Project Feasibility Study

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1.0 Purpose

The purpose of this document is to provide a report on a study which evaluated various options that can be used as a Landfill Daily Cover (LDC).

2.0 Background

Waste is covered at landfills to control odours, blowing litter, fires, scavenging waste by birds or animals, and control diseases. The practice of covering waste in active areas of the landfill is referred to as "Daily Cover". City of Saskatoon (COS) Landfill in the past was issued a permit by the Ministry of Environment (MOE) to operate in accordance with sanitary landfill practices. Sanitary landfill practices consists of proper disposal of waste by adequately compacting and covering the disposed material with approved cover material as per the MOE. These daily cover practices had to be followed not less than three times per week prior to April 2, 2018.

On April 2, 2018, COS received a renewed Permit to Operate a Waste Disposal Grounds in accordance with modified landfill practices, from the MOE. This renewed permit prescribed the frequency of cover not to be less than one time per day from May to November and one time per two days from December to April. In order to meet the new MOE's guideline, the options for LDC and the process to effectively deliver results required to be studied.

A pre-feasibility study was completed in early 2018 to evaluate and select the most appropriate LDC alternatives based on a pre-defined set of values. This feasibility report has captured the recommended options from the pre-feasibility report and a further detailed study was conducted to make the final recommendation for the implementation of a LDC solution.

The pre-feasibility report identified each of the following options as viable, and the feasibility of each was further explored based on additional research and study. The pre-feasibility study also evaluated all known daily cover options available in the marketplace. Ultimately the feasibility report explored the following alternatives:

- Tarp
- Film Deployer – Self Propelled Unit
- Film Deployer with Dozer
- Film Deployer Modification
- Film Deployer with new Loader

The explored alternatives will cover up to 2400 square metres of active face. For this LDC feasibility study, a four year analysis period has been selected.

3.0 Methodology

As has become custom in the past year and a half in the Water & Waste Stream (W&WS) division, the methodology utilized to evaluate the alternatives was based on the Decision Quality (DQ) framework. This was developed at Stanford University and is recommended by the Strategic Decision Group. The DQ process is broken into six steps: *frame, values, alternatives, information, sound reasoning, and commitment to action*. Each of these areas is described below.

3.1 Frame

The decision frame answers “what opportunity is being addressed?”. Refer to the background section for relevant details.

3.2 Values

Values are often referred to as preferences. Clear values ensure that a quality decision can be attained. The purpose of this step is to establish what is most important to the stakeholders in making this decision. One alternative seldom meets all the desired values, and therefore trade-offs are required (i.e. deciding how much of one value to give up in order to get more of another).

The following values were identified by the project team.

- Regulatory compliance;
- Environmental sustainability & leadership;
- Health & safety;
- Customer service;
- Fiscal responsibility;
- Reliability; and
- Implementation time.

4.0 Alternatives

The pre-feasibility report identified each of the following options as viable, so the feasibility of each was further explored based on additional research and study.

4.1 Tarp

This option would involve the purchase of a tarp deployer, and utilization of an existing bulldozer operated by landfill staff to apply tarps as a daily cover. Tarps are built with polypropylene fabric and are very reliable during wind and rain events. Tarps are stored as rolls in the tarp deployer (aka spools) and each spool can cover up to 1200 square metres. A motorized engine is used to deploy tarps from the equipment through a wireless remote control system. Tarps will require removal at the beginning of the next workday prior to the placement of waste.

4.2 Film Deployer – Self Propelled Unit

This option would involve the purchase of a self-propelled film deployer that would be operated by landfill staff. The film would be applied as a daily cover. The film is impermeable, and made from polyethylene. The self propelled unit is a singular motorized unit that does not require a bulldozer to apply daily cover as compared to the other film deployer options.

4.3 Film Deployer with Bulldozer

This option would involve the purchase of a film deployer which would be used as an attachment on an existing bulldozer operated by landfill staff, to apply film as a daily cover. The film is impermeable, and made from polyethylene. This film deployer consists of a hopper that

holds ballast material and deploys the material during the placement of film to hold the film in place. Next day, wastes can be placed on top of the daily cover and will not require removal.

4.4 Film Deployer Modification - Fleet Services Section (FSS)

FSS has custom built a film deployer to fit on the existing track loader at the Landfill. Landfill staff will use this film deployer to apply a daily cover. The film is impermeable, and made from polyethylene. During deployment of film, the loader bucket sprinkles soil on top of the film which covers the waste.

4.5 Film Deployer with new Loader

The City currently owns a film deployer, which will require minor maintenance prior to use. The film is impermeable, and made from polyethylene. This option would involve the purchase of a new track loader and deploying film through the existing deployer unit. Landfill staff could apply this option as a daily cover. The option was evaluated to determine if increasing the capacity of the existing Powered Mobile Equipment (PME) would improve the feasibility of using the existing film deployer.

5.0 Information

5.1 Tarp

5.1.1 Regulatory Compliance

- Minimizes nuisances such as insects, rodents, odours.
- Does not help to prevent fire, or control fire. Does not accelerate fire.
- Prevents litter from being blown.
- Can be used up to 4 inch of snowfall. Tarps should not be used if more than 4 inches of snowfall is expected. Tarps are not designed to support more than four inches of snow.
- Improves site appearance.

5.1.2 Environmental sustainability & leadership

Some of the positive impacts are as follows.

- Utilizes no landfill airspace.
- Estimated equipment runtime of 580 hours yearly. This value is based on two hour daily usage of bulldozer runtime.
- Less Greenhouse Gas (GHG) emissions during the placement and removal of tarp compared to all other options. The total equipment runtime for tarp deployment is the lowest as compared to the other options.
- One element of the City's strategic plan (2013-2023) for environmental leadership is to become a recognized leader in Cold Climate Energy Efficiency. The use of a tarp as an alternative aligns with the strategic plan.

Some of the negative impact are as follows.

- Not applicable at this time.

5.1.3 Health & Safety (employees & public)

- Less risk for both employees and public as compared to rest of the other options.
- Operators will be working from inside the equipment for most of the time. The operator may be required to come out of the equipment to set the tarp, which will result in an exposure to hazards.
- Operators will be working around other PME.

5.1.4 Customer Service

- Landfill operating hours will not increase; however an alteration of shift schedules may be required to place the tarp after the landfill is closed.
- Customer service hours will not be affected.
- No impact on size/availability at the tipping face for drop offs

5.1.5 Fiscal Responsibility

- The capital cost of this option is estimated at $145,000. Contingency of 10% has been included in the capital cost.
- The annual operating cost for year one, two and four are estimated at $17,000 per year. Tarps would require replacement at the end of two years, hence year three operating cost is estimated at $63,000. Contingency of 10% has been included in the year three operating cost for material purchases.
- Recent improvements and reduction in equipment runtimes will allow for the capacity to utilize the dozer for this activity, and will not yield any net increase in dozer operating cost.
- Year one, two and four does not require the purchase of any material.
- Landfill airspace will not be occupied with the use of this cover method.
- Capital cost includes the deployer unit, tarps, and equipment accessories that will last year one and two.
- Operating cost includes operations, maintenance and labour cost for all four years. Year three includes the tarp and accessories replacement cost.
- Refer to Table 1, 2 and 3 in Appendix A for cost break down details.

5.1.6 Reliability

- Not recommend to use when more than four inches of snowfall is expected.
- The tarp may be hard to deploy if it freezes with some moisture over the day
- While collecting the tarps in the morning, it may be difficult to roll them back in to the spool as the material could be frozen.
- Will take approximately one hour to deploy and one hour to collect the next morning.

5.1.7 Implementation Timeline

- This alternative requires the deployer purchase to be publicly tendered and will take approximately 4 to 5 months to be in place.

5.1.8 Assumptions

- Two hours each daily for a Landfill Attendant and a Utility A.
- Takes one hour to deploy and one hour to collect tarp in the next morning. Total deployer runtime of two hours a day.
- Deployer operation and maintenance rate as $27.78 hourly excluding labour cost as provided by the manufacturer.
- On average, Saskatoon sees about 28 snow fall days a year with 73.5 cm of snow.
- 290 days a year estimated for daily cover days. December to April months require the active face to be covered every alternate day.
- The alternative will cover up to 2400 square metres of active face.
- Exchange rate of 1 USD equals 1.35 CAD.

5.2 Film Deployer – Self Propelled Unit

5.2.1 Regulatory Compliance

- Minimizes nuisances such as insects, rodents, odours.
- Does not help to prevent fire, or control fire. Does not accelerate fire.
- Prevents litters from being blown.
- Improves site appearance.

5.2.2 Environmental sustainability & leadership

Some of the positive impact are as follows.

- Uses landfill airspace compared to the tarp option.
- Less GHG emissions compared to the use of the film deployer with bulldozer option.
- Equipment runtime of 725 hours yearly. This value is based on two hours daily of film self-deployer runtime and half hour daily of loader runtime.
- One element of the City's strategic plan (2013-2023) for environmental leadership is to become a recognized leader in Cold Climate Energy Efficiency. The use of a film deployer as an alternative aligns with the strategic plan.

Some of the negative impact are as follows.

- Requires an estimated 5,300 cubic metres yearly of soil to hold the film in place, occupying landfill airspace.

5.2.3 Health & Safety (employees & public)

- Decreased risk for both employees and public compared to the other studied options during the pre-feasibility report.
- Operators will be working from inside the equipment for most of the time. The operator may be required to come out of the equipment to set the film, which will result in exposure to hazards.
- Operators will be working around other PME.

5.2.4 Customer Service

- Landfill operating hours will not increase; however an alteration of shift schedules may be required to cover the active face at the end of the day.
- Customer service hours will not be affected.
- No impact on size/availability at the tipping face during drop offs

5.2.5 Fiscal Responsibility

- The capital cost of this option is estimated at $488,000. Contingency of 10% has been included in the capital cost.
- The annual operating cost is estimated at $488,000 for year one. The year two, three, and four operating cost is estimated at $495,000 per year. Contingency of 10% per year has been included in the annual operating cost. The majority of the annual cost is associated with the film, which is procured in rolls.
- Total four year operating cost is estimated at $1.98 million.
- The equipment and film comes with a manufacturer setup and no modifications are required.
- Due to the use of soil as a ballast material on film, an estimated cost of $300,000 per year of landfill airspace is consumed.
- The capital cost includes a self-deployer unit, equipment accessories, freight, taxes and contingency.
- The annual operating cost includes loader time, deployer operations and maintenance, labour cost, ballast material, film rolls, and freight.
- Refer to Table 4, 5 and 6 in Appendix A for cost break down details.

5.2.6 Reliability

- Soil forms lumps and tends to clog the feeder. Other ballast material may be required during cold weather.

5.2.7 Implementation Timeline

- This alternative requires the deployer purchase to be publicly tendered and will take approximately four to five months to be in place.

5.2.8 Assumptions

- Two hours required daily for a Landfill Attendant and two and a half for a Utility A.
- Takes two hours daily to deploy the film.
- Half an hour of loader time to place soil in the film deployer container.
- 80 rolls a year to be used for cover estimated at $300,000 annually.
- $56 per cubic metre is used for the calculation on landfill space in this reports. This estimate was referenced from the May 2018 Council report, entitled “Landfill Airspace Value”.
- Soil cost is not included as part of the calculation, as the landfill currently receives clean fill at no charge.

- Freezing conditions may clog the ballast feeder during winter months if soil is used. An estimated 1800 cubic metres of alternate ballast material will be used. Other ballast materials cost was averaged at $21 per cubic metre and will cost $38,000 in material use. Average cost of sand, wood chips, and snow was taken to determine the estimated cost.
- 290 days a year estimated for daily cover days. December to April months require the active face to be covered every alternate day.
- The alternative will cover up to 2400 square metres of active face.
- Exchange rate of 1 USD equals 1.35 CAD.

5.3 Film Deployer with Bulldozer

5.3.1 Regulatory Compliance

- Minimizes nuisances such as insects, rodents, odours.
- Does not help to prevent fire, or control fire. Does not accelerate fire.
- Prevents litter from being blown.
- Improves site appearance.

5.3.2 Environmental sustainability & leadership

Some of the positive impact are as follows.

- Uses landfill airspace compared to the tarp option.
- Less GHG emissions compared to the previously explored options during pre-feasibility study.
- Equipment runtime of 870 hours yearly. This value is based on two hours daily of film self-deployer runtime and one hour daily of loader runtime.
- One element of the City's strategic plan (2013-2023) for environmental leadership is to become a recognized leader in Cold Climate Energy Efficiency. The use of a film deployer as an alternative aligns with the strategic plan.

Some of the negative impact are as follows.

- Requires an estimated 5,300 cubic metres of soil as a ballast material to hold the film in place, occupying landfill airspace.

5.3.3 Health & Safety (employees & public)

- Decreased risk for both employees and public compared to the other studied options during the pre-feasibility report.
- Operators will be working from inside the equipment for most of the time. The operator may be required to come out of the equipment to set the film, which will result in exposure to hazards.
- Operators will be working around other PME.

5.3.4 Customer Service

- Landfill operating hours will not increase; however an alteration of shift schedules may be required to cover the active face at the end of the day.
- Customer service hours will not be affected.
- No impact on size/availability at the tipping face during drop offs

5.3.5 Fiscal Responsibility

- The capital cost of this option is estimated at $136,000 . Contingency of 10% has been included in the capital cost.
- The annual operating cost is estimated at $492,000 per year. Contingency of 10% per year has been included in the annual operating cost. The majority of the annual cost is associated with the film rolls.
- Total four year operating cost is estimated at $1.96 million.
- The equipment and film comes with a manufacturer setup and no modifications are required.
- Recent improvements and reduction in equipment runtimes will allow for the capacity to utilize the dozer for this activity, and will not yield any net increase in dozer operating cost.
- Due to the use of soil as a ballast material on film, an estimated cost of $300,000 per year of landfill airspace is consumed.
- The capital cost includes a deployer unit, equipment accessories, freight, taxes and contingency.
- The annual operating cost includes loader time, deployer operations and maintenance, labour cost, ballast material, rolls, and freight.
- Refer to Table 7, 8 and 9 in Appendix A for cost break down details.

5.3.6 Reliability

- Soil forms lumps and tends to clog the feeder. Other ballast material may be required during cold weather.

5.3.7 Implementation Timeline

- This alternative requires the deployer purchase to be publicly tendered and will take approximately four months to be in place.

5.3.8 Assumptions

- Two hours required daily for a Landfill Attendant and three hours for a Utility A. As this option requires an hour extra for loader use to load material.
- Takes two hours daily to deploy the film.
- One hour of loader time to place soil in the deployer container.
- 90 rolls a year to be used for cover estimated at $285,000 annually. The rolls used in this option are different sizes than compared to the self-deployer option, hence requires more rolls.

- $56 per cubic metres is used for the calculation on landfill space in this reports. This estimate was referenced from the May 2018 Council report, entitled “Landfill Airspace Value”.
- Soil cost is not included as part of the calculation, as the landfill currently receives clean fill at no charge.
- 290 days a year estimated for daily cover days. December to April months require the active face to be covered every other day.
- Freezing conditions may clog the ballast feeder during winter months if soil is used. An estimated 1800 cubic metres of alternate ballast material will be used. Other ballast materials cost was averaged at $21 per cubic metres and will cost $38,000 in material use. Average cost of sand, wood chips, and snow was taken to determine the estimated cost.
- The alternative will cover up to 2400 square metres of active face.
- Exchange rate of 1 USD equals 1.35 CAD.

5.4 Film Deployer Modification - FSS

5.4.1 Regulatory Compliance

- Minimizes nuisances such as insects, rodents, odours.
- Does not help to prevent fire, or control fire. Does not accelerate fire.
- Prevents litter from being blown.
- Improves site appearance.

5.4.2 Environmental sustainability & leadership

Some of the positive impact are as follows.

- Uses landfill airspace compared to the tarp option.
- Less GHG emissions compared to the use of film self-deployer, and film deployer with a bulldozer options.
- Equipment runtime of 580 hours yearly. This value is based on two hours of loader runtime.
- One element of the City’s strategic plan (2013-2023) for environmental leadership is to become a recognized leader in Cold Climate Energy Efficiency. The use of a film deployer as an alternative aligns with the strategic plan.

Some of the negative impact are as follows.

- Requires an estimated 5,300 cubic metres of soil as a ballast material to hold the film in place, occupying landfill airspace.

5.4.3 Health & Safety (employees & public)

- Decreased risk for both employees and public compared to the other studied options during the pre-feasibility report.
- Operators will be working from inside the equipment for most of the time. The operator may be required to come out of the equipment to set the film, which will result in exposure to hazard.

- Operators will be working around other PME.

5.4.4 Customer Service

- Landfill operating hours will not increase; however an alteration of shift schedules may be required to cover the active face at the end of the day.
- Customer service hours will not be affected.
- No impact on size/availability at the tipping face during drop offs

5.4.5 Fiscal Responsibility

- Waste Stream Management owns a loader, and the required capital cost for loader modification was $2,000.
- The annual operating cost is estimated at $345,000. Contingency of 10% per year has been included in the annual operating cost. The majority of the annual cost is associated with the rolls.
- Total four year operating cost is estimated at $1.38 million.
- Due to the use of soil as a ballast material on film, an estimated cost of $300,000 per year of landfill airspace is consumed.
- The capital cost includes a loader modification cost.
- The annual operating cost includes loader time, deployer operations and maintenance, labour cost, rolls, and freight
- Refer to Table 10, 11 and 12 in Appendix A for cost break down details.

5.4.6 Reliability

- Track loader availability for maintenance reasons has been a concern in recent years.

5.4.7 Implementation Timeline

- This option has already been implemented for a short term pilot study, to gather data for this report.

5.4.8 Assumptions

- Two hour each daily for a Landfill Attendant and a Utility A.
- Takes two hours daily to deploy the film using a loader.
- 90 rolls a year to be used for cover estimated at $285,000 annually.
- $56 per cubic metres is used for the calculation on landfill space in this reports. This estimate was referenced from the May 2018 Council report, entitled “Landfill Airspace Value”.
- Soil cost is not included as part of the calculation, as the landfill currently receives clean fill at no charge.
- 290 days a year estimated for daily cover days. December to April months require the active face to be covered every alternate day.
- The alternative will cover up to 2400 square metres of active face.
- Exchange rate of 1 USD equals 1.35 CAD.

5.5 Film Deployer with new Loader

5.5.1 Regulatory Compliance

- Minimizes nuisances such as insects, rodents, odours.
- Does not help to prevent fire, or control fire. Does not accelerate fire.
- Prevents litters from being blown.
- Improves site appearance.

5.5.2 Environmental sustainability & leadership

Some of the positive impact are as follows.

- Uses landfill airspace compared to the tarp option.
- Less GHG emissions compared to the use of film self-deployer, and film deployer with a bulldozer options.
- Equipment runtime of 580 hours yearly. This value is based on two hours of loader runtime.
- One element of the City's strategic plan (2013-2023) for environmental leadership is to become a recognized leader in Cold Climate Energy Efficiency. The use of a film deployer as an alternative aligns with the strategic plan.

Some of the negative impact are as follows.

- Requires an estimated 5,300 cubic metres of soil as a ballast material to hold the film in place, occupying landfill airspace.

5.5.3 Health & Safety (employees & public)

- Decreased risk for both employees and public compared to the other studied options during the pre-feasibility report.
- Operators will be working from inside the equipment for most of the time. The operator may be required to come out of the equipment to set the film, which will result in exposure to hazard. Operators will be working around other PME which is one of the identified hazard.

5.5.4 Customer Service

- Landfill operating hours will not increase; however an alternation of shift schedules by two hour as staff will be required to cover the active face at the end of the day.
- Customer service hours will not be affected.
- No impact on size/availability at the tipping face during drop offs

5.5.5 Fiscal Responsibility

- The Capital cost of this option is estimated at $1.08 million. Contingency of 10% has been included in the capital cost.
- The annual operating cost is estimated at $384,000 per year. Contingency of 10% per year has been included in the annual operating cost. The majority of the annual cost is associated with the rolls.

- Total four year operating cost is estimated at $1.53 million.
- The equipment and film comes with a manufacturer setup and no modifications are required.
- Due to the use of soil as a ballast material on film, an estimated cost of $300,000 per year of landfill airspace is consumed.
- The capital cost includes track loader cost.
- The annual operating cost includes loader time, deployer operations and maintenance, labour cost, rolls, and freight
- Refer to Table 13, 14 and 15 in Appendix A for cost break down details.

5.5.6 Reliability

- No foreseen reliability issues are encountered at this time.

5.5.7 Implementation Timeline

- This alternative requires the track loader purchase to be publicly tendered and will take approximately four to five months to be in place.

5.5.8 Assumptions

- Two hour each daily for a Landfill Attendant and a Utility A.
- Takes two hours daily to deploy the film using a loader.
- 90 rolls a year to be used for cover estimated at $285,000 annually.
- $56 per cubic metres is used for the calculation on landfill space in this reports. This estimate was referenced from the May 2018 Council report, entitled “Landfill Airspace Value”.
- Soil cost is not included as part of the calculation, as the landfill currently receives clean fill at no charge.
- Loader yearly maintenance/lease rate is estimated at $34,800 per year.
- Maintenance cost for the deployer unit is negligible and hence not included in the calculation.
- 290 days a year estimated for daily cover days. December to April months require the active face to be covered every alternate day.
- The alternative will cover up to 2400 square metres of active face.
- Exchange rate of 1 USD equals 1.35 CAD.

6.0 Sound Reasoning

The basis of the decision is formed from alternatives, information, and values. This step integrates these and uses reasoning tools to maximize the preferences identified. A weighted decision matrix was used to evaluate the alternatives. All values were given an equal weighing, except for implementation time, as a firm deadline for implementation had not been provided from the Saskatchewan Ministry of Environment. Appendix A contains a table which outlines the alternatives, information, and reasoning applied to help determine the most preferred alternative.

The evaluation between various alternatives was done using Value Based Matrix. Refer to the attached spreadsheet – Alternative Evaluation- for total score of each alternative. Also, a summary is included in Appendix A, Table 16 and 17.

7.0 Recommendation

Daily cover is now a regulatory requirement, and as such, not proceeding with one of these alternatives is not an option. Therefore, the recommendation was based on the combination of alternatives which best met the criteria (values) defined.

Although the tarp alternative best met the values, an inability to utilize this option during snowfall events necessitated the need for another option during that time. The modified film deployer was ranked second in the evaluation. This was deemed a viable option for snowfall days, as this system is currently available to the operating group, with no new capital investments required. This will also provide a back-up, should the tarp system require maintenance or repair.

After a detailed study and evaluation, it is recommended to use modified film deployer option during snow days and to use tarp option for the remainder of the year. This increases the reliability to cover during snow days and the use of tarp saves in lost airspace value. Refer to the Alternative Evaluation spreadsheet for detailed score in each values. Table 18, 19 and 20 shows the breakdown of capital, operating, and overall cost of this recommended option.

Assumptions for the recommended options are as follows:

- Estimated snow days to be 28 days a year with historical records.
- 9 film rolls to be used over the period of 28 days based on the active face.
- Tarp to be used for 262 days.

Appendix A

The tables below provides capital and operations cost for all evaluated options. The operations cost shows equipment and labour line items along with the required material for each year.

WSM already pays for a dozer and track loader on a yearly fixed lease rate. Hence, some of the options will use these equipment and there will be no additional cost to WSM. Whereas, rubber tire loader is based on an hourly rate and additional cost will be charged to WSM. These findings is shown in the table below.

Table 1: Capital Cost of Tarp Option

Capital Costs				
Item	Price(USD)	Quantity	Extension (USD)	Total (CAD)
Tarp Deployment System	$ 25,830.00	2	$ 51,660.00	$ 69,741.00
Diesel Engine Option	$ 2,500.00	2	$ 5,000.00	$ 6,750.00
Tarp Armor	$ 2,000.00	8	$ 16,000.00	$ 21,600.00
Tarp Cable	$ 150.00	48	$ 7,200.00	$ 9,720.00
Proof Coil Chain	$ 2.01	1776	$ 3,569.76	$ 4,819.18
			Sub-Total	$112,630.18
			Freight	$ 6,075.00
			Taxes	$ 12,389.32
			Contingency	$ 13,109.45
			Grand Total	$144,203.94

Table 2: Operating Cost of Tarp Option

	Operating Costs			
Year 1				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total (CAD)*
CAT D7	$ -	290	2	$ -
Tarp Deployer	$ 27.78	290	2	$ 16,112.40
Utility A	$ -	290	4	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total (CAD)*
Tarp Armor	$ -	0	$ -	$ -
Tarp Cable	$ -	0	$ -	$ -
Proof Coil Chain	$ -	0	$ -	$ -
Hydraulic Pump	$ -	0	$ -	$ -
Hydraulic Motor	$ -	0	$ -	$ -
Transmitter	$ -	0	$ -	$ -
			Taxes	$ -
			Contingency	$ -
			Yearly Grand Total	**$ 16,112.40**
Year 2				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total (CAD)*
CAT D7	$ -	290	2	$ -
Tarp Deployer	$ 27.78	290	2	$ 16,112.40
Utility A	$ -	290	4	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total (CAD)*
Tarp Armor	$ -	0	$ -	$ -
Tarp Cable	$ -	0	$ -	$ -
Proof Coil Chain	$ -	0	$ -	$ -
Hydraulic Pump	$ -	0	$ -	$ -
Hydraulic Motor	$ -	0	$ -	$ -
Transmitter	$ -	0	$ -	$ -
			Taxes	$ -
			Contingency	$ -
			Yearly Grand Total	**$ 16,112.40**

Year 3				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total (CAD)*
CAT D7	$ -	290	2	$ -
Tarp Deployer	$ 27.78	290	2	$ 16,112.40
Utility A	$ -	290	4	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total (CAD)*
Tarp Armor	$ 2,000.00	8	$ 16,000.00	$ 21,600.00
Tarp Cable	$ 150.00	48	$ 7,200.00	$ 9,720.00
Proof Coil Chain	$ 2.01	888	$ 1,784.88	$ 2,409.59
Hydraulic Pump	$ 350.00	2	$ 700.00	$ 945.00
Hydraulic Motor	$ 550.00	2	$ 1,100.00	$ 1,485.00
Transmitter	$ 200.00	2	$ 400.00	$ 540.00
			Taxes	$ 4,036.95
			Contingency	$ 5,684.89
			Yearly Grand Total	**$ 62,533.84**
Year 4				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total (CAD)*
CAT D7	$ -	290	2	$ -
Tarp Deployer	$ 27.78	290	2	$ 16,112.40
Utility A	$ -	290	4	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total (CAD)*
Tarp Armor	$ -	0	$ -	$ -
Tarp Cable	$ -	0	$ -	$ -
Proof Coil Chain	$ -	0	$ -	$ -
Hydraulic Pump	$ -	0	$ -	$ -
Hydraulic Motor	$ -	0	$ -	$ -
Transmitter	$ -	0	$ -	$ -
			Taxes	$ -
			Contingency	$ -
			Yearly Grand Total	**$ 16,112.40**

Table 3: Overall Cost of Tarp Option

Tarp					
	Year 1	Year 2	Year 3	Year 4	Grand Total
Capital Cost	$144,203.94	0	0	0	$ 144,203.94
Operating Cost	$ 16,112.40	$ 16,112.40	$ 62,533.84	$ 16,112.40	$ 110,871.04
Total	**$160,316.34**	**$ 16,112.40**	**$ 62,533.84**	**$ 16,112.40**	**$ 255,074.98**

Table 4: Capital Cost of Film Self- Deployer Option

Capital Costs				
Item	Price(USD)	Quantity	Extension (USD)	Total (CAD)
Deployer	$ 289,000.00	1	$ 289,000.00	$390,150.00
Freight for Deployer	$ 7,900.00	1	$ 7,900.00	$ 10,665.00
			Taxes	$ 42,916.50
			Contingency	$ 44,373.15
			Total	$488,104.65

Table 5: Operations Cost of Film Self-Deployer Option

Operating Costs				
Year 1				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total*
Loader	$ 302.89	290	0.5	$ 43,919.05
Deployer	-	290	2	$ 32,150.00
Utility A	$ -	290	4.5	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total*
Rolls	$ 2,571.25	80	$ 205,700.00	$277,695.00
Freight for Rolls	$ -	80	$ 15,480.00	$ 20,898.00
Ballast Material	$ 21.13	1800		$ 38,034.00
			Taxes	$ 30,546.45
			Contingency	$ 37,365.60
			Yearly Grand Total	**$480,608.10**
Year 2				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total*
Loader	$ 302.89	290	0.5	$ 43,919.05
Deployer		290	2	$ 38,900.00
Utility A	$ -	290	4.5	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total*
Rolls	$ 2,571.25	80	$ 205,700.00	$277,695.00
Freight for Rolls	$ -	80	$ 15,480.00	$ 20,898.00
Ballast Material	$ 21.13	1800		$ 38,034.00
			Taxes	$ 30,546.45
			Contingency	$ 37,365.60
			Yearly Grand Total	**$487,358.10**

**Year 1 operating cost is lower than the other years as, year 1 sees less maintenance compared to the rest of the years.

Year 3				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total*
Loader	$ 302.89	290	0.5	$ 43,919.05
Deployer		290	2	$ 38,900.00
Utility A	$ -	290	4.5	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total*
Rolls	$ 2,571.25	80	$ 205,700.00	$277,695.00
Freight for Rolls	$ -	80	$ 15,480.00	$ 20,898.00
Ballast Material	$ 21.13	1800		$ 38,034.00
			Taxes	$ 30,546.45
			Contingency	$ 37,365.60
			Yearly Grand Total	**$487,358.10**
Year 4				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total (CAD)*
Loader	$ 302.89	290	0.5	$ 43,919.05
Deployer		290	2	$ 38,900.00
Utility A	$ -	290	4.5	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total (CAD)*
Rolls	$ 2,571.25	80	$ 205,700.00	$277,695.00
Freight for Rolls	$ -	80	$ 15,480.00	$ 20,898.00
Ballast Material	$ 21.13	1800		$ 38,034.00
			Taxes	$ 30,546.45
			Contingency	$ 37,365.60
			Yearly Grand Total	**$487,358.10**

Table 6: Overall Cost of Film Self-Deployer Option

Film Self-Deployer					
	Year 1	Year 2	Year 3	Year 4	Grand Total
Capital Cost	$ 488,104.65	0	0	0	$ 488,104.65
Operating Cost	$ 480,608.10	$487,358.10	$ 487,358.10	$487,358.10	$ 1,942,682.39
Total	**$ 968,712.75**	**$487,358.10**	**$ 487,358.10**	**$487,358.10**	**$ 2,430,787.04**

Table 7: Capital Cost of Film Deployer with Dozer

Capital Costs				
Item	Price(USD)	Quantity	Extension (USD)	Total (CAD)
Deployer	$ 79,000.00	1	$ 79,000.00	$106,650.00
Freight for Deployer	$ 3,988.00	1	$ 3,988.00	$ 5,383.80
			Taxes	$ 11,731.50
			Contingency	$ 15,000.00
			Total	$138,765.30

Table 8: Operating Cost of Film Deployer with Dozer

Operating Costs				
Year 1				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total (CAD)*
Loader	$ 302.89	290	1	$ 87,838.10
Deployer	-	290	2	$ 6,480.00
CAT D7	$ -	290	2	$ -
Utility A	$ -	290	5	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total (CAD)*
Rolls	$ 2,282.50	90	$ 205,425.00	$267,052.50
Freight for Rolls	$ -	90	$ 13,304.35	$ 17,295.65
Ballast Material	$21.13	1800	-	$ 38,028.00
			Taxes	$ 29,375.78
			Contingency	$ 10,000.00
			Yearly Grand Total	**$456,070.03**
Year 2				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total*
Loader	$ 302.89	290	1	$ 87,838.10
Deployer		290	2	$ 7,280.00
CAT D7	$ -	290	2	$ -
Utility A	$ -	290	5	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total*
Rolls	$ 2,282.50	90	$ 205,425.00	$267,052.50
Freight for Rolls	$ -	90	$ 13,304.35	$ 17,295.65
Ballast Material	$21.13	1800	-	$ 38,028.00
			Taxes	$ 29,375.78
			Contingency	$ 10,000.00
			Yearly Grand Total	**$456,870.03**

Year 3				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total*
Loader	$ 302.89	290	1	$ 87,838.10
Deployer		290	2	$ 7,280.00
CAT D7	$ -	290	2	$ -
Utility A	$ -	290	5	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total*
Rolls	$ 2,282.50	90	$ 205,425.00	$267,052.50
Freight for Rolls	$ -	90	$ 13,304.35	$ 17,295.65
Ballast Material	$21.13	1800	-	$ 38,028.00
			Taxes	$ 29,375.78
			Contingency	$ 10,000.00
			Yearly Grand Total	**$456,870.03**
Year 4				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total (CAD)*
Loader	$ 302.89	290	1	$ 87,838.10
Deployer		290	2	$ 7,280.00
CAT D7	$ -	290	2	$ -
Utility A	$ -	290	5	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total (CAD)*
Rolls	$ 2,282.50	90	$ 205,425.00	$267,052.50
Freight for Rolls	$ -	90	$ 13,304.35	$ 17,295.65
Ballast Material	$21.13	1800	-	$ 38,028.00
			Taxes	$ 29,375.78
			Contingency	$ 10,000.00
			Yearly Grand Total	**$456,870.03**

Table 9: Overall Cost of Film Deployer with Dozer

Film Deployer with Dozer					
	Year 1	Year 2	Year 3	Year 4	Grand Total
Capital Cost	$ 138,765.30	0	0	0	$ 138,765.30
Operating Cost	$ 456,070.03	$456,870.03	$ 456,870.03	$456,870.03	$ 1,826,680.10
Total	**$ 594,835.33**	**$456,870.03**	**$ 456,870.03**	**$456,870.03**	**$ 1,965,445.40**

Table 10: Capital Cost of Film Deployer Modification – Fleet Services

Capital Costs			
Item	Price(CAD)	Quantity	Total (CAD)
Loader Modification	$ 2,000.00	1	$ 2,000.00
Freight for Deployer	$ -	0	$ -
		Total	$ 2,000.00

Table 11: Operating Cost of Film Deployer Modification - Fleet Services

Operating Costs				
Year 1				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total (CAD)*
Loader	$ -	290	2	$ -
Modified Deployer	$ -	290	2	$ -
Utility A	$ -	290	4	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total (CAD)*
Rolls	$ 2,282.50	90	$ 205,425.00	$267,052.50
Freight for Rolls	$ -	90	$ 13,304.35	$ 17,295.65
			Taxes	$ 29,375.78
			Contingency	$ 31,372.39
			Yearly Grand Total	**$345,096.32**
Year 2				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total*
Loader	$ -	290	2	$ -
Modified Deployer	$ -	290	2	$ -
Utility A	$ -	290	4	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total*
Rolls	$ 2,282.50	90	$ 205,425.00	$267,052.50
Freight for Rolls	$ -	90	$ 13,304.35	$ 17,295.65
			Taxes	$ 29,375.78
			Contingency	$ 31,372.39
			Yearly Grand Total	**$345,096.32**

Year 3				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total*
Loader	$ -	290	2	$ -
Modified Deployer		290	2	$ -
Utility A	$ -	290	4	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total*
Rolls	$ 2,282.50	90	$ 205,425.00	$267,052.50
Freight for Rolls	$ -	90	$ 13,304.35	$ 17,295.65
			Taxes	$ 29,375.78
			Contingency	$ 31,372.39
			Yearly Grand Total	**$345,096.32**
Year 4				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total (CAD)*
Loader	$ -	290	2	$ -
Modified Deployer		290	2	$ -
Utility A	$ -	290	4	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total (CAD)*
Rolls	$ 2,282.50	90	$ 205,425.00	$267,052.50
Freight for Rolls	$ -	90	$ 13,304.35	$ 17,295.65
			Taxes	$ 29,375.78
			Contingency	$ 31,372.39
			Yearly Grand Total	**$345,096.32**

Table 12: Overall Cost of Film Deployer Modification – Fleet Services

Film Modification - Fleet Services					
	Year 1	Year 2	Year 3	Year 4	Grand Total
Capital Cost	$ 2,000.00	0	0	0	$ 2,000.00
Operating Cost	$ 345,096.32	$345,096.32	$ 345,096.32	$345,096.32	$ 1,380,385.27
Total	**$ 347,096.32**	**$345,096.32**	**$ 345,096.32**	**$345,096.32**	**$ 1,382,385.27**

Table 13: Capital Cost of Existing Film Deployer with New Loader

Capital Costs			
Item	Price(CAD)	Quantity	Total (CAD)
Loader	$ 883,727.71	1	$ 883,727.71
Freight for Deployer	$ -	0	$ -
		Taxes	$ 97,210.05
		Contingency	$ 98,093.78
		Total	$ 1,079,031.53

Table 14: Operating Cost of Existing Film Deployer with New Loader

Operating Costs				
Year 1				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total (CAD)*
Loader	$ -	290	2	$ 34,800.00
Deployer	$ -	290	2	$ -
Utility A	$ -	290	4	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total (CAD)*
Rolls	$ 2,282.50	90	$ 205,425.00	$ 267,052.50
Freight for Rolls	$ -	90	$ 13,304.35	$ 17,295.65
			Taxes	$ 29,375.78
			Contingency	$ 34,852.39
			Yearly Grand Total	**$ 383,376.32**
Year 2				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total*
Loader	$ -	290	2	$ 34,800.00
Deployer	$ -	290	2	$ -
Utility A	$ -	290	4	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total*
Rolls	$ 2,282.50	90	$ 205,425.00	$ 267,052.50
Freight for Rolls	$ -	90	$ 13,304.35	$ 17,295.65
			Taxes	$ 29,375.78
			Contingency	$ 34,852.39
			Yearly Grand Total	**$ 383,376.32**

Year 3				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total*
Loader	$ -	290	2	$ 34,800.00
Deployer		290	2	$ -
Utility A	$ -	290	4	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total*
Rolls	$ 2,282.50	90	$ 205,425.00	$267,052.50
Freight for Rolls	$ -	90	$ 13,304.35	$ 17,295.65
			Taxes	$ 29,375.78
			Contingency	$ 34,852.39
			Yearly Grand Total	**$383,376.32**
Year 4				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total (CAD)*
Loader	$ -	290	2	$ 34,800.00
Deployer		290	2	$ -
Utility A	$ -	290	4	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total (CAD)*
Rolls	$ 2,282.50	90	$ 205,425.00	$267,052.50
Freight for Rolls	$ -	90	$ 13,304.35	$ 17,295.65
			Taxes	$ 29,375.78
			Contingency	$ 34,852.39
			Yearly Grand Total	**$383,376.32**

Table 15: Overall Cost of Existing Film Deployer with New Loader

Film Deployer with New Loader					
	Year 1	Year 2	Year 3	Year 4	Grand Total
Capital Cost	$1,079,031.53	0	0	0	$ 1,079,031.53
Operating Cost	$ 383,376.32	$383,376.32	$ 383,376.32	$383,376.32	$ 1,533,505.27
Total	**$1,462,407.85**	**$383,376.32**	**$ 383,376.32**	**$383,376.32**	**$ 2,612,536.80**

Table 16: Relative weights of values

Value	Relative weight	Relative weight (%)
Regulatory compliance	10	16%
Environmental sustainability & leadership	10	16%
Health & safety	10	16%
Customer service	10	16%
Fiscal responsibility	10	16%
Reliability	10	16%
Implementation timeline	1	2%
∑	61	100%

Table 17: Alternative scores for each value

Alternative	Total Score	
Tarp	89.39	||||||||
Film Deployer - Self Propelled Unit	78.03	||||||||
Film Deployer with Dozer	77.12	||||||||
Film Modification	81.53	||||||||
Film Deployer with new Loader	78.20	||||||||
Combination of Tarp and Modified Deployer	92.43	||||||||

Table 18: Capital Cost for Tarp and Modified Film Deployer

Capital Costs

Item	Price(USD)	Quantity	Extension (USD)	Total (CAD)
Tarp Deployment System	$ 25,830.00	2	$ 51,660.00	$ 69,741.00
Diesel Engine Option	$ 2,500.00	2	$ 5,000.00	$ 6,750.00
Tarp Armor	$ 2,000.00	8	$ 16,000.00	$ 21,600.00
Tarp Cable	$ 150.00	48	$ 7,200.00	$ 9,720.00
Proof Coil Chain	$ 2.01	1776	$ 3,569.76	$ 4,819.18
Loader Modification				$ 2,000.00
			Taxes	$ 12,389.32
			Freight	$ 6,075.00
			Contingency (10%)	$ 13,309.45
			Grand Total	$ 146,403.94

Table 19: Operating Cost for Tarp and Modified Film Deployer

Operating Costs				
Year 1				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total*
CAT D7	$ -	262	2	$ -
Tarp Deployer	$ 27.78	262	2	$ 14,556.72
Loader	$ -	28	2	$ -
Modified Deployer	$ -	28	2	$ -
Utility A	$ -	290	4	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total*
Tarp Armor	$ -	8	$ -	$ -
Tarb Cable	$ -	48	$ -	$ -
Proof Coil Chain	$ -	1776	$ -	$ -
Hydraulic Pump	$ -	0	$ -	$ -
Hydraulic Motor	$ -	0	$ -	$ -
Transmitter	$ -	0	$ -	$ -
Rolls	$ 2,282.50	9	$ 20,542.50	$ 27,732.38
Freight for Rolls	$ -	9	$ 1,769.23	$ 2,388.46
			Taxes	$ 3,050.56
			Contingency (10%)	$ 4,772.81
			Yearly Grand Total	**$ 52,500.93**
Year 2				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total*
CAT D7	$ -	262	2	$ -
Tarp Deployer	$ 27.78	262	2	$ 14,556.72
Loader	$ -	28	2	$ -
Modified Deployer	$ -	28	2	$ -
Utility A	$ -	290	4	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total*
Tarp Armor	$ -	0	$ -	$ -
Tarb Cable	$ -	0	$ -	$ -
Proof Coil Chain	$ -	0	$ -	$ -
Hydraulic Pump	$ -	0	$ -	$ -
Hydraulic Motor	$ -	0	$ -	$ -
Transmitter	$ -	0	$ -	$ -
Rolls	$ 2,282.50	9	$ 20,542.50	$ 27,732.38
Freight for Rolls	$ -	9	$ 1,769.23	$ 2,388.46
			Taxes	$ 3,050.56
			Contingency (10%)	$ 4,772.81
			Yearly Grand Total	**$ 52,500.93**

Year 3				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total*
CAT D7	$ -	262	2	$ -
Tarp Deployer	$ 27.78	262	2	$ 14,556.72
Loader	$ -	28	2	$ -
Modified Deployer		28	2	$ -
Utility A	$ -	290	4	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total*
Tarp Armor	$ 2,000.00	8	$ 16,000.00	$ 21,600.00
Tarb Cable	$ 150.00	48	$ 7,200.00	$ 9,720.00
Proof Coil Chain	$ 2.01	888	$ 1,784.88	$ 2,409.59
Hydraulic Pump	$ 350.00	2	$ 700.00	$ 945.00
Hydraulic Motor	$ 550.00	2	$ 1,100.00	$ 1,485.00
Transmitter	$ 200.00	2	$ 400.00	$ 540.00
Rolls	$ 2,282.50	9	$ 20,542.50	$ 27,732.38
Freight for Rolls	$ -	9	$ 1,769.23	$ 2,388.46
			Taxes	$ 7,087.52
			Contingency (10%)	$ 8,846.47
			Yearly Grand Total	**$ 81,377.14**
Year 4				
Equipment/Labour	*($/Hr)*	*Days*	*(Hr/Day)*	*Total (CAD)*
CAT D7	$ -	262	2	$ -
Tarp Deployer	$ 27.78	262	2	$ 14,556.72
Loader	$ -	28	2	$ -
Modified Deployer		28	2	$ -
Utility A	$ -	290	4	$ -
Material	*Price (USD)*	*Quantity*	*Extension (USD)*	*Total (CAD)*
Tarp Armor	$ -	0	$ -	$ -
Tarb Cable	$ -	0	$ -	$ -
Proof Coil Chain	$ -	0	$ -	$ -
Hydraulic Pump	$ -	0	$ -	$ -
Hydraulic Motor	$ -	0	$ -	$ -
Transmitter	$ -	0	$ -	$ -
Rolls	$ 2,282.50	9	$ 20,542.50	$ 27,732.38
Freight for Rolls	$ -	9	$ 1,769.23	$ 2,388.46
			Taxes	$ 3,050.56
			Contingency (10%)	$ 4,772.81
			Yearly Grand Total	**$ 52,500.93**

Table 20: Overall Cost for Tarp and Modified Film Deployer

Option Tarp and Modified Film Deployer					
	Year 1	Year 2	Year 3	Year 4	Grand Total
Capital Cost	$ 146,403.94	0	0	0	$ 146,403.94
Operating Cost	$ 52,500.93	$52,500.93	$ 81,377.14	$ 52,500.93	$ 238,879.93
Total	**$ 198,904.87**	**$52,500.93**	**$ 81,377.14**	**$ 52,500.93**	**$ 385,283.88**