CONTINUOUS IMPROVEMENT FUND

Depot Compactor Guide

CIF Project 764

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1 Introduction

The cost of transporting recyclable materials can be a significant contributor to a municipality's overall recycling costs. Moreover, the light weighting of consumer packaging is causing these costs to increase dramatically. For example, for many rural municipalities, residential depot/transfer costs can be more than 50% or 75% of their total gross blue box costs.

In recent years, the Continuous Improvement Fund (CIF) has been working with a number of rural Ontario municipalities to explore the benefits of using compactors instead of open top roll-off containers for the storage and transportation of recyclable material in depot operations. This report has been prepared to identify better practices in purchasing and operating compaction containers, as learned through the experiences of these municipalities.

The experience of the municipalities participating in the CIF compactor projects have been positive, with the most common benefit being a reduction in the number of loads hauled to the processing facility for recyclable materials and subsequent reduction in transport costs. These and other benefits will be explored in this guide. In all cases, the operations were previously using open top roll-off containers to store and transfer materials. The benefits and savings associated with the use of compactors is based primarily on a comparison to this alternative for the purposes of this guide.

This guide is divided into eight sections, including:

- Section 1: Introduction;
- Section 2: Purchasing a Recycling Compactor;
- Section 3: Considering a Compactor;
- Section 4: Solar Powered Compactors;
- Section 5: Cost Considerations;
- Section 6: Site Considerations;
- Section 7: Operational Considerations (including lessons learned); and
- Section 8: For More Information.

2 Purchasing a Recycling Compactor

2.1 Considerations

There are a number of factors that should be examined when determining whether a recycling operation would benefit from installing a compactor. These include:

- **Distance from the processing facility and frequency of shipments** - The farther (e.g., 40 km or more) and more often a community ships its recycling, the more reasonable it is to consider a compactor. This is because transport costs increase as shipping distances increase, resulting in a greater opportunity for savings if the frequency of trips are reduced. For example, a municipality paying $200 or more per trip for 80 trips or more for an un-compacted container could realize significant savings. The size of the opportunity for savings will be greater as the cost per trip and trip frequency increases.

- **Amount and type of material collected for recycling** - Communities that ship large quantities of recyclable materials will have more opportunities for cost savings than those that ship very little, as savings are realized by reducing the number of shipments required. The cost effectiveness for a compactor increases with greater rates of compaction, which can vary according to material. For example, based on a recent density study completed by CIF, volume reductions may be as low as 36% for mixed fibres to as high as 85% for old corrugated cardboard (OCC) (see Table 1).

- **Ability of the MRF to receive compacted recyclables** - Some MRFs (Material Recycling Facilities) and commodity buyers may have a maximum density they will accept for loads of recyclable materials. For example, some MRFs limit the compaction of mixed plastics to a 2:1 ratio. Compaction restrictions can limit the potential for any savings a compactor could provide.

- **Size of the recycling depot** - The ability of compactors to store more material in a smaller ‘footprint’ can be an important consideration in space constrained operations where the alternative would be placement and storage of numerous roll off containers.

- **Availability of power supply at the site** - Because compactors require power to operate, the availability of power at the site, at sufficient amperage levels, is an important consideration. If the site does not have access to hydro, a generator and/or solar power would be required to run the compactor and has labour and cost implications.

Table 1: Compaction Densities for Various Recyclable Materials

Material	Uncompacted Density (kg/m3)	Compacted Density (kg/m3)	Compaction Ratio	Uncompacted Volume of 1 tonne of material (m3)	Compacted Volume of 1 tonne of material (m3)	Volume Reduction (%)
All Fibres	106.9	166.9	1.6	9.4	6.0	36%
Fibres, no OCC	110.6	198.91	1.8	9.0	5.0	44%
OCC	17.2	111.7	6.5	58.1	9.0	85%
Containers and glass	64.4	118.8	1.8	15.5	8.4	46%

Data Source: Continuous Improvement Fund. CIF Project #737 - Density Study Phase 1 Project Synopsis.

2.2 Benefits of a Recycling Compactor

There are a number of potential benefits to incorporating a compactor into your recycling diversion depot or transfer operations. These include:

1. **Economic Savings from Reduced Transportation and Staff Requirements** - Compactors provide cost savings in a number of ways:

    a. Compactors hold more material so they reduce the total number of containers transferred throughout the year resulting in lower annual transportation costs. For example, Table 2 provides examples of Ontario municipalities that have reduced the number of container transfers by 68% to 84%.

    b. The potential to store the same amount of material on site in fewer containers can result in reduced container rental costs.

    c. Compactors can be fitted with remote monitoring systems which can reduce staff monitoring time especially for remote depots. Many depots using open top roll-offs also schedule regular pickups whether containers are full or not. Compactors, because of their ability to hold more material allow site operators to optimize shipping schedules

    The Ontario examples of compactor installations listed in Table 2 show transport cost savings in the range of 61% to 82%.

2. **Space Savings** - Collecting recyclables in compactor containers requires less square footage (i.e., a smaller footprint) than if the materials are collected loose in open top roll-off containers.

3. **Environmental Benefits** - Fewer shipments made to transport recyclable material will reduce the amount of fuel used and greenhouse gas emitted from transportation.

4. **Safety** - Risks of injury can be reduced, particularly when staff is required to manually or physically compact the recyclables. The enclosed design of compactors also reduces the risk of residents and/or staff accidently falling in a container or otherwise entering a container (e.g., to salvage materials).

5. **Site Cleanliness** - Compactors reduce the likelihood of materials falling out of containers or being blown around the site. Because compactor containers are enclosed, they also minimize the ability of animals and birds getting into the recycling containers and spreading material around.

6. **Reduced contamination** - With many rural depots being unstaffed, the enclosed nature of compactors provides some protection against contamination compared to open collection containers. For example, recycling is typically deposited into a compactor through a small side panel or hatch, which prevents the public disposing large unacceptable items.

Table 2 on the following page highlights the results of a sample of Ontario municipalities that have installed compactors to manage recyclable material.

Table 2: Compactor Use Outcomes

Municipality	Number of Drop-off Transfer Sites	Distance Shipped (kilometres)	Material Shipped (Tonnes)	Number of Shipments (pre-Compactor)	Number of Shipments (post-Compactor)	Reduction in Lifts (%)	Transport Cost (pre-Compactor)	Transport Cost (post-Compactor)	Transport Costs Reduction (%)	Investment Payback[1]
Township of Seguin	4	65 km (average)	45 tonnes (Jan - Mar)	61 (Jan - Mar)	10 (Jan - Mar)	84%	$19,800 (Jan - Mar)	$3,700 (Jan - Mar)	81%	6 years
Township of McKellar	1	113 km	71 tonnes	79	15	81%	$39,400	(projected) $9,400	76%	4.1 years
District of Muskoka	4	31 to 69 km	260 tonnes	184 (May - Sept)	59 (May - Sept)	68%	(projected) $65,900	(projected) $25,400	61%	n/a
Township of Carling	2	108 km (average)	n/a	n/a	n/a	n/a	$60,000	$10,800	82%	3.5 years
Municipality of McDougall	2	89 km (average)	170 tonnes	105	44	62%	$40,094	$17,816	64%	3.1 years
Municipality of Whitestone	2	132 km (average)	n/a	n/a	n/a	n/a	$12,353 (Jan - Apr)	$2,467 (Jan - Apr)	80%	n/a

n/a = information not available

Note 1: Investment payback calculated as the division of ***the capital cost by the annual transport cost savings****. This calculation does not include annual operating expenses or capital replacement reserve costs.*

3 Compactor Selection

It is common practice at municipal recycling depots to collect and transfer roll-off containers on a regular schedule e.g. Monday and Friday. This practice is the function of the limited storage capacity of roll-off containers, which results in the need to empty containers at a depot before the weekend residential traffic traditionally peaks followed by an additional Monday morning pickup in order to maintain operations. While scheduled pick-ups simplify coordination of container transfer, the consequence is that the municipality frequently pays full price to transfer partial loads. Municipalities using compactors have found that the greater holding capacity of compactors and ability to monitor container 'fullness' remotely allows them more control over when and how often containers require transportation to the MRF and further reduced their operating costs beyond the savings achieved by material compaction.

There are a wide range of type and size of compactors that are suitable for recycling depots and transfer stations, depending on their individual needs. Municipalities should consult with a trusted supplier and/or other municipalities to identify a compactor that best suits their needs. Questions a supplier should be able to answer include:

- What size and type of compactor and degree of compaction is required at the site, based on the type and quantity of recyclable material collected and MRF requirements?
- How many and what size of collection containers are required at the site, based on the recommended type and number of compactors?
- What are the spacing and structural requirements for the compactor and collection containers?
- What is the best configuration of containers and compactors, based on the existing and/or possible layout of the site and flow of traffic?
- What are the power requirements for the compactor, based on the power configuration and availability at the site?

Figure 1 shows an example of a compactor installation in a rural recycling depot.

There are two main options for powering compactors. The first and most conventional option is by connecting the compactor to the hydro power grid. However, this option may be less feasible for depots or transfer stations in remote locations. A second option is a solar powered compactor. A solar compactor includes a solar panel that is used to charge a bank of batteries which, in turn, runs the compaction motor and is backed up by a generator and/or 110V hydro line. Solar powered compactors are discussed in more detail in Section 4.

Automation and Remote Monitoring

Compactors typically come equipped with pressure sensors that provide the operator with an indication of the remaining capacity of the container. On sites that are permanently staffed, staff can routinely check to see if the compactor needs to be cycled and/or the container is full enough to require collection. Many sites in Ontario are only staffed occasionally or are entirely unstaffed. For these types of sites, automation and remote monitoring may be useful approaches.

Automated compactors allow for compaction to occur without requiring the action of an operator. A typical automated compactor would operate as follows:

- Recyclable materials are deposited into the compactor through slots or chutes, which are designed to keep out oversized materials such as furniture or propane tanks. They are also designed to prevent someone from falling or crawling inside.
- An optical sensor is located within the compactor. When the receiving chamber is full, the material interrupts the beam emitted at the sensor. This indicates to the compactor that the hopper is full and a compaction cycle can be run. Once the compaction cycle is run, the material is compacted and the beam is no longer interrupted.
- This cycle repeats until either a programmed number of cycles or a specified ram pressure is reached. The desired number of cycles or ram pressure is determined through calibration of the equipment.
- In addition to the slots and chutes designed to prevent access inside the containers, the compactors can also be equipped with a light and alarm that goes off prior to running a compaction cycle or camera to monitor the charge chamber.

Remote monitoring systems provide another means for operators of remote sites to manage their equipment without having to be physically on location. Remote monitoring systems include a wireless modem that transmits data about the compactor to the operator. The monitoring system can collect information from the compactor such as the number of times the compactor has run (e.g., number of rams), the ram pressure, and other items. When this data is sent to the operator, he or she can determine whether a collection is required and schedule it without having to go to the site. The system can also advise when there is a problem at the site with the compaction system. For example, if an automated system is being used and something is blocking the optical sensor, the attendant is advised and can go to the site to fix the issue. This allows for a more efficient allocation of labour and avoids unnecessary travel costs (e.g., fuel, wear and tear on vehicle, staff time).

The remote monitoring system can also include video from within the compaction container. This gives the attendant the ability, from a remote location, to visually monitor for contamination and to make sure it is safe to start a compaction cycle (see Figure 2).

Figure 1: Compaction Containers, Sequin Ontario

Access to these compaction containers are via an elevated surface, with recyclable materials deposited into the compactor via a chute. The recyclable materials are fully enclosed, preventing blown litter and access by animals. The brown chute depicted is for cardboard and fibres (see image below)

Access to the container recycling container is through a hinged compartmentalized chute door (similar to that of a post office drop box or a library book return). This prevents access of large unsuitable materials. Access to the cardboard and fibres container is thorugh a wide slot, which encourages flatening of boxes.

Figure 2: Remote Monitoring

Top left: Video camera inside a material receiving enclosure, which allows attendant to monitor contents of enclosure prior to running compaction cycle.
Top right: Example of video footage from within the enclosure.
Bottom left: Pandora remote communications modem and electrical panel on compaction container.

4 Solar Powered Compactors

In situations where three phase hydro is not available at the depot site, and where the costs of installing it are prohibitive, a battery bank with sufficient capacity to cycle the compactor efficiently is necessary.

Solar power can provide an energy source to supply the battery bank and in turn run a compactor. A solar power system typically includes:

- Solar panels;
- Batteries, which store the energy generated by the panels (e.g., four 6V batteries); and
- A supplemental energy source to provide power during periods where there is insufficient sunlight, such as a generator or connection to hydro.

Best practices related to using solar powered compactors include:

- **Battery Protection –** Storage areas should be designed to prevent batteries from freezing. Low temperatures can reduce the efficiency of the batteries and extended exposure of batteries to freezing conditions can cause costly replacements. For example, batteries can be kept within the attendant building, assuming it is heated. Otherwise, an insulated and heated outside storage unit for the batteries may be required.
- **Regular Cleaning –** Solar panels require regular cleaning (e.g., removal of snow or wiping off dust and dirt) to ensure they are operating at maximum efficiency. The frequency of the cleaning would depend on the season and local conditions at the site. For example, snow will need to be removed from the panels in the winter, and sites with unpaved or dirt traffic areas may need to wipe away dust on a daily basis. However, these tasks can be integrated with regular site house-keeping duties with minimal added cost, whether the site is permanently staffed or not.
- **Back-up Energy Source –** A solar power system requires a supplemental energy system to recharge the batteries when solar input and/or temperatures are low (e.g., winter months in Ontario). Typically, this comes in one of three forms: connection to the hydro grid; a permanent generator; or a portable generator (which is not recommended). If available, connection to the hydro grid may be most advantageous because it requires the least amount of maintenance and operator intervention. Otherwise, a generator would be required, which would require maintenance and upkeep. Whether it is a portable or permanent generator would depend on the setup of the solar powered units. For example:
    - A portable generator may be useful if there are a few sites using solar power, if an attendant routinely visits each site, and if the portable generator is of sufficient size to efficiently charge the batteries. However, this would include an on-going labour cost and would increase the risk of damage to battery capacity if they are allowed to fall below a critical charge.
    - A permanent generator is likely more advantageous, particularly if only one or two sites require supplemental power or if the size of the battery installation requires a larger generator.

- **Arrangement of Solar Panel Array -** While some configurations for solar powered compactors include a small dedicated panel array and batteries for each compaction unit, another option is to have a larger centralized system of solar panel arrays and batteries to power all the compactors onsite (see Figure 3). In such a configuration, the compactors would only run one at a time, either manually cycled by an attendant, or by the timing of automated systems. Advantages of this type of configuration is that the batteries can be housed in one central heated storage unit and maintenance/cleaning of the panels becomes easier. Also, the panels can be situated in the optimum location on the site with respect to collection of solar energy, rather than attached directly to the compaction containers.
- **Oversizing the Solar Power Units –** When selecting the solar power units, consider upsizing them (e.g., purchasing a unit 10% larger than the minimum required size). This may help offset diminished efficiency of the batteries over time and provide some buffer if power requirements unexpectedly increase. Also, as the light-weighting of recyclable materials continues, volumes of recyclables will keep increasing and therefore increase how often compaction is required.

Figure 3: Example of Centralized Solar Power Configuration

Top left: Structure with solar panels in foreground is a centralized solar panel configuration. Inside left side of structure in vented portion containing standby power generator, with battery storage on the right side. The compaction units are in the background of the picture.
Bottom left: View of compaction units.
Top right: Standby power generator.
Bottom right: Electrical panels inside centralized solar power structure.

5 Cost Considerations

Depending on the municipality's Blue Box program and volume of material, a compactor installation may include two or more units. A traditional two stream Blue Box program would require separate compactors for the fibres and containers. Even a co-mingled (i.e., single stream) program may require a secondary compactor to deal with seasonal resident volumes or unique circumstances, such as where a program operator wishes to keep large volumes of a particular material (e.g., cardboard or expanded polystyrene) separate. Table 3 below illustrates typical capital costs for a single compactor installation at a site with 3 phase power supply, including remote monitoring.

Table 3: Typical Compactor Installation (Capital) Unit Costs

Component	Typical Cost
Compactor including installation (assumes 1 compactor unit)	42,000 [1]
Two 40 yd^3 roll of container	9,000
Site preparation (concrete pads)	$6,000 to $10,000
Power Connection	$1,000 [2]
Back-up generator	$8,000
Labour	$3,000
Remote monitoring	$1,800 to $2,800
Signage	$500
Total	**$71,300 to $76,300**

Note 1: The capital cost for equipment can vary substantially due to various factors, particularly the exchange rate between the Canadian and American dollars. For example, the average annual Bank of Canada exchange rate to US Dollars was $0.99 in 2011, $1.03 in 2013, and $1.28 in 2015[1].

Note 2: While $1,000 has been assigned to power connection in Table 3 above, this value can increase if there are significant power upgrades required. For example, compactors connected to the hydro grid should run on three phase power. Single phase can be used, but it will require more power and could have a higher operating cost in the long run. It will also typically require a minimum 100 amp service.

Typically, each compactor requires at least two 40 cubic yard enclosed containers assigned to it, so that full containers can be swapped with an empty one, thereby allowing the compactor to continue operating while the full container is in transit. However, depending on the travel time to reach the recycling facility, some municipalities may be able to manage their program with three 40 cubic yard roll off containers per two compactor units.

When estimating the cost-benefit of a compactor, the following should be considered:

- The cost to transfer un-compacted materials compared to compacted;
- Anticipated staff and/or labour costs associated with proceeding and not proceeding with compaction; and
- Costs for a capital replacement reserve (generally 10 years, depending on use, weather, etc.);
- Costs related to maintenance of the equipment, which would be approximately $400 to $600 per year if contracted out, or less if performed in-house; and

[1] Bank of Canada. http://www.bankofcanada.ca/rates/exchange/annual-average-exchange-rates/.

- Operational costs in addition to staff/labour costs, which could include:
  - Electricity (~ $1,600 to $2,000, if solar panels are not being used).
  - Generator fuel costs (~ $2,000 to $2,500 per year, if solar panels are being used); and
  - Monthly monitoring subscription ($25 per month, or a one-time licensing fee of about $1,000).

As noted in Table 1, payback periods for the investment can vary but may range between 2 to 10 years.

6 Site Considerations

There are a number of things that need to be considered when configuring the site layout. These include:

- **Power Supply** - The compactor will need a power supply of sufficient capacity. For units connected directly to the hydro grid, a three phase 230v connection is preferred. A single phase connection is possible, but it will be more expensive to install and operate, as it is less efficient than a three phase. If solar panels are being used to generate the electricity and the hydro grid is used as a supplemental power supply, then a single phase 120v connection should be adequate. In any case, when connection to the hydro grid is used in a remote setting, consideration for security should be made during installation to protect against the risk of electricity theft.

- **Site Elevation and Grade** - The site layout will need to be flat to help protect against unintended rolling or tipping of the container and concrete pads for the compactor units should be at grade level to prevent a tripping hazard. For a site configured for un-compacted containers where recyclable material is loaded by users from an elevated platform such as a 'sawtooth'), the compactor can be fitted with a hopper that accommodates loading from an elevated level. The cost of such a hopper and chute is approximately $30,000.

- **Traffic Flow** - Layout of the containers and compactors should consider a number of aspects of traffic flow through the site, including:

    - Safe flow of public traffic through the site, including provision for the stopping and unloading of vehicles;

    - Safe queuing of vehicles entering the site and waiting to park and unload;

    - Pedestrian routes through the facility and near containers, particularly during times when the compactor is cycling (compacting) and the public must be kept at a safe distance;

    - Flow of staff either on foot or using work vehicles, including collection vehicles emptying the collection containers; and

    - Safe flow of traffic exiting the facility, including sightlines for exiting onto the road.

- **Security** - The site should be protected from unauthorized access, including illegal dumping or vandalism.

- **Position of Solar Panels** - If the compactor is using solar panels, then the panels must be located and oriented in such a way that it has unimpeded access to sun. Solar panels should also be located out of the way of pedestrian and vehicle traffic to avoid accidents.

- **Sizing of Concrete Pads** - Concrete pads to accommodate the compactor and associated roll off container should be adequately sized for the dimensions and full weight of the compactor and container (e.g., approximately of 16 centimetres deep by 3 metres wide by 10 metres long for a 40 cubic yard compactor).

- **Safety** - The compactor's material receiving area must be constructed or monitored to prevent a person, either accidentally or intentionally disposing potentially harmful items such as propane tanks. This can be accomplished by using appropriately sized and configured chutes or openings for recyclable material only. This is especially important when compaction is automated. An additional safety element is the use of flashing lights and alarms that run when the operator starts the compaction cycle.

7 Operational Considerations

7.1 Health and Safety

The following are health and safety considerations when installing and operating a compactor at a recycling depot:

- Compactors typically come equipped with lock outs to prevent unintentional operation and an emergency shut off button.
- The top of concrete pads that accommodate the compactors should be at grade; otherwise, the concrete lip can create a tripping hazard (see Figure 4).
- The location of the compactor's control panel and solar panels should be installed in a location where it is safe from being walked into by staff or the public or backed into by a vehicle.
- Hopper doors should include a latch that keeps it open during operating hours, as opening the door to dispose material may be difficult for members of the public. Furthermore, it prevents the hopper door from accidently swinging closed and hitting the user.
- Guard rails or posts may need to be installed to protect the compactor unit and associated controls.

Figure 4: Concrete Pad Trip Hazard and Corrections

Top left: Solar compactor on concrete pad. Elevated pad creates trip hazard.
Top right: Trip hazard corrected through building of asphalt ramp.
Bottom left: Similar concrete pad trip hazard corrected through application of gravel to correct grade.

Source of images: County of Peterborough. CIF Project # 275 Final Report. December 2011.

7.2 Lessons Learned

A review of other municipality's experiences with recycling depot and transfer station compactors (including solar) reveal the following lessons learned:

Design, Purchase and Installation

- Ensure that power line connection to the compactor is protected from potential damage. For example, one municipality experienced damage to its wires when a bear tried to climb up on top of a compactor. The damage to the wires meant that the municipality was unable to open the hopper door. The municipality addressed this by welding angle iron over the exposed wiring.
- Depending on the type of hydraulic oil used in the compactor, it may need to be heated during the winter months to ensure it remains at a sufficient viscosity to operate the ram. If the oil viscosity gets too low, more power will be required to run a compaction cycle. This in turn will reduce the number of cycles that can be powered by the batteries. Some grades of hydraulic oil can be used year-round without heating, while others will require heating.
- Provide a large enough area around the hopper for residents to stand and/or park cars (particularly for cardboard) and encourage residents to breakdown oversized items before depositing them into the hopper. Stations that are too close to each other could cause traffic jams and increase the risk of accidents between a pedestrian and vehicle.
- Purchasing used equipment can provide cost savings; however, equipment should be checked by a qualified technician.
- When installing a new compactor, budget time for commissioning and troubleshooting activities, such as:
    - Fine-tuning compactor compression rates to maximize capacity;
    - Testing remote monitoring systems;
    - Calibrating compactor settings, particularly if an automated system is being used; and
    - Testing power supply and (if solar powered) battery charging processes.
- Ensure your contractor provides an adequate warranty on all parts and installation and is willing and able to provide immediate assistance with troubleshooting potential compactor issues post-installation. For example, a contractor that is from outside of your region or Ontario may face challenges responding to issues that require their technicians on-site.

Power Supply

- If power is not available at the site, then a back-up generator for solar power compactors should be included to run the compactor and charge batteries when the amount of available sunlight is insufficient.
- Establish a procedure for monitoring the battery charging system, based on the supplier's recommendations, and train site staff to ensure it is working properly.

Operations and Maintenance

- Sites should include at least one open top loose material container that can be made accessible to the public for overflow requirements or in case of a compactor malfunction.
- For remote depots, include a remote monitoring system as part of the initial design and installation of the compactor system.
- As with any operation, compaction containers should be monitored closely during peak times, such as during the Christmas and New Year's holidays, to avoid overflow or unsightly conditions.
- Facility operators will need to identify a suitable frequency of when to run the compactor. If the compactor is not operated often enough, then the hopper can become over-filled, which will require more time for the operator to cycle the compactor and result in a higher risk of the compactor jamming.
- Solar compactors have a longer compaction cycle time, particularly during colder months. For example, a compactor connected to the hydro grid will have a typical cycle time of 50 to 60 seconds, while a solar powered compactor may take 3 to 5 times longer. During very cold weather periods, solar cycle time can be as long as 15 minutes. Typically, rural depots are underutilized in the winter compared with the summer so this factor may not pose an issue for most sites. However, hydro or generators may be a better alternative to power the compactor at sites that are busy year round or where panel maintenance will be an issue.
- As part of the municipality's on-going efforts to encourage better waste management practices among residents, provide facility staff with the necessary information to communicate to the public the importance of the compaction technology, for example the reduction of trucks entering and leaving the site, reduced greenhouse gas emissions, financial savings, etc.
- Regular maintenance of compactors is required and should be included in the annual operating budget.

8 For More Information

The following reports summarize the experience of CIF-funded Ontario municipalities with the purchase, installation and operation of compaction units for recycling, including solar compactors:

- CIF Project #275: County of Peterborough Final Report;
- CIF Project #280: Township of McKellar Solar Compactors Project;
- CIF Project #281: The Municipality of Whitestone Solar Powered Compactors Project;
- CIF Project #282: Municipality of McDougall;
- CIF Project #283: Carling Transfer Station Solar Powered Recycling Compaction Container Project;
- CIF Project #303: Final Report and Project Evaluation for Solar Powered Compactors for Recyclable Material Containers at Eveleigh (Port Carling), Mclean (Baysville) and Franklin (Dwight) Waste Transfer Stations in The District Municipality of Muskoka;
- CIF Project #405: The Township of McMurrich/Monteith Compactors Project; and
- CIF Project #832: Township of Seguin Installation of Compactor Systems.

Project reports are available online at http://cif.wdo.ca/projects/index.htm.