Biosolids Management Master Plan Update

Public Works Committee Presentation - July 11, 2023

Problem and Opportunity Statement

The purpose of the Biosolids Management Master Plan Update is to develop a holistic, long-term strategy for biosolids management in Niagara in a manner that is transparent, sustainable, reliable, environmentally friendly, cost-effective and flexible.

What are Biosolids?

Biosolids are the organic materials resulting from the physical, chemical and biological treatment of sewage sludge generated at wastewater treatment plants.

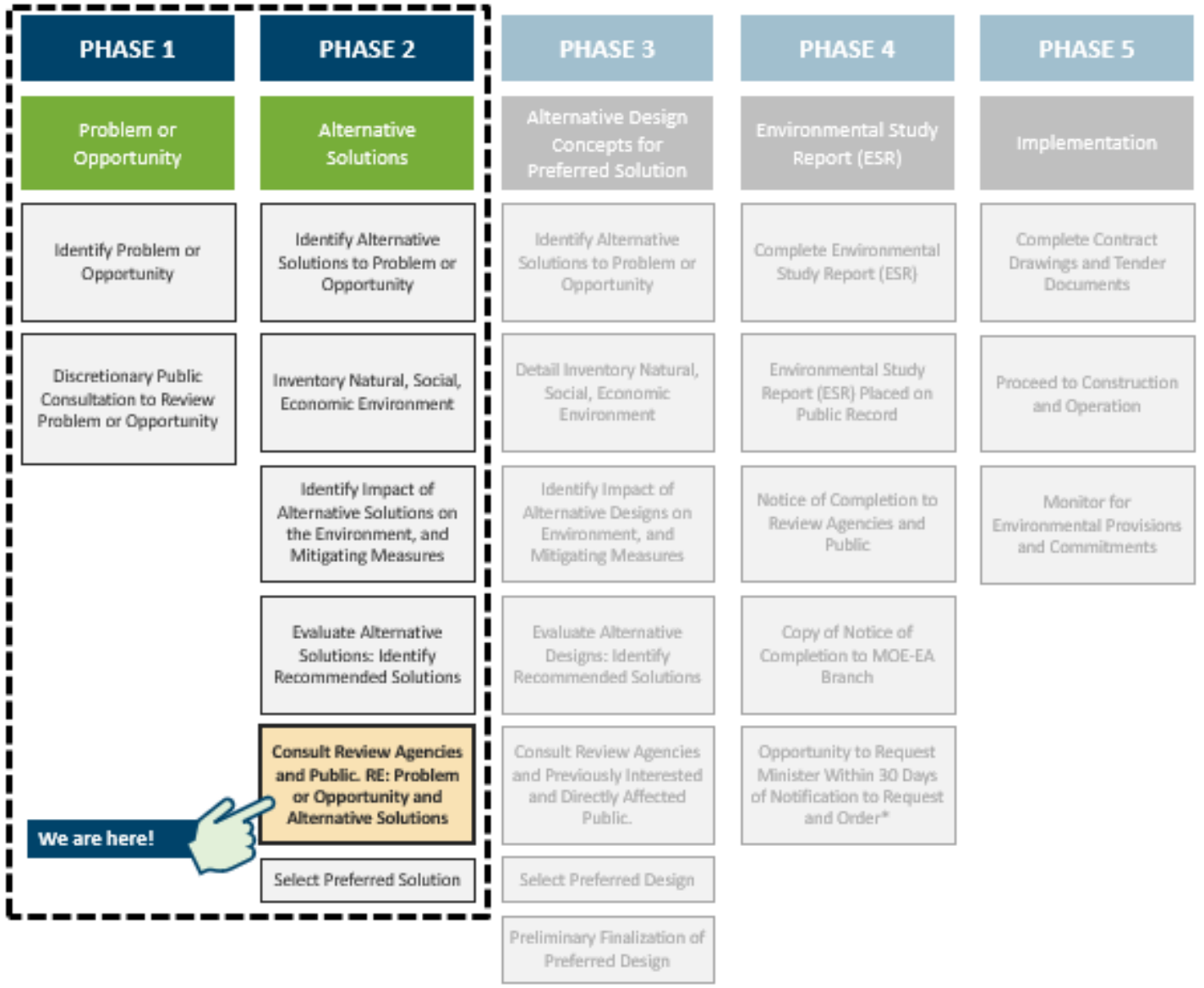
Biosolids have many potential beneficial uses including land application on agricultural lands and use in landscaping projects in parks, on golf courses and at private residences. The Region’s biosolids are currently land applied throughout Niagara Region.

The Region's biosolids also incorporate residuals from water treatment.

Project Approach

This project is following the Class Environmental Assessment (EA) process for Master Plan Projects, which is a decision-making process that all Ontario municipalities follow for rehabilitating and building new infrastructure.

The 2021 BMMP follows the Municipal Engineers Association (MEA) Class Environmental Assessment (EA) process for Master Plans and will satisfy Phases 1 and 2 of the Class EA process.



Existing Beneficial Uses Program
Liquid Biosolids Management

Garner Road Biosolids Facility

Liquid biosolids and residuals (~50% of biosolids produced in Niagara Region) are:

1. Hauled to the Garner Road Biosolids Facility by Third Party Contractor (currently Thomas Nutrient Solutions),
2. Stored and thickened in lagoons at the Garner Road Biosolids Facility,
3. Hauled away and applied as a liquid fertilizer to agricultural land by Third Party Contractor

Land application of biosolids

Existing Beneficial Uses Program
Dewatered Biosolids Management

Biosolids Management Centre with Alkaline Stabilization

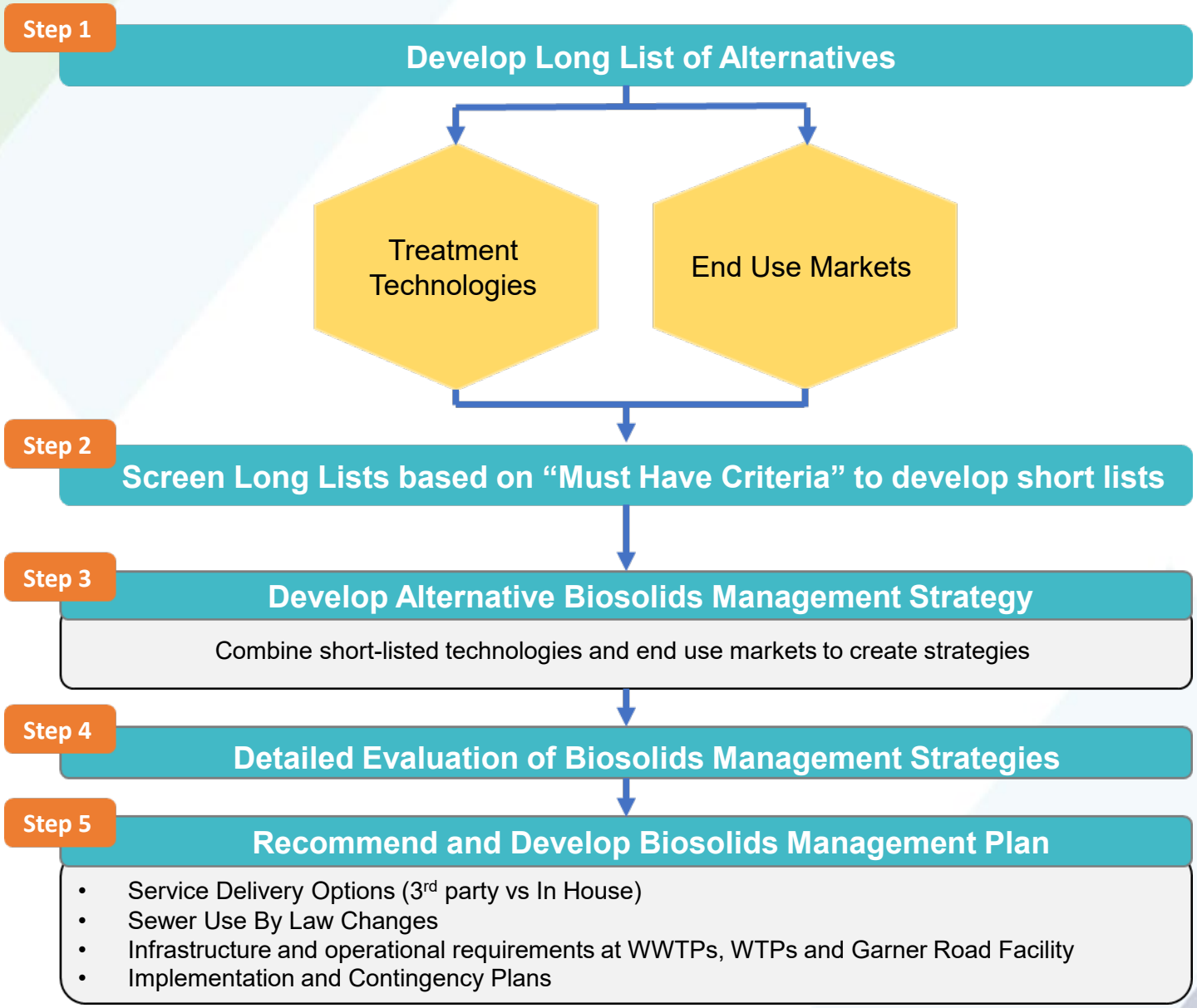
Dewatered biosolids from the Garner Road Biosolids Facility and Niagara Falls WWTP (~50% of biosolids produced in Niagara Region) are:

1. Hauled to a privately owned Biosolids Management Facility in Niagara Falls.

2. Treated using alkaline stabilization to produce a high solids, nutrient rich soil-like product

3. Hauled away and applied as a solid cake fertilizer to agricultural land by Third Party Contractor

Alternative Evaluation Approach



Step 1 – Develop Long List of Biosolids End Use Markets

Beneficial Reuse

- Agriculture, Silviculture and Horticulture
- Parks and Recreation Departments
- Ontario Ministry of Transportation
- Landscape Contractors
- Golf Courses
- Land Rehabilitation
- Co-management with Source Separated Organics
- Fuel Additives (ie. syngas, biochar).

Disposal

- Landfill

Step 1 – Develop Long List of Biosolids Treatment Technologies

Biological Digestion Technologies

- Anaerobic Digestion ***(existing conditions)***
- Thermal Hydrolysis Process Post Anaerobic Digestion

Thermal Conversion Technologies

- Incineration
- Gasification
- Pyrolysis
- Wet Oxidation
- Hydrothermal Liquification

Thermal Drying Technologies

- Direct Contact (Convection)
  - Rotary Drum
  - Belt Dryer
  - Fluidized Bed
- Indirect Contact (Conduction)
  - Paddle / Disc
  - Solar Dryer

Chemical Stabilization Technologies

- Alkaline Stabilization
  - Alkaline Stabilization
  - Alkaline Stabilization with Supplement Heat or Acid ***(existing conditions)***
  - Alkaline Stabilization with Heat and High Speed Mixing

Composting

- Windrow
- Aerated Static Pile
- Agitated Bin

Step 2 – Screen Long List of Biosolids End Use Markets

	Market Availability		Long Term Reliability and Sustainability	Implementable	Considered for Detailed Evaluation
Agricultural, Silviculture and Horticulture	✓ Pass	✓ Pass	✓ Pass	✓ Pass	**Carried Forward**
Parks and Recreation Department	✓ Pass	✓ Pass	✓ Pass	✓ Pass	**Carried Forward**
Ontario Ministry of Transportation	✗ Fail	✓ Pass	✓ Pass	✓ Pass	**Screened Out**
Landscape Contractors	✓ Pass	✓ Pass	✓ Pass	✓ Pass	**Carried Forward**
Golf Courses	✓ Pass	✓ Pass	✓ Pass	✓ Pass	**Carried Forward**
Land Rehabilitation	✗ Fail	✓ Pass	✗ Fail	✓ Pass	**Screened Out**
Co-management with Source Separated Organics	✓ Pass	✓ Pass	✓ Pass	✓ Pass	**Carried Forward**
Fuel Additions (i.e. Syngas)	? Further Review	✓ Pass	✓ Pass	? Further Review	**Carried Forward**
Landfill	✗ Fail	✓ Pass	✗ Fail	✓ Pass	**Screened Out**

Step 2 – Screen Long List of Biosolids Treatment Technologies

		1. Maturity of Technology	2.Compatibility with Existing and Future Site Development and Biosolids End Use Markets	3. Proven Applicability at Similar Scale Facilities	4. Implementable	Consider for Detailed Evaluation
Biological Digestion Technologies	Thermal Hydrolysis Post-Treatment (THP)	✓ Pass	✓ Pass	✓ Pass	✓ Pass	**Carried Forward**
Thermal Drying Technologies	Direct Thermal Dryer (Drum Dryer, Belt Dryer)	✓ Pass	✓ Pass	✓ Pass	✓ Pass	**Carried Forward**
	Fluidized Bed Dryer	✓ Pass	✓ Pass	✗ Fail	✗ Fail	**Screened Out**
	Indirect Thermal Dryer (Paddle Dryer, Disc Dryer)	✓ Pass	✓ Pass	✓ Pass	✓ Pass	**Carried Forward**
	Solar Dryer	✓ Pass	✓ Pass	✗ Fail	✗ Fail	**Screened Out**
Chemical Stabilization Technologies	Alkaline Stabilization	✓ Pass	✓ Pass	✓ Pass	✗ Fail	**Screened Out**
	Alkaline Stabilization with Supplemental Heat or Acid	✓ Pass	✓ Pass	✓ Pass	✓ Pass	**Carried Forward**
	Alkaline Stabilization with Supplemental Heat and High-Speed Mixing	✓ Pass	✓ Pass	✓ Pass	✓ Pass	**Carried Forward**
Composting Technologies	Composting (Open Technologies Aerated Static Pile and Windrow Composting)	✓ Pass	✓ Pass	✓ Pass	✓ Pass	**Carried Forward**
Thermal Conversion Technologies	Incineration	✓ Pass	✓ Pass	✓ Pass	✓ Pass	**Carried Forward**
	Gasification	✗ Fail	✓ Pass	✗ Fail	✗ Fail	**Screened Out**
	Pyrolysis	✗ Fail	✓ Pass	✗ Fail	✗ Fail	**Screened Out**
	Wet Oxidation	✗ Fail	✓ Pass	✗ Fail	✗ Fail	**Screened Out**
	Hydrothermal Liquification	✗ Fail	✓ Pass	✗ Fail	✗ Fail	**Screened Out**

Step 3 – Develop Alternative Biosolids Management Strategies

	Management Alternative	Technology	Product	End Use
Strategy	Beneficial Use on Land	AD	Stabilized Liquid biosolids	Land application with liquid biosolids
Strategy		AD + Dewatering	Stabilized Biosolids Cake	Land application with biosolids cake
Strategy		AD+ Advanced Digestion + Dewatering	Fertilizer quality Cake	Land application of cake / un-restricted use
Strategy		AD + Dewatering + Advanced Alkaline Stabilization	Fertilizer / soil amendment	Un-restricted use on land
Strategy		AD + Dewatering + Composting	Compost	Un-restricted use on land
Strategy		AD + Dewatering + Drying	Dried Product	Un-restricted use on land or fuel source
Strategy	Thermal Processing	AD + Dewatering + Incineration	Ash	Ash beneficial use + landfill

Strategy 0 – "Do Nothing" was screened out as it does not pass criteria for 'Long Term Sustainability and Reliability' due to capacity limitations in existing system to process future biosolids quantities.

AD = Anaerobic Digestion

Step 4 - Detailed Evaluation Criteria

Natural Environment
- Terrestrial Systems
- Aquatic Systems
- Surface Water Quality
- Groundwater Quality, Quantity and source water protection
- Soil Quality
- Air Quality/GHG

Technical Considerations
- Performance
- Sustainability
- Ease of Operation
- Resiliency
- Ease of Implementation
- Compatibility with existing infrastructure
- Energy use and recovery
- Climate change adaptability
- Permits and Approvals

Socio-Cultural Environment
- Odour
- Noise/Vibrations during operation
- Visual/Aesthetics
- Truck Traffic
- Disruption during Construction
- Property Acquisition and Easements
- Recreational Use and Users
- Agricultural Land Users
- Human health and well being
- Existing and Future Adjacent Land Use Compatibility
- Archaeology / Cultural Heritage

Economic Considerations
- Capital Cost
- Operating and Maintenance Cost
- Life Cycle Costs
- Best Use of Existing Investments

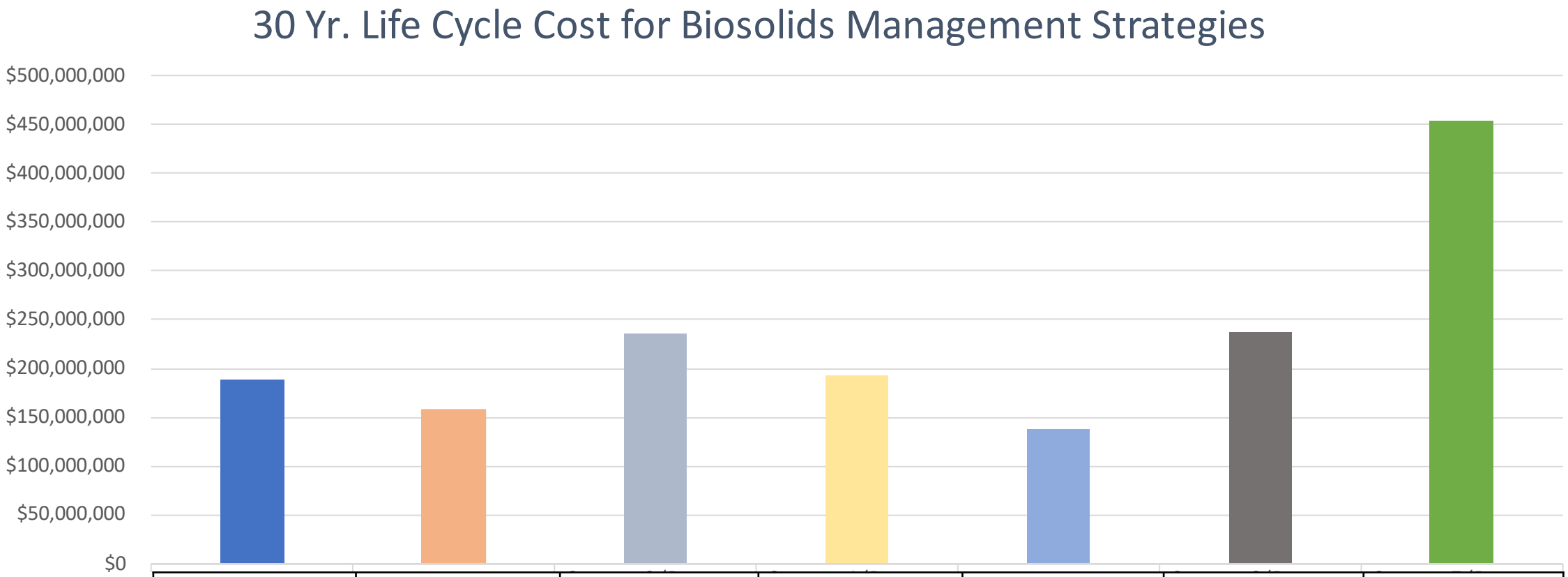
Approach: Equal weighting initially followed by sensitivity analysis prioritizing different criteria categories

Step 4 – Detailed Evaluation Results

LEGEND
Good / Low Impact
Neutral / Moderate Impact
Poor / High Impact

Key Differentiating Criteria	**Strategy 1:** AD + Liquid Biosolids Land Application	**Strategy 2:** AD + Dewatering + Cake Land Application	**Strategy 3:** AD + Advanced Stabilization (THP) + Fertilizer Quality Product	**Strategy 4:** AD + Dewatering + Advanced Alkaline Treatment	**Strategy 5:** AD + Dewatering + Composting + Product Distribution	**Strategy 6:** AD + Dewatering + Thermal Drying + Product Distribution	**Strategy 7:** AD + Dewatering + Thermal Processing (Incineration)
Greenhouse Gas Emissions	Neutral	Neutral	Good	Neutral	Good	Good	Poor
Nutrient Recovery and Potential for Beneficial Reuse by Agricultural Users	Good	Good	Good	Good	Good	Good	Poor
Proven Performance	Good	Good	Neutral	Good	Good	Good	Good
Odour at Garner Road Facility	Good	Good	Good	Neutral	Neutral	Neutral	Good
Truck Traffic	Neutral	Good	Good	Neutral	Good	Good	Good
Long Term Sustainability	Good	Good	Good	Good	Good	Good	Poor
Ease of Operation	Good	Good	Poor	Good	Neutral	Neutral	Neutral
Resiliency	Neutral	Neutral	Good	Good	Good	Good	Good
Ease of Implementation	Good	Good	Poor	Poor	Poor	Poor	Poor
Life Cycle Cost	Neutral	Good	Good	Good	Good	Good	Poor
RANKING	**3**	**2**	**5**	**1**	**6**	**4**	**7**

Step 4 – Detailed Evaluation Results - Costs



	Strategy 1 (Liquid Land App)	Strategy 2 (Dewater + Cake Land App)	Strategy 3 (Dewater + THP + Fertilizer Product)	Strategy 4 (Dewater + Advanced Alkaline Treatment)	Strategy 5 (Dewater + Compost + Product Distribution)	Strategy 6 (Dewater + Thermal Drying + Product Distribution)	Strategy 7 (Dewater + Incineration + Ash Disposal)
30Yr. Life Cycle Cost	$189,301,000	$158,324,000	$235,647,000	$192,708,000	$137,309,000	$236,896,000	$453,251,000
Cost per Dry Tonne (based on O&M only)	$250/dt	$408/dt	$441/dt	$561/dt	$293/dt	$516/dt	$656/dt

Step 4 – Detailed Evaluation Results - RANKING

Develop implementation plan to incorporate top 3 strategies

1	**Strategy 4:** AD + Dewatering + Advanced Alkaline Treatment + Fertilizer Quality Product
2	**Strategy 2:** AD + Dewatering + Cake Land Application
3	**Strategy 1:** AD + Liquid Biosolids Land Application
4	**Strategy 6:** AD + Dewatering + Thermal Drying + Product Distribution
5	**Strategy 3:** AD + Advanced Stabilization (THP) + Fertilizer Quality Product
6	**Strategy 5:** AD + Dewatering + Composting + Product Distribution
7	**Strategy 7:** AD + Dewatering + Thermal Processing

AD = Anaerobic Digestion

Step 5 – Preliminary Recommendations and Implementation

- Short Term Solution (1-3 years)
  - Conduct pilot study involving local farmers and third-party hauler to assess feasibility of direct land application of cake
  - Use portable centrifuge for temporary dewatering at Garner Road when existing centrifuges are unavailable
  - Continue transporting dewatered cake to N-Viro from Garner Road and Niagara Falls WWTP

- Mid Term Solution (3-5 years)
  - Add biosolids dewatering at Baker Road WWTP

- Long-Term Solution (5+ Years)
  - Construct additional dewatering capacity at Garner Road, which may incorporate flows from Niagara Falls (NF) WWTP once centrifuge at NF WWTP reaches end of useful life
  - Construct cake storage facility at Garner Road if the pilot program confirms feasible / acceptance
  - Continue liquid storage at Garner Road to maximize flexibility. Add further liquid tank storage if direct land application of cake is not pursued.

Step 5 – Preliminary Recommendations and Implementation

KEY BENEFITS

1. **Increase diversity** of biosolids program by incorporating **direct land application of cake**

2. **Reduce biosolids hauling** through increased dewatering, reducing transportation costs, GHG emissions and community impacts

3. **Increased resiliency during wet weather years** by reducing reliance on liquid storage

4. **Lower 30 Year Life Cycle Cost**

Project Schedule