and others interested in developing the agricultural potential in the county.

- Develop a county research/demonstration committee or group to evaluate and set priorities on research, demonstration projects.
- Utilize area farms and the U.P. Tree Improvement Center at Pine Ridge as research and demonstration sites.
- Develop a financial support group and techniques to help finance research over and above public supported University research.
- Work with agri-business firms to increase private and corporate research and demonstration work in Delta County with particular emphasis on oil seed, forage, certified seed and small grain production and marketing.
- Conduct research and demonstrations on forest management, utilization and marketing to maximize profits for farmers and small landowners.

SUPPORTING AGENCIES AND ORGANIZATIONS: MSU, MSUCES, MSU EXP STA, SCS, SCD, MTU, CUPPAD, agri-business, NMU, BdNCC.