

CleanFARMS Inc.
Draft Report
**Saskatchewan Agricultural Plastic Packaging – Study of
Potential Collection and Processing Options**

April 2013

Submitted by:



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Table of Contents

Executive Summary	iv
To be completed	iv
1.0 Introduction	1
2.0 Recycling and Stewardship Program in Saskatchewan	2
2.1 Beverage Containers (not including milk).....	3
2.2 Milk Containers	3
2.3 Tires.....	4
2.4 Paint and Paint Cans.....	4
2.5 Waste Electronics	5
2.6 Obsolete Pesticides and Empty Pesticide and Fertilizer Containers	5
2.7 Used Oil, Oil Containers and Filters.....	5
2.8 Cell Phones and Rechargeable Batteries.....	6
2.9 Key Considerations that can Inform Agricultural Plastics Recycling.....	6
3.0 Current State Analysis of Agricultural Plastic Recycling Pilots	7
3.1 Moose Jaw River Watershed Agricultural Plastic Round Up.....	8
3.1.1 General Description of Collection System Used	8
3.1.2 Grain Bags	9
3.1.3 Twine	10
3.1.4 General Description of Marketing Approach.....	10
3.1.5 Operational Costs and Marketing Revenues	11
3.1.6 General Analysis of Program Funding/Subsidy Levels and Terms	11
3.2 PCAB and ADD Grain Bag Recycling Project	11
3.2.1 General Description of Collection System Used	11
3.2.2 Grain Bags	13
3.2.3 Twine	13
3.2.4 General Description of Processing and Marketing Approach	14
3.2.5 Operational Costs and Marketing Revenues	14
3.2.6 General Analysis of Program Funding/Subsidy Levels and Terms	15
3.3 Key Considerations that can Inform Agricultural Plastics Recycling.....	15
4.0 Agricultural Plastic Diversion Steps	16
4.1 Generation	16
4.2 Collection.....	16
4.1.3 Consolidation and Transfer.....	18
4.1.4 Processing	18
5.0 Analysis of Options for the Recycling Agricultural Plastics	19
5.1 Collection.....	20
5.1.1 Option 1 - Farmer Delivers Agricultural Plastic Waste to Consolidation Depot 20	
5.1.2 Option 2 - On Farm Collection by a Service Provider and Delivery to Consolidation Depot	20
5.2 Consolidation and Transfer.....	20
5.2.1 Standalone Consolidation Depots	21
5.2.2 Public Consolidation Depots.....	2224
5.2.3 Private Consolidation Depots.....	24

5.2.4	Transfer	25
5.3	Processing	25
5.3.1	Local Processing.....	26
5.3.2	National Processing.....	2726
5.3.3	US Processing	27
6.0	Cost Analysis of Collection, Consolidation and Transfer and Processing Options	27
6.1	Options.....	28
6.1.1	Option 1 Farmer Delivers Agricultural Plastic Waste to Consolidation Depot	28
6.1.2	Option 2. On Farm Collection by Service Provider and Delivery to Consolidation Depot	3231
6.2	Financing and Administration of Agricultural Plastics Recycling.....	3534
6.3	Summary.....	3534
7.0	Methods to Facilitate the Capture of Agricultural Plastics	3837
7.1	Financial Incentives	3938
7.1.1	Bounty Based	3938
7.1.2	Deposit Return.....	3938
8.0	Conclusions and Recommendations	4039
9.0	References	4240

Appendix 1	Summary Tables of Extended Producer Responsibility (EPR) Programs in Saskatchewan
Appendix 2	List of Subject Matter Experts
Appendix 3	Cost Assumption Tables for Option 1 and Option 2

Key Acronyms used in report

EPR	Extended Producer Responsibility
MJRWS	Moose Jaw River Watershed Stewards Inc.
PCAB	Provincial Council of Agriculture Development and Diversification (ADD) Boards for Saskatchewan Inc.
RI	Return Incentive
RM	Regional Municipality
	Plastic Resin Types
HDPE	high density polyethylene
LDPE	low density polyethylene
LLDPE	Linear low density polyethylene
PP	Polypropylene

Executive Summary

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Study of Potential Collection and Processing Options
Draft Report
Executive Summary

iv of iv
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Waste
Management
Consulting
Services

1.0 Introduction

CleanFARMS Inc. (CleanFARMS) is a non-profit industry stewardship organization committed to environmental responsibility through the proper management and disposal of agricultural waste.

The Saskatchewan Ministry of Environment provided funding to CleanFARMS to undertake this work entitled 'Saskatchewan Agricultural Plastic Packaging – Study of Potential Collection and Processing Options' (the Study). 2cg Inc., in association with Sheri Praski Environmental Consulting, were retained to undertake this Study. The Study was supported in-kind by CleanFARMS and with oversight from the Saskatchewan Agricultural Stewardship Council (SASC), a subcommittee of the CleanFARMS Board.

Comment [KT1]: Barry to double check

SASC is made up of manufacturers and distributors of grain bags, bale/silage wrap, twine and netting.

The Ministry has indicated they are seeking the development of a regulation (target launch date of June 2014) that would require Stewards in Saskatchewan to establish a stewardship program. This program would include collection/processing programs for four designated products (Grain Bags, Bale Wrap/Silage Film, Twine and Net Wrap). For the purpose of this Study, 'Stewards' are defined as the first seller of the designated products into the province of Saskatchewan.

Table 1.1. presents a brief summary of current agricultural plastics use and management.

Table 1.1 Overview of Agricultural Plastic Use and Management

Agricultural Plastic	Plastic Resin	Use	Management
Grain Bags	LDPE	Used to store grain	Stored on farm Burned on farm Landfilled off farm Recycled
Twine	PP	Used for baling hay and straw	Stored on farm Burned on farm Landfilled off farm Recycled
Bale wrap	LLDPE	Used to wrap hay	Stored on farm Burned on farm Landfilled off farm
Silage wrap	LDPE	Used to store silage	Stored on farm Burned on farm Landfilled off farm Could be recycled with grain bags
Net wrap	HDPE or PP	Used to wrap hay and straw	Stored on farm Burned on farm Landfilled off farm

The use of plastic products has transformed the way in which materials such as hay, straw and other animal forage is stored to prevent damage from pests and rot. Similarly, crops such as grain can be stored prior to shipment or use without silos or grain bins through the use of large grain bags. Plastic baler twine has replaced most natural products and in certain applications net wrap has replaced baler twine. Once these products have performed their intended function they most often are burned, buried on farm, landfilled or in some cases recycled. The open burning of these products is often prohibited however the practice continues to the detriment of the environment and the health of those engaged in the action.

Ultimately any collection and processing option must be convenient for the farmer, cost effective and demonstrate environmental benefit. As well it will be imperative that Stewards work cooperatively and collaboratively with the agricultural community to develop practical solutions.

This Study includes a review and assessment of current Stewardship programs for used beverage containers, used milk containers, used oil containers, used tires, paint, waste electronics, obsolete and used pesticide containers and cell phones and rechargeable batteries to determine if there are aspects of these programs that could be used for agricultural plastic wastes.

There are two pilot scale programs operating in Saskatchewan for the diversion and recycling of agricultural plastics. One is the "Moose Jaw River Watershed Agriculture Plastic Recycling Pilot" (2010-ongoing) and the other is the Provincial Council of Agricultural Development and Diversification Boards (PCAB) Grain Bag Recycling Pilot Project.

This Study includes a review of the results from these pilot projects and determines what can be used to inform the development of future collection and processing options that will need to be implemented to conform to a potential regulation.

This Study includes the development of a number of collection and processing options that could be further developed and implemented to recover these agricultural plastic packaging materials. This will include consideration of where to establish collection programs and where to take collected materials for processing and final recycling.

Finally this Study includes a cost analysis of the various collection and processing options developed to help determine which option(s) are the most cost efficient and environmentally and socially acceptable.

The options will be assessed with consideration to the time/effort/cost to the farmer/producer being asked to participate in the collection program. Environmental criteria will include the impact on greenhouse gas generation (transportation). Social criteria will include the impact of a collection program on employment.

2.0 Recycling and Stewardship Programs in Saskatchewan

Saskatchewan has a number of programs aimed at recycling end-of-life products. All of the programs are funded either directly or indirectly by Stewardship organizations – some have recycling fees that are visible to the consumer and some are funded by the manufacturer directly to the recycling contractor(s).

Table 2.1a (Appendix 1) presents a summary of Stewardship programs and focuses on collection, processing and marketing. Table 2.1b (Appendix 1) presents a summary of Stewardship programs and focuses on financing, funding system and the recovery rate. Each program was reviewed to determine benefits and opportunities including return incentives, collection rates, depot availability and co-siting opportunities.

Current Stewardship programs include the following:

- Beverage containers not including milk;
- Milk containers;
- Tires;
- Paint and paint cans;
- Waste electronics;
- Obsolete pesticides and empty pesticide and fertilizer containers;
- Used oil, oil containers and filters; and
- Rechargeable batteries and phones.

A brief overview of each program is presented.

2.1 Beverage Containers (not including milk)

SARCAN Recycling is a division of the Saskatchewan Association of Rehabilitation Centres (SARC). SARC was established in 1968 to provide service for persons with disabilities. SARCAN was set up to handle the non-refillable beverage container recycling program in Saskatchewan and has been doing so since its inception in 1988.

Funding for the program is through an environmental handling fee which is used to fund SARCAN recycling. Consumers also pay a deposit (legislated by the Government of Saskatchewan) that is returned to them when they return the container to a SARCAN depot for recycling. Both the fee and deposit are shown on the sales receipt.

The return rate for deposit beverage containers in Saskatchewan in 2011-2012 was over 87% with almost 374 million containers returned. This is amongst the highest return rate of any stewardship programs in Canada and is attributed to the deposit return.

2.2 Milk Containers

The Unified Dairy Recycling System is an environmental stewardship program by Saskatchewan's dairy industry that is operated through its recycling partner, SARCAN. The system involves voluntary collection and recycling of plastic milk jugs and milk cartons.

The Unified Dairy Recycling System was established in 2001. It was an agreement between the four major national dairy companies, the Ministry of Environment, SARCAN and the Saskatchewan Milk Control Board.

Milk containers are excluded from the deposit refund system that is utilized on other beverage containers in Saskatchewan.

The basis of the program is an Environmental Handling Charge (shown on till receipt) on the sale of fluid milk. Consumers pay a recycling charge on the larger sized milk containers at purchase (1¢ on 1 litre and 2 litre containers; 2¢ on 4 litre containers). There is no fee on the smaller milk containers. Funds are remitted to the Saskatchewan Milk Control Board and used to fund the collection and recycling of the material through the SARCAN depots.

Customers do not pay a deposit on the milk container at point of purchase and consumers do not get a refund when returning empty milk containers to the depot.

Milk containers can be returned to any one of SARCAN's 71 recycling depots (or to unstaffed 'drop-off' depots).

2.3 Tires

The Saskatchewan Scrap Tire Corporation (SSTC), which was formed in 1996, is a non-profit, non-government organization that delivers the Saskatchewan tire recycling program. This program diverts tires from landfills but has also cleaned up old tires from municipal landfills and other storage sites.

Consumers are charged a Tire Recycling Fee (TRF) at the point of sale, which is used to fund the program. The TRF varies depending on the tire size. There is no refund to the consumer for recycling tires.

Used tires are collected by retailers. Provincial legislation requires that all retailers in Saskatchewan who sell new tires as part of their business operations must establish a provincially approved "product management program" for the proper handling of their scrap tires.

All tires are recycled by two local recycling companies - Shercom Industries and Assiniboia Rubber Recycling.

2.4 Paint and Paint Cans

Product Care is a non-profit industry sponsored association that manages product stewardship for household hazardous waste in Canada. Product Care currently manages the Saskatchewan Paint Recycling Program and contracts SARCAN for paint collection and recycling.

The program is funded by an eco-fee that is paid to Product Care by member companies. The eco-fee is charged to the consumer and used to pay Product Care for management of the program. There is no refund to consumers for recycling paint.

Paint that is not part of the reuse program is recycled into raw materials for Portland cement, used for energy recovery or incinerated (if potentially containing PCBs).

2.5 Waste Electronics

SWEEP (Saskatchewan Waste Electronic Equipment Program) is a non-profit corporation that was established in 2007 by manufacturers and retailers of electronics.

SARCAN is contracted to collect and coordinate disassembly of equipment and recycling of its parts. Electronics can be returned to anyone of the 71 SARCAN depots.

The manufacturer is charged an environmental handling fee (EHF) which is usually passed on to the consumer. The EHF covers depot costs, transportation costs, recycling and consumer information. Not all products have an EHF and there is no refund to the consumer for recycling electronics.

2.6 Obsolete Pesticides and Empty Pesticide and Fertilizer Containers

CleanFARMS is a non-profit industry stewardship organization that operates the obsolete pesticide and empty pesticide and fertilizer container program in Saskatchewan.

The empty container program is funded by industry through a levy for every container put into market each year. The container fee in 2013 is \$0.49 for each container less than 23 litres in size. The obsolete pesticide collection program is funded by a separate fee charged to all members based on the volume of product put into market each year. The obsolete pesticide fee varies from year to year depending on industry costs. Both fees are not visible at the retail level and are paid by the manufacturer or brand owner.

There are approximately 400 collection locations (at agricultural products retailers and 9 municipal sites). Consumers (farmers) return their empty, triple rinsed containers to a location convenient to them. There is no refund incentive.

Containers are bagged and shipped to a central processing facility.

2.7 Used Oil, Oil Containers and Filters

The Saskatchewan Association for Resource Recovery Corp. (SARRC) is a non-profit corporation that was incorporated in 1996 to implement and maintain a Used Oil, Filter and Container Recycling Program for Saskatchewan. SARCC was formed by the oil and filter industry.

Funding is paid by brand-owners and the industry stewardship handling charge is passed on to the consumer at retail level (shown on till receipt) for oil, oil containers and oil filters.

There are approximately 300 year-round collection locations in almost 200 communities in Saskatchewan for small volumes (farmers and do-it-yourself mechanics) and several registered collectors for larger volumes. These collection facilities are called EcoCentres.

The program managers noticed that the majority of oil collected was from larger centers, centers close to recyclers and/or large volumes. As a result SARCC recently implemented a "Return Incentive" (RI) program. The RI program pays registered trucking companies to go pickup oil at smaller sites (it is paid to truckers after confirmation that what is picked up goes to proper recycling facilities) and is paid on increasing radius from Saskatoon (higher fee paid to materials from farther distance). The RI program compensates drivers for less volume and/or longer distances to ensure smaller volumes or materials from farther distances get recycled.

Prior to the RI program, less than 25% of these products were recycled (5 -6 million litres of 24 million liters). In 2012, recycling reached approximately 80% (18 million litres). The program has also implemented a processing incentive in the form of a payment to plastic processors of \$0.03./kg. The intent of this incentive is to stimulate the marketplace.

2.8 Cell Phones and Rechargeable Batteries

Call2Recycle is a non-profit organization that started in 1996 with the focus of diverting cell phone and batteries from landfills. There is no industry stewardship program in Saskatchewan for cell phones or rechargeable batteries. Call2Recycle has several collection sites in Saskatchewan that are mostly at retailers. Materials are brought to the collection sites by retailers and users.

Manufacturers that help pay for the program place Call2Recycle stickers on their product.

2.9 Key Considerations that can Inform Agricultural Plastics Recycling

There are a number of key considerations that can inform the recycling of agricultural plastics including:

- Most programs appear to be funded by fees assessed to manufacturers/brand owners that are then passed on to consumers, some through a visible retail fee;
- With the exception of the beverage container deposit program there are no financial incentives for consumers to recycle the various materials;
- Deposit return on beverage containers is relatively simple because the entire used container (unit) is returned, not fragments of the container. (i.e. would be more challenging to implement for used silage wrap, bale twine, net wrap);
- There is a high rate of return in the case of beverage containers because of the financial incentive provided to consumers (i.e. deposit);
- The purchaser/consumer is not always the same person who returns the beverage container. Many consumers simply throw out/set aside beverage containers and let others return and keep the refund. This is relevant because in the case of

agricultural plastics, the refund would still have to be sufficient to incent the farmer to take extra steps to recycle the plastics;

- Once a deposit/return-based incentive is in place to drive recycling behaviour, it is extremely challenging to remove;
- The administrative cost/burden of deposit returns is significant partially because it introduces a second set of financial transactions at the point of recycling;
- The recycling of milk containers uses the same collection system as beverage containers and demonstrates that a single collection system can handle materials that are handled by separate regulatory frameworks/financing mechanisms;
- The Recycling Incentive (RI) implemented to recover used oil, oil filters and containers is used to stimulate the marketplace to collect these materials throughout the province, with additional incentives to collect from more remote locations;
- Densification/compaction of recyclables (e.g. beverage containers) results in significant cost savings and emission reductions;
- In the case of tires the SSTC has recently had success in partnering with community groups to clean up tires as a fundraising partnership;
- In the case of tires requiring retailers to have a “product management program” ensures a convenient return option for consumers (when they get new tires, their old ones can be recycled without any extra handling from the consumer);
- In the case of obsolete pesticide and empty pesticide and fertilizer container farmers appreciate the convenience of “the return to the site where you get more of the product”;
- SARCAN operates 71 depots throughout the Province. Advantages to potential partnering with SARCAN sites are that they are well known in communities and they are staffed;
- There are some SARCAN sites that would have sufficient space to accommodate agricultural plastics. The feasibility of using these sites and their staff to manage agricultural plastic could be investigated;
- Convenience or access to depots is important to all of these programs with the lowest number of return sites being 71 throughout the province; and
- Agricultural plastics could go back to retailer or other convenient sites such as grain elevators. Storage space, potential vector and odour issues, staffing and loading would need to be considered.

3.0 Current State Analysis of Agricultural Plastic Recycling Pilots

Many farmers in Saskatchewan currently use low density polyethylene (LDPE) “grain bags” to store their grain between harvesting and shipping the grain. These grain bags have become known as a low cost and convenient alternative to grain bins or grain piles. Grain bins, which are commonly made from wood or steel, have the advantage of being relatively permanent but have a higher up-front cost and cannot be easily moved to a field for storage. On high yield crop years, there may not be enough storage space in grain bins. Grain piles, which are open to the elements and wildlife, are a relatively no-cost option but generally result in reduced volumes and/or a reduction in the grade of the grain due to

spoilage from moisture or vectors. Utilizing grain bags for feed storage on ranches has also become a common practice.

Grain bags are at least 250 feet long (76 metres) and weigh approximately 300 pounds (135 kg). In 2010 CleanFARMS estimated that there are more than 1,100 tonnes of this material sold in Saskatchewan each year (CleanFARMS, 2010). Grain bag fillers and extractors make these convenient to fill and empty but users find them difficult to handle post-use, there are limited opportunities for re-use (e.g. used as substitute for tarpaulins as ground covering, roofing, and for covering equipment, etc.) and they are currently largely ending up in landfills, being buried or burned on fields.

There are currently two programs to collect grain bags and other agricultural plastics in Saskatchewan.

3.1 Moose Jaw River Watershed Agricultural Plastic Round Up

3.1.1 General Description of Collection System Used

The Moose Jaw River Watershed includes 22 rural municipalities, 2 towns, 10 villages and the City of Moose Jaw. The Moose Jaw River Watershed Source Water Protection Plan was developed by the Moose Jaw River Watershed Advisory Committee in 2006. This report includes recommendations aimed at protecting source water within the Moose Jaw River Watershed. The Moose Jaw River Watershed Stewards Inc. (MJRWS) have the duty to carry out the protection plan. The plan contains many recommendations, one of which is to “minimize negative agricultural impacts in the watershed” (MJRWS, 2006).

The MJRWS launched a pilot program to collect and recycle grain bags and bale twine in March 2010. It is set to conclude in March 2014. The project was started, in part, as they were fielding calls from producers wanting to know what to do with agricultural plastics and in particular used grain bags.

Three key goals of the MJRWS pilot program include:

- Determining the amount of agricultural plastics used;
- Determining how much agricultural plastics users are willing to recycle; and
- Determining how far users would travel to recycle these materials

Education and awareness was important to reach all potential users. Communication consisted of flyers delivered to 3,000 rural landowners (on two occasions), radio advertisements, tradeshow attendance (providing information to target audiences), articles in local papers and news interviews.

Consolidation depots where users can drop off their used grain bags and bale twine, were set up in the Rural Municipalities (RMs) of Moose Jaw, Mossbank and Caledonia.

The depots vary in size but it was determined that approximately one acre is appropriate for these sites. Sufficient area was required to facilitate storage of grain bags and twine until there was enough material to ship to markets. Consolidation depots also require sufficient turning and loading space to accommodate trucks with van trailers.

The depots are gated so materials that do not meet requirements may be rejected by an attendant. The grain bags are required to be “clean” (not contain grain, water, soil or vectors), rolled and tied with twine as it has been learned that they should not be stored or shipped loose. It is important that what processors consider “clean” is clearly communicated to farmers.

The depots use a “bobcat” and/or tractor equipment to load the rolled grain bags onto trailers. MJRWS organize each pick up, including the loading equipment, transportation and booking appointments with Crowfoot Plastics in Hussar, Alberta. Currently all the plastics (with the vast majority being grain bags) go to Crowfoot Plastics. MJRWS works to ensure that trucks are loaded with as close to legal load limits as possible as this is more efficient and cost effective. The cost of the shipment is usually compensated by the revenue generated from the sale of the plastic.

MJRWS have recycled approximately 225,000kg of plastic from March 2010 to December 2012. This works out to about 83,000 kg/year.

3.1.2 Grain Bags

Grain bags are dropped off at the consolidation depots by farmers. The grain bags are large, heavy and cumbersome to handle. Originally, farmers were rolling them on their own by hand or with old hay bale makers or dropping them off un-rolled or un-folded. Due to the large amount of material, the grain bags were difficult for farmers to transport so the MJRWS purchased a grain bag roller (invented and manufactured by Brown Bros Welding of Milestone, SK in 2009) and made it available for no charge to users. The roller made transport of the grain bags more convenient and efficient for both farmers and for final transportation to recyclers/markets. The rollers have been modified since 2009 making them easier to use.

Collection and Processing lessons learned to date include:

- Ensure rolled grain bags are tied well as breaking when stacking causes efficiency issues. MJRWS ensures that there is twine available on the grain bag roller for use free of charge;
- Ensure farmers are careful to not pick up too much soil with grain bags as it has created a weight deduction from the recycler of between 5 and 10% (and issues with recycling). Anything larger than fist sized soil clumps could be rejected at the consolidation depots as well as by the processor;
- Maximizing the truck load weight helps maximize cost effectiveness and efficiency of the program (ensure there are enough grain bags prior to taking a load, ensure the bags are consolidated as much as possible);
- The only way the processors in Alberta (Crowfoot Plastics/Merlin Plastics) will accept grain bags is if they were consolidated (through rolling);
- Vectors will be a problem if grain bags are stockpiled too long. MJRWS learned that having spaces between stacks of bags reduced the ability for pests to stay hidden and allowed for baiting. An advantage of RM yards or landfills is that preventative baiting is possible which cannot be done in a town site;

- The rolled grain bags are generally transported in a van trailer. The disadvantage of this approach is that a bobcat or tractor is required for loading but the advantage is that if stacked carefully, it has a high volume and lower cost than flatbeds or walking floor trailers; and
- It is important to ensure that loading equipment can handle the weight of rolled grain bags (had issues with trailer damage during loading) and that the operator has liability insurance, as damage could be incurred while loading the van trailer.

3.1.3 Twine

Twine has been received in various ways at consolidation depots.

Collection and Processing lessons learned to date include:

- Twine should be bagged in order creating a mess at the depots;
- Initially, the MJRWS used seed totes (polypropylene bags that have straps that can hook on to a bobcat) to collect the twine. During the pilot it was learned that these totes may create issues at the US border as inspectors cannot see inside. The seed totes were provided to the MJRWS at no cost from Merlin Plastics;
- The pilot program currently uses 40 gallon plastic bags that were provided at no cost by CleanFarms; and
- Twine should be free from any foreign material and as dry as possible.

3.1.4 General Description of Marketing Approach

During this pilot program there were only 2 local markets available which included Crowfoot Plastics/Merlin Plastics and Crown Shred and Recycling (Crown Shred).

MJWRS opted to work with Crowfoot Plastics and Merlin Plastics because they were relatively close by and provided logistical assistance to recycle grain bags. The materials were delivered to Crowfoot Plastics for processing and then sold to Merlin Plastics (for \$0.10-\$0.15/kg). There were some issues since the latter half of 2012 with delivering plastics to Crowfoot Plastics.

Revenues were determined by fair market value and were found to be non-negotiable. These terms are fairly consistent across North America. MJRWS did identify other processors that were interested in the volumes of LDPE but it was determined that shipping to these markets was not feasible at this time. As the LDPE is non-toxic (has not been in direct physical contact typically with pesticides or herbicides), there is a potential Chinese market for this product.

Twine received to date has been clean which will help with the resale. It is understood that twine is worth between \$0.13-0.22/kg (plus the purchaser will pay for shipping). There has not been enough twine received to make a full load so MJRWS has no direct experience with shipping or markets at this time.

3.1.5 Operational Costs and Marketing Revenues

Environment Canada (2012) reported that the pilot program costs from 1 April 2011 to 31 March 2012 were \$73,000, which included hard costs of \$51,600 and in-kind work of \$21,000. A summary of approximate pilot program costs are presented in Table 3.1.

The revenues from the sale of grain bags during this period was \$13,000 (which included all grain bags recovered during the pilot to date (approximately 2.5 years) but all were sold during the 2011-2012 period).

3.1.6 General Analysis of Program Funding/Subsidy Levels and Terms

The pilot program was funded by Environment Canada Eco Action Grant (\$30,220), MJRWS (\$16,534 cash and \$15,323 in-kind); plastics revenue and in-kind donations from the Saskatchewan Ministry of Agriculture, Agri-Environmental Services Branch, Saskatchewan Association of Rural Municipalities (SARM), volunteers, RM Caledonia, RM of Moose Jaw, RM Lake Johnson and the Recycling Council of Alberta.

Table 3.1 Summary of Approximate Pilot Program Costs (1 April 2011-31 March 2012)

Item	Description	Actual	In-kind (estimate)
Salary and Wages	Program coordinator, Volunteers, Technical Assistance, Administration	\$19,800	\$ 12,300
Collection/Recycling	Contractors	\$24,000	
Advertising	Includes communication and printing	\$4,000	\$1,800
Equipment Rental		\$2,400	
Land	Land acquisition, leases, etc.		\$5,100
Office Space	Overhead		\$1,800
Contractors		\$700	
Travel		\$700	
Sub Total		\$51,600	\$21,000
Total		\$72,600	

3.2 PCAB and ADD Grain Bag Recycling Project

The non-profit agriculture organization Provincial Council of Agriculture Development and Diversification (ADD) Boards for Saskatchewan Inc. (PCAB) has been operating a province wide pilot program targeted at grain bags and twine since March, 2011.

The key goal of the PCAB pilot program is:

- To explore solutions that would allow farmers to recycle agricultural plastics in an environmentally friendly manner.

3.2.1 General Description of Collection System Used

The main focus of the pilot program is grain bags. Some twine is collected.

The sites used for consolidation depots vary in both size and shape. They include landfills, RM yards and retailers (Viterra, Flamans). The sites were identified through PCAB's internal structure, that is regional and district ADD boards were contacted to see if/how they wanted to participate in an agricultural plastics recycling program.

Some of the advantages identified with using these sites were that they have both staff and controlled access. One of the drawbacks identified with some of the sites was that shipping options were limited because equipment was not available for loading. When looking for sites, PCAB wanted to ensure that there was adequate storage and loading facilities. The preferred size for consolidation depots was a few acres. No buildings are used for storage at these sites.

Current consolidation depots include:

- Unity (collection site with roller trailer);
- Viscount (collection site with roller trailer);
- Humboldt (collection site only – no roller trailer);
- Cudworth (collection site only – no roller trailer);
- Prince Albert (collection site with roller trailer). Producers drop of rolled grain bags at Crown Shred;
- Kelvington; (collection site with roller trailer);
- Estevan area – includes Oungre, Hirsch & Macoun (ADD board owns roller trailer and uses at all 3 sites);
- Rush Lake (collection site with roller trailer);
- Moose Jaw (MJRWS – Moose Jaw, Mossbank, Milestone). PCAB purchased the roller trailer but MJRWS operates the collection sites; and
- Mankota (just twine collection site, no roller trailer).

Education and awareness was a big part of the PCAB program to ensure farmers know the options available to them. Demonstration events were hosted at each consolidation as well as ads in prominent magazines and attendance at cattle and farm shows.

Farmers generally drop off their grain bags at the site simply by driving up to the pile and rolling/pushing the grain bags off (although the Unity site has the 'drop-off days' scheduled). The bags are generally left on the pile until they are ready for shipping. The bags are moved as little as possible as experience shows that the ties can break or the bags let loose and then they become difficult to handle.

Once there are enough bags for a load, a transportation company is hired to haul them to a processor.

PCAB recycled 148,000 kg of plastic in 2012.

Some of the feedback on the program (Quirk, 2013) included:

- There have been other interested parties for recycling the materials but the markets for this material have not been favourable during the course of this pilot;
- Farmers within 50 km of the collection sites are keen to use the program;

- More rollers and collection sites would increase recycling of grain bags;
- Some users would be willing to pay a small recycling fee but others do not want to have a fee involved (there is a concern that the fee would be too high);
- Some feel they should be paid for returning the plastic (similar to other take-back incentives like oil); and
- Some think that someone should come to their farm to pick up the materials for recycling.

3.2.2 Grain Bags

Trailer mounted grain bag rollers are available at each main collection site for farmers to use free of charge to roll up their used grain bags. Producers call the collection sites to reserve rollers. Producers must sign out the roller and complete a survey when they return the roller. The survey focuses on program improvements and questions about an environmental handling fee. The equipment is easy to use and results in the bags being bundled and secured with twine. Once rolled and secured, the bags are taken to a collection site until there is enough to be transported to a recycler. The program started with 9 sites (including the 3 MJRWS sites) and continues to operate with 14 sites (including the MJRWS sites).

Collection and Processing lessons learned to date include:

- Controlled access is much better as it results in better quality bag rolls. Having staff available to tell producers where to place the grain bags results in a better organized site which is more efficient for loading for shipping;
- An advantage of RM yards or landfills is that you can do preventative pest control which cannot be done in a town site;
- Having collection days is easier in terms of staffing and control but any-time drop-off allows for rolled bags to come back with the grain roller and is more convenient for users; and
- Various types of trailers have been used. Van trailers are the least expensive but loading requires equipment and more care. Flat Deck trailers with side kits are the easiest to use and the weight of plastic that can be shipped but they are the least common to obtain. Walking floor trailers are the easiest to load but cost more to rent and require specific equipment to load as they must be top loaded.

3.2.3 Twine

The PCAB consolidation depots do offer twine collection at their sites but twine is not a main focus. There was a bit of emphasis on twine collection last year as they offered incentives to 4H groups who collected twine for recycling. The 4H groups would bring twine to collection sites in large, clear plastic bags. Currently there are 13 youth groups participating across the province.

There has not been enough twine to justify a load to a recycler but it is anticipated that there will be enough twine for the first shipment in summer 2013.

3.2.4 General Description of Processing and Marketing Approach

In order to market the agricultural plastics, PCAB contacts companies that recycle film plastic and inquire if they are interested in grain bags. PCAB continues to follow up with any potential contacts/markets as they arise.

PCAB generally utilizes brokers to locate truckers with appropriate equipment although the project manager has direct contact when companies are referred to them.

In order to negotiate terms, PCAB obtains quotes from interested trucking companies for specific shipments and compares these with previous costs (based on distance travelled and expected weight of plastic to ship). Due to the restricted loading conditions and equipment that is suitable to transport the plastic, there are a very limited number of trucking companies that are suitable to move this agricultural plastic. The rate is agreed to prior to the shipment being confirmed.

Once enough grain bags are collected for a load they are shipped to Crowfoot Plastics (who process the material for Merlin Plastics) at Hussar, Alberta or to Crown Shred and Recycling Inc., in Prince Albert. As Crown Shred has limited capacity and does not pay for any of the plastic, only grain bags from the Prince Albert depot, and occasionally from nearby sites (Viscount & Kelvington), went to Crown Shred. The majority went to Crowfoot Plastics until December 2012. Crowfoot Plastics temporarily stopped accepting agricultural plastics but is understood to have resumed accepting these plastics.

3.2.5 Operational Costs and Marketing Revenues

The estimated program costs are presented in Table 3.2.

3.2 Summary of Estimated PCAB Pilot Program Costs for 2012

Items	Description	Actual	In-Kind
Salary and Wages	Program Staff - Portion of Exec Director, coordinator (60% time), site representatives,	\$52,800	
	Travel	\$3,600	
	Additional 2 sites not yet claimed		\$4,000
	In-kind administrative support staff at PCAB		\$3,000
Collection	Shipping	\$20,200	
	Revenue (includes grain bags collected in 2011 & 2012)	(\$10,100)	
Advertising		\$11,000	
Equipment Rental / Contractors	Loading trucks	\$2,800	
	In-kind by RM's		\$3,000
Land	In-Kind - estimate \$1000 per site x 14 sites	\$0	\$14,000

Items	Description	Actual	In-Kind
Office Space Overhead	In-kind		\$20,000
Rolling equipment	Amortization over 5 years on 6 grain bag roller trailers		\$8,000
	Insurance & repairs	\$2,000	\$2,000
Sub Total		\$82,300	\$54,000
Total		\$136,300	

3.2.6 General Analysis of Program Funding/Subsidy Levels and Terms

In 2011, the federal and provincial governments provided \$160,000 for the Grain Bag Recycling Pilot Project through the federal-provincial Growing Forward framework. This money was used for the operation of all of the collection sites with the exception of the MJRWS sites which received funding through other grants. PCAB provided \$50,000 and administered the project. The Federal Government committed another \$205,000 for 2012 and 2013 (\$105,000 per year).

3.3 Key Considerations that can Inform Agricultural Plastics Recycling

The data from the MJRWS and PCAB programs were extrapolated, annualized and summarized as depicted in Table 3.3.

Table 3.3 Extrapolated and Annualized Cost Estimates for the Pilot Programs

Program	Recovered	Cost	Revenue	Net Cost	Depots	Depot Costs	Recycling Costs
	kg/ year	\$/ year	\$/ year	\$/ year	#	\$/ year	\$/ kg
MJRWS	83,000	\$73,000	\$5,000	\$68,000	3	\$22,667	\$0.82
PCAB	148,000	\$141,300	\$5,000	\$136,300	11	\$12,391	\$0.92

Based on available information it is estimated that on average a pilot depot costs \$11,000-\$23,000 to operate; that agricultural plastics cost between \$0.82-\$0.92/kg to recycle and that the revenue for agricultural plastics is \$0.04-0.06/kg (i.e. \$40-\$50/tonne). A relevant lesson is that more depots may increase the overall recovery but not necessarily the amount of agricultural plastics recovered (i.e. MJRWS sites collected 28,000/depot; PCAB depots collected 13,500/depot)

4.0 Agricultural Plastic Diversion Steps

The diversion of agricultural plastics (grain bags, twine, bale and silage film and net wrap) from Saskatchewan must follow a series of steps, similar to that depicted in Figure 4.1.

There are four key steps:

- Generation;
- Collection;
- Consolidation and transfer; and
- Processing.

A network of consolidation depots would be set up to receive agricultural plastics. Farmers could deliver their agricultural plastics to these depots or a network of service providers could be deployed to undertake this work. The depots would transfer agricultural plastics to processors for recycling.

4.1 Generation

Table 4.1 depicts the estimated generation rates of agricultural plastics on the farm.

Table 4.1 Estimated Generation Rates of Agricultural Plastics

Plastic	Plastic Resin	Annual Tonnage*
Grain Bags	LDPE	1,130
Twine	PP	1,070-1325
Bale/Silage Wrap	LDPE	540-970
Net Wrap	HDPE	210

* CleanFARMS, 2010

4.2 Collection

To divert agricultural plastics from disposal they must first be collected on farm. This includes segregating like materials together- i.e. grain bags, bale and silage wrap, twine and net wrap. Agricultural plastics collected would be taken to a consolidation depot by the farmer or through a service provider.

Care needs to be maintained during the collection process. A contamination rate of 5-10% is tolerated by processors. Contamination includes grain, hay, straw, manure, soil and rocks.

Some detail on the collection of agricultural plastics is presented.

Grain Bags

Grain bags need to be rolled to facilitate the efficient transfer of grain bags. It is envisaged that a grain bag roller (roller) would be available from a consolidation depot or service provider. As noted in Section 3 two pilot projects let farmers use rollers by appointment. The peak generation time for grain bags is from October through March.

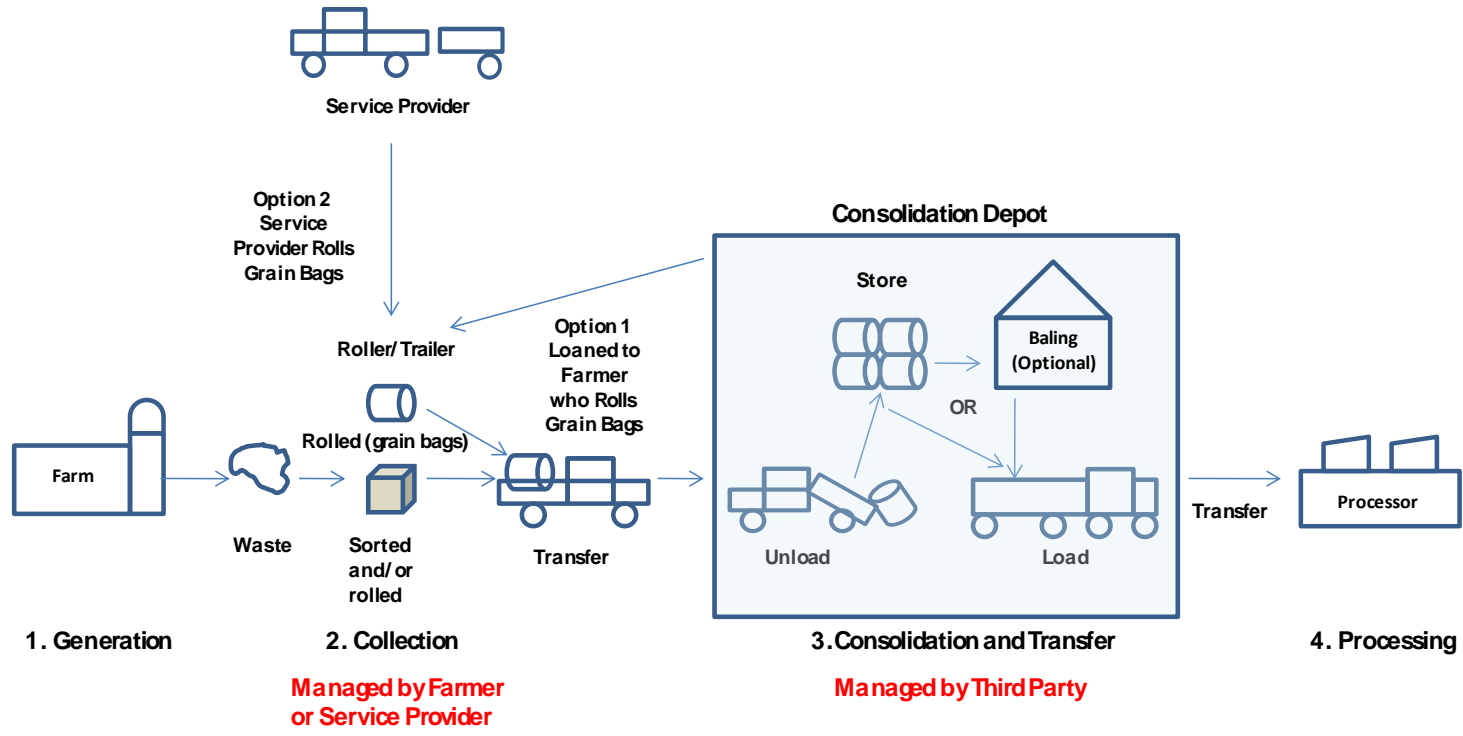


Figure 4.1 Overview of the Generation and Diversion of Agricultural Plastics

Twine

Twine would be wound by hand and placed into bags.

Examples of bags include large bulk bags (used to convey seed and feed) or large clear plastic bags. There appears to be a trend for farms to use clear plastic bags to collect twine for recycling. Normally some sort of frame is used to hold up the plastic bag. Twine is thrown in the bag after removal from bales. When full it can be tied off and taken away to be recycled.

Bale and Silage Wrap

Bale wrap and silage film would have to be consolidated on the farm. They are generally lighter and easier to bundle and handle than grain bags (can be done without a bag roller), but still require time and energy to do so.

Bale wrap is made from Linear Low Density Polyethylene and sold in rolls. Silage plastic is Low Density Polyethylene and comes in tubes or is in flat sheets and used as bunker covers. Silage film is more similar to grain bag material and though usually dirtier than grain bag material, would be more likely to be kept separate and recycled with the grain bag material. It is understood that there is currently little recycling of these materials.

Net wrap

Net wrap would have to be consolidated on the farm. It could be bundled or bagged for collection. Net wrap is generally heavily contaminated as stored products and other materials stick to it. Best practices for its collection need to be developed.

There does not appear to be any markets for net wrap because it is difficult to handle and because it can be made from either HDPE or PP (and are indistinguishable), which are not compatible in recycling processes.

4.1.3 Consolidation and Transfer

Consolidation and transfer would take place at a network of consolidation depots.

Agricultural plastics would be stored on site until there were sufficient materials to transfer to a processor. Staff from the consolidation depot would arrange for the transfer of these materials to processors and would be responsible for tracking on site costs, transfer costs and revenue.

4.1.4 Processing

The agricultural plastics would be processed and recycled. The processor may pay revenue for the agricultural plastics received. This will depend on the type of agricultural plastic, its state (i.e. level of contamination) and current market prices for plastic resins.

5.0 Analysis of Options for the Recycling Agricultural Plastics

There are a multitude of possible options for the collection, consolidation and transfer and processing of agricultural plastics. Based on the analysis outlined in previous sections, this report focuses on options as summarized in Table 5.1.

Table 5.1 Summary of Options for Recycling Agricultural Plastics

	Options	Description
Collection	Option 1 Farmer Delivers Agricultural Plastic Waste to Consolidation Depot	Farmer manages collection of agricultural plastics from his farm and delivers to consolidation depot
	Option 2 On Farm Collection by a Service Provider and Delivery to Consolidation Depot	An Industry Stewardship Organization provides on farm collection of agricultural plastics and takes to a consolidation depot
Consolidation and Transfer	Standalone Consolidation Depot	Standalone consolidation depots are owned and operated by Industry Stewardship Organization
	Public Consolidation Depot	Consolidation depots are operated at existing public facilities (e.g. landfill) by Industry Stewardship Organization
	Private Consolidation Depot	Consolidation depots are operated at existing private sector facilities (e.g. retail location, elevator) by Industry Stewardship Organization
Processing	Local Processing	Agricultural plastics are processed and marketed in Saskatchewan
	Canadian Processing	Agricultural plastics are processed and marketed in Canada
	US Processing	Agricultural plastics are processed and marketed in US

This Section describes the various options in some more detail.

5.1 Collection

Detailed cost estimates of each collection option are provided in Section 6.

5.1.1 Option 1 - Farmer Delivers Agricultural Plastic Waste to Consolidation Depot

A farmer would roll up his grain bags and collect any other agricultural plastics and deliver them to the nearest consolidation depot. It is assumed that the consolidation depot is staffed on at least a part time basis. The roller used could either be one that is purchased and owned by the owners of the consolidation depot or it could be one owned by the farmer himself.

5.1.2 Option 2 - On Farm Collection by a Service Provider and Delivery to Consolidation Depot

A network of service providers, owned or contracted by an Industry Stewardship Organization, would each have a flat-bed truck (or similar) and roller that includes space to hold rolled grain bags and other agricultural plastics.

5.2 Consolidation and Transfer

A network of consolidation depots, owned or contracted by an Industry Stewardship Organization, will be used to receive, consolidate and transfer agricultural plastics.

There are three main types of consolidation depots envisaged:

- Staffed (at least part time) depot where farmers drop off agricultural plastic; and
- Unstaffed depot where service providers drop off agricultural plastics; and
- Combination of the previous two depot types.

Staffed consolidation depots would receive agricultural plastics from the local agricultural community, with local being defined as the closest consolidation depot to a farm. From Saskatchewan focus group research it is understood that farmers would be prepared to go up to 50km “out of their way” (i.e. beyond what they would normally travel to pick up supplies etc.) to drop off agricultural recyclables.

The consolidation depot could be open year round or be focussed on times of peak generation. It would not necessarily need to be constantly staffed. Farmers could access consolidation depots during regular business hours or through some other approach. Ultimately this will be a function of balancing costs with the quality of incoming agricultural plastics. On site staff will result in better policing of incoming agricultural plastics and minimize the influx of other wastes.

Unstaffed depots would be used by service providers delivering loads of agricultural plastics collected on various farms. They would only receive loads from service providers who would also manage the sites.

Depot staff or service providers would store the agricultural plastics in such a way that their quality is not compromised, minimize vectors and to facilitate efficient loading when there are sufficient quantities.

It is assumed that little consolidation of agricultural plastics will take place on site although it may be necessary to roll or re-roll poorly rolled grain bags. Incoming twine will need to be stored together..

At minimum every consolidation depot will require the following:

- Land for storage and loading;
- Roller and trailer (only for staffed depots);
- Loading ramp to accommodate van trailers;
- Part-time operator;
- Site management; and
- Access to Bobcat (or similar) for loading van trailers.

System costs would include:

- Purchasing/leasing of land;
- Land development including fencing, storage area, possible processing areas and loading areas;
- Roller and trailer (only for staffed depots);
- Rental of loading equipment; and
- Transportation costs.

There are three main staffed/unstaffed consolidation depots options:

- Standalone;
- Public; and
- Private.

Table 5.2 presents the advantages and disadvantages of each of these options.

The following provides a more in-depth examination of consolidation depot options.

5.2.1 Standalone Consolidation Depots

This would entail locating suitable lands and developing “green field” consolidation depots. These depots would incur considerable capital costs (i.e. land and site development).

If necessary the depot would need to be staffed by an Industry Stewardship Organization to receive and transfer agricultural plastics.

Potential liability would need to be considered and appropriate insurances obtained.

It is assumed that standalone depots would represent the most expensive depots because of capital requirements and because dedicated staff would need to be hired to operate it. There is no opportunity to develop cost efficiencies through the shared use of land and staff.

5.2.2 Public Consolidation Depots

This would entail working with a public entity to use an existing facility as an agricultural plastic consolidation depot.

This could include:

- Landfills;
- Municipal Depots;
- Regional Municipality Public Works Yards;
Existing Materials Recovery Facilities (MRFs) or drop-off sites currently collecting other materials (tires, oil, beverage containers)

Table 5.2 Summary of Advantages and Disadvantages for Consolidation Depot Options

Depot option	Advantages	Disadvantages	Assessment
Standalone	<ul style="list-style-type: none"> • Dedicated site • Ability to develop standard design for consolidation depots across Province 	<ul style="list-style-type: none"> • Need to purchase or lease land and develop a green field consolidation depot • Operating costs dedicated exclusively to diversion of agricultural plastics 	<ul style="list-style-type: none"> • May be a useful option if there are no public or private locations available for a consolidation depot
Public	<ul style="list-style-type: none"> • No need to purchase land • Ability to develop efficiencies by combining consolidation depot with an existing facility • There are a number of public facilities that already handle other waste streams • Depending on the type of facility it may be possible to co-market agricultural plastics with other plastics being sent to market 	<ul style="list-style-type: none"> • Need to work within confines of existing facility • Potential for insufficient storage space • Potential for conflict with existing uses although less so at facilities that already accept waste 	<ul style="list-style-type: none"> • Use of an existing public location should be explored for each consolidation depot • This option should be reasonably feasible in most cases
Private	<ul style="list-style-type: none"> • No need to purchase land • Farmers already travel to location to deliver grain or purchase supplies • Possible cost efficiencies because existing location may have staff and equipment 	<ul style="list-style-type: none"> • Need to work within confines of existing facility • Potential for insufficient storage space • Pronounced potential for conflict with existing retail uses (e.g. vectors, and odour 	<ul style="list-style-type: none"> • Use of an existing private location should be explored for each consolidation depot • It is likely that this option will be deemed not feasible at most locations

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This would involve sharing space and possibly labour with existing facilities that already typically handle some type(s) of waste.

Both the MJRWS and PCAB have employed this approach for part of their pilot programs.

A method of payment would need to be developed to cover the cost of using the facility, contribution to staffing costs to ensure orderly receipt of materials and loading of transfer vehicles.

Potential liability would need to be considered and appropriate insurance obtained.

Public Consolidation Depots have proved to be an efficient way of collecting agricultural plastics (although current pilots only collected grain bags and twine). Utilizing existing facilities that have similar operations has the potential to reduce equipment, infrastructure and staffing costs.

Landfills, Municipal Depots and RM Public Works yards are generally already zoned for equipment and storage, familiar to potential users and many have already addressed vector issues. MRFS are generally in communities (may not be able to bait for vectors; may have zoning issues) but would have the loading equipment, consolidation equipment and loading docks. MRFs would function as *de facto* processors as they would direct the agricultural plastics to processors. Many existing drop-off sites for other recyclable materials such as SARCAN depots) are generally in communities and may not have the equipment or zoning for grain bag storage.

5.2.3 Private Consolidation Depots

This would entail working with a private entity to adapt an existing facility to include an agricultural plastic consolidation depot.

This could include:

- Grain Elevators;
- Private sector transfer stations; and
- Retailers/Suppliers take back.

A method of payment would need to be developed to cover the cost of using the facility, contribution to staffing costs to ensure orderly receipt of materials and loading of transfer vehicles.

Potential liability would need to be considered and appropriate insurance obtained.

While this approach works well for other stewardship programs there are some potential conflicts for agricultural plastics. Rolled grain bags may continue to house some grain. This can lead to vector attraction and the generation of odours. Other recycled agricultural plastics may have contaminants (e.g. manure) which are incompatible with facility operations.

An advantage of utilizing grain elevators is that as grain is removed from grain bags, it is generally hauled to an elevator. Elevators are convenient, are utilized by farmers and have staff and equipment on site. There may be concerns from elevator operators related to vectors and odour. Current grain extracting equipment does not roll grain bags so a farmer would likely not be able to transport the grain bag to the elevator when hauling the grain.

The advantages of utilizing local retailers and/or suppliers are similar to the grain elevators in that the location is familiar and utilized by farmers, there is staff and generally equipment. Bulk fuel and/or chemical retailers are generally on the edge of municipalities and may also have vector baiting in place. Many of these retailers (especially those located in communities or those that handle food) may have space issues and concerns related to vectors and odours.

5.2.4 Transfer

Agricultural plastics would be removed from the depot when there is a full load (20,000 kg) and taken to a processor selected by the consolidation depot. A full load could consist of a single agricultural plastic (e.g. grain bags) or a combination of materials. This would depend on the end processor.

Ideally a consolidation depot has sufficient agricultural plastics for a full load but there could be collection from a number of consolidation depots to fill a load. This will add to the loading cost as the collection vehicle needs to drive to more than one depot and incur loading time at each depot before departing to the processor.

It is possible for consolidation depot staff or service providers to contract transportation companies directly to remove loads of agricultural plastics. It may be advantageous to work with the processor to arrange for transportation as they typically have relationships with trucking companies and can obtain better pricing.

It is important for each consolidation depot to have appropriate loading infrastructure. This includes a loading ramp to load van trailers.

As well, each consolidation depot will need to have access to loading equipment (e.g. rental of Bobcat or similar) to load van trailers. It is important that experienced and insured operators load the van trailers.

The cost of a load of agricultural plastics appears to be from \$1,500 to \$3,000 per load or from \$1.00-\$1.50/km or about \$75-\$150/tonne (based on a 20,000 kg load).

5.3 Processing

Once there are sufficient quantities of agricultural plastic at a consolidation depot they will need to be transferred off site for processing and marketing. The selection of processors will be based on those that provide the best revenues.

Table 5.3 presents a summary of the various processing outlets for agricultural plastics.

April 2013

Table 5.3 Overview of Processing Outlets for Agricultural Plastics

Agricultural Plastic	Plastic Resin	Processors	Revenue Range
			\$/tonne
Grain Bags	LDPE	Merlin Plastics (AB, BC, CANADA) Crown Shred and Recycling (SK, CANADA)	\$50-\$100 -\$50 (tipping fee)
Bale and Silage Wrap	LDPE	Terra Con (CA, USA) EFS Plastics (ON, CANADA) Merlin Plastics (AB, BC, CANADA) Crown Shred and Recycling (SK, CANADA)	\$100 \$100 \$100 -\$50 (tipping fee)
Twine	PP	Bridon Cordage (MN, USA) JBI Inc. (NY, USA) Agilyx (OR, USA) Crown Shred and Recycling (SK, CANADA)	\$290 up to \$50 up to \$50 \$50 (tipping fee)
Net wrap	HDPE	There are no obvious processors of net wrap. It may be possible explore energy from waste opportunities.	\$50 (tipping fee)

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The following provides a more in-depth examination of processing options.

5.3.1 Local Processing

Agricultural plastics could be processed in Saskatchewan.

Crown Shred and Recycling Inc. (CSR) is able to collect and process grain bags, bale/silage wrap and twine. They are not able to handle net wrap.

They have the ability to collect and return agricultural plastics from consolidation depots to its locations in Regina and Prince Albert (they already accept agricultural plastics here). There would be handling, transportation and tipping fees to bring agricultural plastics to their materials recovery facilities (MRFs). There would be no revenue for agricultural plastics.

They also have the ability to direct agricultural plastics to other MRFs in Saskatchewan where they could be baled (charge) prior to directing to a processing facility.

They also indicated that they would consider offering a mobile baling service where a baler/trailer could be taken to consolidation depots a number of times per year to bale up agricultural plastics prior to transporting them to MRF for processing.

5.3.2 National Processing

Agricultural plastics could be processed elsewhere in Canada.

For instance Merlin Plastics Supply Inc. (Merlin) is able to receive and process bale and silage wrap and grain bags. They work with a Hutterite colony in Hussar, Alberta to process these agricultural plastics (Crowfoot Plastics). This facility continues to accept agricultural plastics, despite a stoppage in late 2012. Merlin has a facility in Delta, BC which can process these agricultural plastics. Material volume has been steadily increasing over the past three years. The plant has available capacity. They have also expanded plastic recycling operations into Alberta.

There are other potential Canadian processors as noted in Table 5.3.

5.3.3 US Processing

Agricultural plastics could be processed in the US.

Bridon Cordage of Albert Lea, MN, USA is a key recycler of twine. They arrange and/or pay for collection for the generating location to their facility. Typically the twine is collected loose (i.e. not baled). Typical loads are between 38,000 and 40,000 pounds (i.e. 17-18 tonnes). Baled loads can come in at 45,000 pounds (i.e. 20 tonnes).

It is critical that twine not have more than 8% contamination, although some is expected. It is critical that twine remain dry to facilitate processing and recycling. Steps would need to be taken at the consolidation depot to ensure that the twine remains clean and dry.

There are other potential US processors as noted in Table 5.3.

6.0 Cost Analysis of Collection, Consolidation and Transfer and Processing Options

As noted in Section 5 there are two general options for the collection of agricultural plastics:

- Option 1. Farmer Delivers Agricultural Plastic Waste to Consolidation Depot; and
- Option 2. On Farm Collection by Service Provider and Delivery to Consolidation Depot.

Cost estimates were generated for both of these options.

The following general assumptions were used:

- Consolidation depots located at public sector (default) or private sector locations;
- Staffed consolidation depots receive a minimum of **50** tonnes/year of agricultural plastics;
- Service providers can collect a minimum of **180** tonnes/year of agricultural plastics and take them to unstaffed consolidation depots;
- Grain bags arrive at consolidation depots rolled;
- Baling can be made available (if required) for twine and net wrap;

- Agricultural plastics are transferred to processors that offer the highest revenue for agricultural plastics; and
 - Grain bags- **\$100/tonne**
 - Twine-**\$290/tonne**
 - Bale and Silage Wrap-**\$50/tonne**
 - Net wrap-**\$50/tonne tipping fee**
- Transfer costs are **\$0.00-\$1.50/km**.

It should be noted that, when implemented, the amount of agricultural plastics received at consolidation depots or collected by service providers will vary and may be lower or higher than the above assumptions. The above collection assumptions do not represent a maximum but a reasonable mid-point.

Additional detail on costing assumptions can be found in Appendix 3.

Total system costs, including administration and communication and education program costs are also described.

6.1 Options

6.1.1 Option 1 Farmer Delivers Agricultural Plastic Waste to Consolidation Depot

In this option the farmer is responsible for collecting and delivering agricultural plastics from their farm to a consolidation depot operated by an Industry Stewardship Organization.

A template consolidation depot was developed and would consist of the following:

- Land for storage and loading (ca. 1 acre) at an existing public site;
- Roller and trailer;
- Loading ramp to accommodate van trailers;
- Access to baler (if required);
- Full-time or Part-time operator (i.e. on-site staff);
- Site management; and
- Access to Bobcat (or similar) for loading trailers.

A model was developed to help estimate consolidation depot costs.

The default costing model was tested based on an estimate of the agricultural plastics that would be received at a consolidation depot (Table 6.1). This assumed that each depot would accept about 50 tonnes/year of agricultural plastic.

It was assumed that capital costs would include:

- Roller and Trailer (\$8,000); and
- Site Development (could include construction of ramp, fencing) (\$5,000).

It was assumed that agricultural plastics are taken out of province (Alberta, British Columbia and Minnesota, US) because these locations provide the highest revenues or processing options.

Table 6.1 Estimate of Agricultural Plastics Diverted at a Template Consolidation Depot

Agricultural Plastic	Annual Amount Diverted	Logic Used to Develop Estimate
Grain Bags	300 rolls	Estimate of two loads/year. Relatively easy to consolidate on farm (with roller) and has good markets.
Bale and Silage Film	2,000kg	1/10 load. On farm consolidation methods still need to be developed. Has no potential market and contamination is a concern.
Twine	10,000kg	½ load. Twine is produced in abundance, is relatively easy to consolidate on farm and has good markets.
Net wrap	2,000kg	1/10 load. On farm consolidation methods still need to be developed. Has no potential market and contamination is a concern.

Two Scenarios based on facility operating times and staffing level were tested.

Scenario 1-Low	6 months per year with part time on site personnel during business hours (ca. 16 hours/month).
Scenario 2-High	12 months per year with part time on site personnel during business hours (ca. 80 hours/month).

Table 6.2 provides some detail on estimated annual consolidation depot operating costs.

Table 6.2 Overview of Estimated Annual Consolidation Depot Operating Costs

Cost Items	Scenario 1-Low	Scenario 2-High
Capital	\$2,100	\$2,100
Land leasing	\$3,000	\$6,000
Management time	\$2,000	\$3,900
Staff time	\$2,400	\$24,000
Maintenance	\$1,000	\$1,000
Insurance	\$1,000	\$1,000
Other	\$1,000	\$1,000
Standby Time	\$900	\$900
Bobcat rental	\$1,000	\$1,000
Bags	\$800	\$800
Baling Cost	\$600	\$600
Transportation	\$5,700	\$5,700
	\$21,500	\$48,000
Revenue	\$6,300	\$6,300

Table 6.3 details the estimated operating costs, revenue and net annual operating costs. The net annual operating cost would range between \$0.28 and \$0.77/kg.

Table 6.3 Overview of Consolidation Depot Operating Costs

	Scenario 1-Low	Scenario 2-High
	kg/ year	
Agricultural Plastics	54,500	54,500
	\$/ year	
Operating Costs	\$21,500	\$48,000
Revenue	\$6,300	\$6,300
Net Annual Operating Cost	\$15,200	\$41,700
	\$/ kg	
Net Annual Operating Cost	\$0.28	\$0.77

If one assumes agricultural production spans the width of the province (about 600 km) wide and that it extends north from the US border about 700 km to Meadow Lake then it would take 42 consolidation depots to provide coverage so that each farm would not need to travel more than 50 km to access a consolidation depot.

Table 6.4 depicts the estimated costs if 42 consolidation depots were implemented. Based on the template consolidation depot capture rate of about a minimum of 50 tonnes/year, this could result in the capture of 2,100 tonnes/year of agricultural plastics. There is currently an estimated 3,300 tonnes/year of agricultural plastics in the province.

Table 6.4 Overview of Multiple Consolidation Depot Costs

Consolidation Depots	Scenario 1-Low	Scenario 2-High
42		
Net Annual Operating Costs	\$639,000	\$1,752,000

6.1.2 Option 2. On Farm Collection by Service Provider and Delivery to Consolidation Depot

In this option a service provider hired by an Industry Stewardship Organization would come to the farm and collect agricultural plastics and deliver them to a consolidation depot. There would be no out-of-pocket costs for this service for the farmer.

A farmer would contact a central dispatcher and indicate the number grain bags and other agricultural plastics that are available to be collected from their location. The central dispatcher would coordinate and schedule the service provider to proceed to the farms. The central dispatcher would work to ensure that there is a critical mass of agricultural plastics to be collected in a region and incorporate this into scheduling.

The service provider would arrive at the farm to roll and load grain bags and any other agricultural plastics. There would be some assistance from farmers required to roll grain bags and load agricultural plastics. There would be no out-of-pocket costs for this service for the farmer.

A template for the on farm collection of agricultural plastics by a service provider was developed by undertaking research into vehicle types and cost and staffing costs.

A template service provider system was developed and would consist of the following:

- Flat bed work truck, trailer and roller;
- Access to baler (if required);
- Operator(s) (one or two);
- Cell phone and GPS;
- Fuel for travel to and from the sites; and
- Hotel and accommodations for operators while collecting from a geographic area.

A model was developed to help estimate on farm collection costs with the following assumptions:

- Service providers would be on the road from October through March to coincide with grain bag extraction;
- Each service provider could collect 10 grain bags or equivalent agricultural plastics each day;
- Costs were based on the collection of grain bags;
- There would be one consolidation depot per service provider; and
- The consolidation depots would be unstaffed and used only by service providers.

It was assumed that capital costs would include:

- Roller and Trailer (\$8,000);

April 2013

- Flat bed work truck (\$60,000); and
- Site Development (could include construction of ramp, fencing) (\$5,000).

Two Scenarios based on the number of operators was tested.

Scenario 1-Low	Collection service provided for 6 months with one full time operator.
Scenario 2-High	Collection service provided for 6 months with two full time operators.

Table 6.5 provides some detail on estimated operating costs.

Table 6.5 Estimate of Collection by Service Provider Costs

Cost Items	Scenario 1-Low	Scenario 2-High
	\$/ year	
Capital	\$12,000	\$12,000
Management time	\$0	\$0
Staff time	\$32,000	\$64,000
Mileage	\$33,000	\$33,000
Daily expenses	\$20,000	\$40,000
Other	\$1,000	\$1,000
Total	\$98,000	\$150,000

Table 6.6 provides some detail on productivity and estimated unit costs for on farm service provider collection and delivery to a consolidation depot.

Table 6.6 also includes the cost to manage these agricultural plastics at an unstaffed consolidation depot. It is assumed that these consolidation depots receive only agricultural plastics delivered by service providers and that they are used for 6 months/year.

Table 6.6 Estimate of Collection by Service Provider Costs

	Scenario 1-Low	Scenario 2-High
On Farm Service Provider Collection		
#/ day		
Grain bag rolling and removal	10	10
kg/ bag		
Weight of a grain bag	135	135
kg/ load		
Weight per load	1,350	1,350
bags/ year		
Bags collected	1,320	1,320
\$/ bag		
Cost per bag	\$74	\$113
kg/ year		
Kg collected	178,200	178,200
\$/ kg		
Cost per kg	\$0.55	\$0.84
Consolidation Depot Costs		
\$/ kg		
Cost per kg	\$0.11	\$0.11
Total Cost		
\$/ kg		
Total cost	\$0.66	\$0.95

Therefore the cost to manage agricultural plastics would range from \$0.66 to \$0.95/kg.

Table 6.7 depicts the estimated costs if 10 service providers were utilized. Based on the template service provider capture rate of about 180 tonnes/year (including grain bags and other agricultural plastics), this would result in the capture of up to 2,000 tonnes/year of agricultural plastics. There is currently an estimated 3,300 tonnes/year of agricultural plastics in the province.

Table 6.7 Estimate of Collection by Service Provider Costs

Service Providers	Scenario 1-Low	Scenario 2-High
	On Farm Service Provider Collection	
10	#/ day	
Net Annual On Farm Operating Costs	\$980,000	\$1,500,000
Net Annual Consolidation Depot Operating Costs	\$191,000	\$191,000
Total Annual Cost	\$1,171,000	\$1,691,000

6.2 Financing and Administration of Agricultural Plastics Recycling

The cost to administer an agricultural plastic recycling program in Saskatchewan is depicted in Table 6.8.

This office would work with each of the consolidation depots to help track the capture of recyclables, help arrange for transportation of agricultural plastics to processors and help secure best revenues for recycling agricultural plastic. It is assumed that program administration would be the same for both Option 1 and 2. These costs would need to be added to the costs of Option 1 and 2 (Section 6.3).

The cost of education and awareness programs will need to be added to this. In general expenditures of \$50,000 per \$1,000,000 of overall costs can be assumed.

Table 6.8 Estimated Program Administration Costs

Office	\$8,000
Staff (1.25 FTE)	\$120,000
Membership Services	\$5,000
Travel	\$15,000
Committee meetings	\$8,000
Insurance	\$6,000
Accounting	\$10,000
Legal	\$10,000
Annual report	\$8,000
Total	\$190,000

6.3 Summary

Table 6.9 presents a summary of the cost/kg for the two options under the various scenarios analyzed in this study.

Table 6.9 Summary of Costs

	Description	Low	High	Comments
		\$/ kg		
Option 1	Farmer Delivers Agricultural Plastic Waste to Consolidation Depot	\$0.28	\$0.77	50 tonnes per staffed consolidation depot
Option 2	On Farm Collection by Service Provider and Delivery to Consolidation Depot	\$0.66	\$0.95	180 tonnes per service provider to unstaffed consolidation depot

For Option 1 It will cost an estimated \$16,000-\$42,000/year to operate a staffed consolidation depot. Each consolidation depot would receive about 50 tonnes/year. Based on the assumptions outlined in this report, it is estimated that 42 consolidation depots may be required to adequately service the province. Bag rolling equipment would be provided on loan to farmers but they would be expected to collect and deliver their own agricultural plastics to the depots.

For Option 2 it will cost \$100,000-\$150,000/year/service provider to collect agricultural plastics directly from the farm and that each would collect 180 tonnes/year. The service provider would take these agricultural plastics to an unstaffed consolidation depot (i.e. that would only receive agricultural plastics from service providers). Based on the assumptions outlined in this report, it is estimated that up to 10 service providers may be required to adequately service the province. This service would be provided to farmers by the Industry Stewardship Organization and the costs would be added to the stewardship fee/levy charged on the various agricultural plastics as they are purchased.

Both Option 1 and Option 2 allow for private sector on-farm collection service businesses to emerge. Under Option 1, farmers, would have the option of hiring and paying these service providers to collect agricultural plastics and take it to a consolidation depot. Under Option 2 the Industry Stewardship Organization would pay the costs and add it to stewardship fee/levy. Either way it is anticipated that the cost to operate consolidation depots is the same as described in Option 1. Similarly it is anticipated the collection cost of private service providers is the same as noted in Table 6.6.

Option 1 and Option 2 presented the estimated costs to recycle agricultural plastics in Tables 6.10 and 6.11. This includes administrative and communication and education program costs that were described in Section 6.2.

Comment [M3]: May I suggest introducing and putting table 6.10 here instead. Putting the two tables at the end of the section is overly confusing.

Comment [M4]: Similarly as above comment, may I suggest introducing and putting Table 6.11 here instead.

Table 6.10 Summary of Total System Costs- Option 1

Consolidation Depots	Scenario 1-Low	Scenario 2-High
42		
Net Annual Operating Costs	\$639,000	\$1,752,000
Administrative Costs	\$190,000	\$190,000
Subtotal	\$829,000	\$1,942,000
Education and Awareness Cost	\$42,000	\$98,000
Total Cost	\$871,000	\$2,040,000

Table 6.11 Summary of Total System Costs- Option 2

Service Providers	Scenario 1-Low	Scenario 2-High
	On Farm Service Provider Collection	
10	#/ day	
Net Annual On Farm Operating Costs	\$980,000	\$1,500,000
Net Annual Consolidation Depot Operating Costs	\$191,000	\$191,000
Total Annual Cost	\$1,171,000	\$1,691,000
Administrative Costs	\$190,000	\$190,000
Subtotal	\$1,361,000	\$1,881,000
Education and Awareness Cost	\$69,000	\$95,000
Total Cost	\$1,430,000	\$1,976,000

7.0 Methods to Facilitate the Capture of Agricultural Plastics

A permanent province wide program to capture agricultural plastics should be easy to use and convenient. The expertise gained through the MJWRS and PCAB pilot programs should be used as a starting point.

The process of collecting agricultural plastics must be relatively straight forward and something that fits in with ongoing farm activities. In the case of grain bags it is imperative that a roller/trailer is readily available to facilitate rolling grain bags. For twine it may be prudent to supply clear plastic bags for farmers to use. For bale and silage film and net wrap systems need to be developed to efficiently capture these materials on farm.

Consolidation depot opening times need to be convenient and align with when agricultural plastics are generated. Staffing of consolidation depots can help facilitate the orderly delivery of agricultural plastics.

There are a number of approaches that can be taken to develop a permanent program to capture agricultural plastics. This ranges from voluntary to mandatory and includes financial incentives and supportive tools.

In any event a permanent program should be accompanied by a comprehensive communication and education program that speaks to farmers about why and how to participate in an agricultural plastics recycling program.

7.1 Financial Incentives

Financial incentives can be used to stimulate the capture rate of agricultural plastics. These incentives will need to be over and above the costs of recycling these plastics.

It would provide farmers with a financial interest in the proper after use management of the agricultural plastics they purchase.

Furthermore, and importantly it also opens up opportunities for entrepreneurs to develop businesses that can help facilitate the capture of agricultural plastics. This includes businesses that can collect agricultural plastics from farmers and deliver them to consolidation depots.

Regardless of the financial incentive it is important to consider implementing some type of 'certificate' system to ensure that a fee has been paid on all agricultural plastics. This is to ensure that all manufacturers are in the system and to ensure there are no outside products coming in from outside the province.

There are a number of financial incentives that could be implemented.

7.1.1 Bounty Based

A service provider financial incentive (bounty) could be developed whereby a collector of agricultural plastics would be financially rewarded (on a per kg or per unit basis) for agricultural plastics that it is able to collect from farms.

If the incentives are sufficient this would incent service providers to develop programs to capture these materials.

This is similar to the Return Incentive (RI) program used for used oil and oil containers and described in Section 2.7.

This would require a weighing system or other enumerating method to calculate rebates for service providers bringing agricultural plastics to a consolidation depot.

7.1.2 Deposit Return

A deposit return system could be used to encourage farmers to divert agricultural plastics. This would include the addition of a deposit fee placed on agricultural plastics at the point of purchase. To be clear this deposit return would be over and above the fees required to finance the agricultural plastic recycling program.

With the return of those items the deposit would be returned.

A system would need to be set up to collect deposits at the point of purchase. This could include some type detachable certificate that comes with each product. For instance for grain bags there could be a fixed deposit per bag. When a bag is purchased a farmer would receive a paper certificate for each bag (i.e. proof that a deposit has been paid). Upon returning the grain bag to a consolidation depot it should be accompanied by the certificate. A similar program could be set up for twine, bale and silage wrap and net wrap but on a weight basis. The deposit would be paid on the weight of material sold (e.g. a roll of twine will have a standard weight).

The deposit return approach would work similarly to the RI approach except that the farmer now has a vested financial interest in the proper management of these agricultural plastics.

This may further stimulate the ability of an entrepreneur (i.e. service provider) to set up a business to collect agricultural plastics and work out with the farmer a fair approach on how to split up the deposit for recycling agricultural plastics.

8.0 Conclusions and Recommendations

General Conclusions

- The provision of consolidation depots where farmers deliver their own agricultural plastics are less expensive (Option 1) than where a service provider collects agricultural plastics (Option 2);
- Public sites such as municipal/regional landfills that already handle wastes appear to be the best candidates for consolidation depots;
- Private sites such as agricultural equipment and supply retail stores, grain elevators, etc are less feasible for consolidation depots because of possible conflicts with their operation including vectors and odour; and
- The two agricultural plastic recycling pilot programs provide a good starting point for a province wide program and current depots, infrastructure and systems should be incorporated where practical.

General Recommendations

- Start with a voluntary program for farmer participation;
- Use PCAB/MJWRS consolidation depots sites as starting point and ensure that all have loading ramps;
- Assess current consolidation depots to ensure they achieve a critical mass of a minimum van trailer load and consolidate as necessary;
- Identify other high agricultural plastic generation areas and develop consolidation depots around these areas;
- Provision in the program plan for undertaking a pilot using Option 2 (i.e. service provider) in part of the province once consolidation depots are operational; and
- Encourage private sector to set up service delivery programs to collect agricultural plastics from farmers. This could be coupled with financial incentives.

Comment [KT5]: No mention of Western Canadian approach. I think this may create some nervousness

Comment [KT6]: Sorry... still don't get it. Voluntary for farmers but mandatory for stewards.

9.0 References

2010. CleanFARMS. Saskatchewan Agriculture Film Plastic Study.
2006. MJRWS. The Moose Jaw River Watershed Source Water Protection Plan.
2013. Quirk, Travis. Collection, Processing & Recycling of Agricultural Plastics in Saskatchewan. Provincial Council of ADD Boards. Pilot Program > 2011 – current. (Presentation at Saskatchewan Agricultural Plastics Stewardship Kick-off meeting, January 30, 2013)
2011. CleanFARMS. Primer for Extended Producer Responsibility. Closing the Loop on Agricultural Waste
2013. PCAB. Collection, Processing and Recycling of Agricultural Plastics in Saskatchewan

Appendix 1
Summary Tables of Extended Producer Responsibility (EPR)
Programs in Saskatchewan

Table 2.1 a Extended Producer Responsibility Programs in Saskatchewan-Overview

Product	Stewardship Organization	Website	Collection	Processing/Marketing
Beverage Containers (not including milk)	Saskatchewan Association of Rehabilitation Centres (SARC)	http://www.sarcsarc.ca/	Containers are brought to SARCAN depots by consumers.	SARCAN
Milk Containers	Unified Dairy Recycling System is a stewardship program by Saskatchewan's dairy industry	http://www.sarcsarc.ca/	Washed out containers are brought to SARCAN depots by consumers.	SARCAN
Scrap Tires	Saskatchewan Scrap Tire Corporation	http://www.scraptire.sk.ca/	Material is brought to collection sites by users (1350 retailers)	Two Saskatchewan companies process and market the material: Shercom Industries and Assiniboia Rubber Recycling
Paint and Paint cans	Product Care	http://productcare.org/Saskatchewan	Material is brought to SARCAN depots by users	Envirotec Services Ltd. Is the processor/marketer of used paint.
Waste electronics computers, audio visual machines, display devices	SWEEP	http://www.sweepit.ca/	Material is brought to SARCAN depots	SARCAN processes and markets products that are returned to SARCAN (assume the same applies to all private collectors)
Obsolete Pesticides and Empty Pesticide Containers. VOLUNTARY	CleanFarms	www.cleanfarms.ca	Materials are brought by users to collection sites where pesticides are safely disposed of and containers are recycled	Processor - Curtis Construction Ltd.

Product	Stewardship Organization	Website	Collection	Processing/Marketing
Used Oil, Oil Filters and Containers	SARRC - Saskatchewan Association for Resource Recovery Corp.	http://usedoilrecyclingsk.com/	Material is brought to approved collection sites by users	List of processors at: http://usedoilrecyclingsk.com/registered-used-oil-materials-processors.php
Rechargeable batteries and cell phones. VOLUNTARY	Call2recycle (no (known) formal Saskatchewan stewardship organization)	www.call2recycle.ca	Material is brought to collection sites and retailers by users	Multiple collection locations in Saskatchewan but no (known) formal stewardship, processor or marketer for the Province of Saskatchewan

* Adapted from CleanFARMS (2011) and expanded

Table 2.1 b Extended Producer Responsibility Programs in Saskatchewan-Financing/Funding and Performance

Product	Stewardship Organization	Financing	Incentive Programs	Tonnes Collected	Recovery Rate
				tonnes/year	%
Beverage Containers (not including milk)	Saskatchewan Association of Rehabilitation Centres (SARC)	Beverage distributors are charged an environmental handling charge (EHC) by government which is passed through to consumers at the till.	In addition to the EHC, consumers also pay a deposit (legislated by the Government of Saskatchewan) that is returned to them when they return the container to a SARCAN depot for recycling	2011-2012 18,198	2011-2012 87
Milk Containers	Unified Dairy Recycling System is a stewardship program by Saskatchewan's dairy industry	Program is funded through an environmental handling charge (EHC) on the sale of fluid milk. Non-refundable recycling charge on large containers. Funds are remitted to the Saskatchewan Milk Control Board and used for the collection and recycling of the material through the SARCAN depots.	No monetary incentive for consumers to return the product at end-of-life.	2011-2012 Milk Jugs - 475 Milk Containers - 173	2011-2012 Plastic Milk Jugs - 46.1 Milk Containers - 24.6
Scrap Tires	Saskatchewan Scrap Tire Corporation	Tire consumers are charged Tire Recycling Fee (TRF) which is used to finance the program	No monetary incentive for consumers to return the product at end-of-life.	2011 17,794 tonnes recycled (18,597 tonnes collected)	SSTC Does not publish a recovery rate.

Product	Stewardship Organization	Financing	Incentive Programs	Tonnes Collected	Recovery Rate
				tonnes/year	%
Paint and Paint cans	Product Care	The manufacturer is charged an eco- fee which is usually passed through to the consumer. Consumer is charged an eco fee when purchasing paint.	No monetary incentive for consumers to return the product at end-of-life.	2011 349,660 L 101 tonnes metal paint cans 5 tonnes plastic paint containers	There is no recovery rate as the product is intended to be used up rather than returned.
Waste electronics computers, audio visual machines, display devices	SWEEP	The manufacturer pays an Environmental Handling Fee (EHF) which is usually passed through to the consumer. Consumer pays an environmental handling fee at purchase.	No monetary incentive for consumers to return the product at end-of-life.	2011-2012 3,425 tonnes	No recovery rate is currently available as the program is new and the products collected is diverse.
Obsolete Pesticides Program	CleanFarms	Financed by product manufacturers.	No monetary incentive for consumers to return the product at end-of-life.	36.4 tonnes	No recovery rate as the product is intended to be used up.
Empty Pesticide and Fertilizer Container Program.	CleanFarms	Financed by product manufacturers.	No monetary incentive for consumers to return the product at end-of-life.		66% (average of participating provinces)

Product	Stewardship Organization	Financing	Incentive Programs	Tonnes Collected	Recovery Rate
				tonnes/year	%
Used Oil, Oil Filters and Containers	SARRC - Saskatchewan Association for Resource Recovery Corp.	Financed by product brand-owners which is usually passed through to the consumer	Return Incentive™ (RI) program The RI program pays registered trucking companies to go pickup oil at smaller sites (it is paid to truckers after confirmation that what is picked up goes to proper recycling facilities)	2011 Used oil 18.6 million litres 2.47 million filters 410 tonnes of plastic recycled	2011 Used oil – 75% Oil Filters – 83% Plastic oil containers -47% 24% reused on farm (pails)
Rechargeable batteries and cell phones. VOLUNTARY	Call2recycle	Financed by product manufacturers	Return sites are often at locations where purchase of new products occurs.	2012 Cell Phones: 4,250 Rechargeable Batteries: 13,511 lbs Non-rechargeable Batteries: 6,995 lbs	No recovery rate available as materials are often purchased and recovered in different years. Many rechargeable batteries are recycled with electronic products making it difficult to properly account for rechargeable batteries only.

* Adapted from CleanFARMS (2011) and expanded

Appendix 2
List of Subject Matter Experts

List of Subject Matter Experts

Organization	Contact Name	Area of Expertise
AT Films Inc.	Carl Watkins	Manufacturer
Bridon Cordage	Terry Van Kampen	Manufacturer
Federated Co-operatives Limited	Trevor Carlson	Distributor
Grain Bags Canada	Aaron Yeager	Distributor
Peavey Industries	Harold Dyck	Distributor
Agricultural Producers Association of SK	Norm Hall	Farmer/Producer
Crown Shred and Recycling Inc.	Jack Shaw	Recycling Market
Merlin Plastics	Kevin Kernaghan	Recycling Market
Moose Jaw River Watershed Stewards Inc.	Tammy Myers	SK AgWaste Collection/Processing
PCAB	Tamara Weir-Shields	SK AgWaste Collection/Processing
Saskatchewan Ministry of Environment	Marlon Killaby	Government
Saskatchewan Ministry of Environment	Shelly Nicolle-Phillips	Government

Appendix 3
Assumptions and Inputs for Options 1 and 2

Option 1 Consolidation Depot Costing Assumptions

Capital	Scenario 1 - Low	Scenario 2 - High		
Roller/ Trailer	\$8,000	\$8,000		
Site Development	\$5,000	\$5,000		
Total	\$13,000	\$13,000		
Annual payment	\$2,087	\$2,087		
Operating	Scenario 1 - Low	Scenario 2 - High	Units	
Capital Amoritization	7	7		
Capital Interest Rate	3	3		
Operation	6	12	months/ year	
Monthly land leasing cost	\$500	\$500	\$/ month	
Management time	8	8	hours/ month	
Management time	\$40.00	\$40.00	\$/ hour	
Staff time	16	80	hours/ month	
Staff time	\$25.00	\$25.00	\$/ hour	
Maintenance	\$1,000.00	\$1,000.00	\$/ year	
Insurance	\$1,000.00	\$1,000.00	\$/ year	
Other	\$1,000.00	\$1,000.00	\$/ year	
Bobcat rental	\$85.00	\$85.00	\$/ hour	
	Grain Bags	Bale and Silage Wrap	Twine	Netwrap
	Rolls	kg	kg	kg
Annual Weight	300	2,000	10,000	2,000
	\$/ kg			
Bags	0	0	0.07	0.07
	\$/ tonne			
Baling	0	0	\$50.00	\$50.00
	%			
Contamination	10	20	8	30
	kg			
Weight of Full Load	20,000	20,000	20,000	20,000
	Hours			
Time to Load	4	4	4	4
	\$/ hour			
Standby Time (Transporter)	\$75	\$75	\$75	\$75
	km			
Distance to Processor	1,750	1,750	1,700	700
	\$/ km			
Transportation Fee	\$1.50	\$1.50	\$0.00	\$1.50
	\$/ kg			
Revenue	\$0.10	\$0.05	\$0.29	-\$0.05
Rolled Grain Bag Weight	135	kg		
Van Trailer Load	20	tonnes		
Grain Bag Rolls	150	rolls/ van trailer		

Option 2 Service Provider Costing Assumptions

Scenario 1	Collection service provided for six months with one full time operator.		
Scenario 2	Collection service provided for six months with two full time operators.		
Capital	Scenario 1-Low	Scenario 2-High	
Depots	1	1	
Roller/ Trailer	\$8,000	\$8,000	
Truck	\$60,000	\$60,000	
Site Development	\$5,000	\$5,000	
Total	\$73,000	\$73,000	
Annual payment	\$11,716.96	\$11,716.96	
Operating	Scenario 1-Low	Scenario 2-High	Units
Capital Amortization	7	7	years
Capital Interest Rate	3	3	%
Operation	6	6	months/ year
Work days	22	22	#/ month
Work hours	8	8	hours/ day
Management time	0	\$0	\$/ month
Management time	\$40.00	\$40.00	hours/ month
Staff	1	2	#
Staff time	\$30.00	\$30.00	hours/ month
Mileage	250	250	km/ day
Mileage	\$1.00	\$1.00	\$/ km
Daily Expenses	\$150	\$150	\$/ day
Other	\$1,000	\$1,000	\$/ year