CASE HISTORY OF SMALL COMMUNITY EVALUATION TO LONG-HAUL WASTE VS MANAGE A SMALL LANDFILL

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SUMMARY: Small rural landfills must often be developed and operated to the same standards as large regional landfills. Because of their small size, rural landfills are disadvantaged because they lose the economies of a larger scale, and their cost per tonne of disposal may be relatively higher than that of a large regional facility. An alternative for small communities is to long-haul their waste to a large facility that has a lower tipping fee, but the transfer and transportation costs must be accounted for. The offsetting costs may show that the total cost is not significantly different between maintaining local operations versus long-hauling the waste. In the end, other factors may influence the final decision, such as keeping the money and jobs circulating in the local economy, complimentary public works operations, carbon footprint, and long-term cost stability. This paper presents preliminary analyses for two rural landfills in the State of Wyoming in the USA.

1. INTRODUCTION

This case history examines two small communities in the State of Wyoming, and presents cost and logistical data that is being evaluated to make their decisions on whether to manage their own landfills for municipal solid waste (MSW), or long-haul to the one large regional landfill in the State of Wyoming. These decisions are being made in the context of the current regulations in the State of Wyoming, and the perceived costs of infrastructure development, operations, and transportation. Both of the case histories described in this paper are still in progress, and this paper represents just a snapshot in time of the process being considered.

One of the communities is located in Park County, Wyoming, which is in the northwest part of Wyoming. Its principle population center and largest landfill is located next to the city of Cody. The other location is Johnson County, Wyoming, which is in the north-central to northeast part of Wyoming. Its landfill is located next to the town of Buffalo.

2. BACKGROUND

Both communities described in this case history have existing old landfills. Therefore the arduous task of siting locations for new landfills was not needed. However, the existing landfills do not have modern liner systems, which are now being required in the State of Wyoming for MSW. Both sites also manage construction and demolition (C&D) waste, which does not require a liner system for the physical conditions that exist at those sites. Therefore, the

challenge was defined as evaluating the feasibility of constructing lateral or vertical expansions of the existing landfills for the MSW portion of the waste stream, using modern composite liner and leachate collection systems, along with the associated operational, maintenance, closure and post-closure requirements.

The largest landfill in the state is located at the city of Casper in central Wyoming. The Casper landfill has been upgraded to a modern Subtitle-D compliant landfill and offers a tipping fee of approximately $40 per tonne (subject to change) for unbaled waste arriving from other jurisdictions. The long-haul distance from Cody to Casper is approximately 355 km, and the distance from Buffalo to Casper is approximately 185 km.

A cost pro-forma was developed for landfill management options for both locations. The following two alternatives were evaluated for logistics and economics:

a) Closure of the existing landfills, and construction of new Subtitle-D compliant landfills on the same properties. Composting of dead animals and operation of separate unlined C&D disposal pits would continue.
b) Closure of the existing MSW landfills; continuation of composting dead animals and operation of unlined C&D disposal pits at the existing sites would continue; long-hauling MSW to the Casper regional landfill.

3. ECONOMIC MODELING

3.1 General

The costs in this study were distilled into a local "tipping fee" as a disposal cost per tonne for each of the two counties evaluated. The tipping fee for each county was established for the total assumed number of tonnes of MSW and C&D waste delivered to its respective facility. The tipping fee would be based on the principle of "full-cost accounting" for managing the wastes from the point of receipt at the landfill, through their assumed regulatory life. In the case of a locally-managed landfill, that life would include a 30-year post-closure care period after the final date of waste receipt. In the case of long-hauling the waste to another facility, the care would end at the point that the 3rd-party facility accepted the waste, although the County's existing landfill would require 30-year post-closure care.

The following costs were excluded from the analyses, and were considered equal for both the on-site development and long-haul scenarios:

- Waste collection and transport to the local facility, whether it is a landfill or a transfer station. In either scenario, it was assumed that the local collection companies would have to bring their waste to the existing disposal facility location, either for onsite disposal or for long-haul transfer.
- Local recycling initiatives which are already in existence, and would remain at whatever level the local programs and economies wish to support.
- The tipping fees were evaluated to stand on their own, without subsidies from other programs, and without providing subsidies to other programs (such as recycling).

3.2 Evaluation of the In-County Landfilling Alternative

Engineering layouts of proposed lateral expansion geometries were prepared to develop the pro-forma costs estimates for evaluating the alternative of maintaining a local in-county landfill at the existing disposal sites. The layouts were prepared taking into account landfill life, cell sequencing, slope stability, settlement, access, leachate management, and stormwater control. The layouts were prepared to ensure a minimum of 30 years of capacity, accounting for daily

and intermediate soil cover practice unique to each site, and for site-specific waste compaction based on historical performance.

Liner systems were proposed to meet the state regulations, which mimicked the USEPA Subtitle D regulation. The liners assumed for the pro-forma cost estimate include a composite liner comprised of a 1.5 mm geomembrane over geosynthetic clay liner liner, and a 30-cm thick gravel and pipe leachate collection system that would control leachate buildup to be less than 30 cm.

The final cover systems were assumed to consist of 1.2 m of cover soil that would provide a water-balance final cover system appropriate for these arid areas. The final cover costs included stormwater control, an access road to the top of the landfill, and relatively minor landfill gas control systems because of the very small amount of gas generated in these small, arid sites.

The costs for developing, operating, closing, and caring for the disposal facilities at each site were developed in accordance with the following sections, with some of the key site-specific parameters summarized in Table 1.

3.2.1 Capital investment to build the initial infrastructure

The cost for the initial capital investment to upgrade the facility to operate as a modern landfill included the following elements:

- Permitting costs.
- Closing the existing old landfill.
- Upgraded site ancillary facilities for leachate management (e.g. pipelines and storage ponds or tanks), waste reception (e.g. road, gate house, scales), fencing, and utilities.
- Construction of the first new modern landfill cell.
- The estimated total capital investment was amortized over an operational period of 30 years using the appropriate borrowing rate shown in Table 1. The annual debt service was divided by the estimated number of tonnes per year (MSW plus C&D) to obtain the portion of the tipping fee required for initial infrastructure debt service.

3.2.2 Future cell development funding

The costs for funding future cells accounted for the following elements:

- The size, timing, and cost for future cells were estimated based on site-specific planning. Soil excavation and waste fill slopes were both assumed to be 1(V):3(H).
- The future costs were adjusted for anticipated inflation rates for the expected years in which the future cells were to be constructed.
- An annual fund was established that was generally assumed to be constant over the operational period at a level that would pay for the costs of the future cell construction. In the years that the fund level was positive, the fund was assumed to earn interest. In the years that the fund was negative, the fund was assumed to have to pay interest for borrowing. The fund level was iteratively adjusted so that it would be a net zero at the end of 30 years.
- The annual cell development funding was divided by the estimated number of tonnes per year to obtain the portion of the tipping fee required for future cell development.

3.2.3 Closure and post-closure care funding

The costs for funding future closure construction, and for providing for 30-years of post-closure care after the final receipt of waste materials at the site, accounted for the following elements:

- The size, timing, and cost for final closure construction was estimated based on site-specific planning.
- The future costs were adjusted for anticipated inflation rates for the expected years in which the future closures were to be constructed.

- The future costs for 30-years of post-closure maintenance were estimated.
- An annual fund was established that was generally assumed to be constant over the operational period at a level that would pay for the costs of the closure construction, and post-closure care. The fund level was iteratively adjusted so that it would be a net zero at the end of the operational life, plus the 30-year post-closure period.
- The annual closure/post-closure funding was divided by the estimated number of tonnes per year to obtain the portion of the tipping fee required for closure/post-closure.
- The closure fund was established as a separate fund. The post-closure care costs were included as part of the operational costs on a per-tonne basis.

3.2.4 Operational costs

The costs for funding landfill site operations accounted for the following elements:

- Staff and personnel to manage and operate the landfill.
- Equipment purchase, operations, maintenance, and replacement as needed over the operational life of the landfill.
- Site utilities and fees.
- Leachate was assumed to require some onsite storage but could all be treated by recirculation in the landfill, which would not be a significant issue in these arid climates.
- Post-closure care costs were wrapped into the operational costs.
- The annual operating cost was divided by the estimated number of tonnes per year to obtain the portion of the tipping fee required for landfill operations.

3.3 Evaluation of the Long-Haul Alternative

Per-tonne disposal costs were also developed for the alternative strategy of long-hauling the MSW waste to the State's largest compliant regional landfill in Casper, WY. These costs included:

- Closing the existing landfills and performing post-closure monitoring.
- Building a transfer station at the existing landfill sites.
- Continuing to fill C&D waste at the existing facilities.
- Transporting the waste in trucks to the Casper regional landfill.
- Paying the 3rd-party tipping fee at the Casper landfill.

The annual costs for these items were added together and divided by the estimated number of tonnes per year (MSW plus C&D) to obtain the total estimated tipping fee for this alternative.

Table 1. Key site-specific elements for the pro-forma cost estimates.

Item	*Park County (Cody)*	*Johnson County (Buffalo)*
Estimated annual flow rate of MSW waste (tonnes/year)	18,100	4,500
Estimate annual flow rate of C&D waste (tonnes/year)	6,350	2,700
Area of existing landfill requiring closure and post-closure care (ha)	6.5 ha	7.3 ha
Estimated effective waste density (tonnes/m3)	0.40	0.32
Total volume of excavation required for future development (m3)	726,000 m^3	243,000 m^3
Total volume of embankment require for future development (m^3)	14,000 m^3	3,000 m^3
Approximate soil balance for landfill operations and development with excavation plan? (yes or no)	Yes	Yes
Total area of future new development (ha)	9.3 ha	4.6 ha
Operational life of expansion (yr)	50 yrs	40 yrs
Number of cells (including initial cell) to be amortized over operational life	3 cells	4 cells
Interest rate for borrowing	2%	5%
Interest earnings rate for positive cash balance	2%	2%
Assumed inflation rate	3%	3%
Estimated cost of transporting waste by truck in highway	$0.226 per tonne-km	$0.226 per tonne-km
Estimated tipping fee at regional landfill in Casper, WY	$44/tonne	$44/tonne
Distance to regional landfill in Casper, WY (km)	355 km	185 km

4. RESULTS AND DISCUSSION

3.1 Results

The comparative results for both sites are shown in Tables 2 and 3. The results indicate that the estimated tipping fees are relatively close for both alternatives at each site. The long-haul option was estimated to be 22% higher cost than the local landfill development option for Park County, and 6% lower for Johnson County. These values are close enough such that for practical purposes, within the range of accuracy of the pro-forma, the long-haul versus local landfill development alternatives could be considered nearly equal. Thus the decision on which option would be best for each county might be determined based on considerations other than cost.

Table 2 – Economic results for Park County (preliminary).

Item	*Option 1 – Expand Local Landfill to Dispose MSW Waste and Continue C&D Pit*	*Option 2 – Close Local MSW Landfill, Operate Local C&D Pit, and Long Haul MSW Waste*
Annual Debt Service for Initial Investment	$ 360,715	$ 98,000 (includes cost for closed existing landfill)
Future Cell Development Fund	$ 418,000	$ 60,000
Annual Funding for Closure	$ 118,014	NA
Annual Funding for Site Operations	$ 1,802,905	$ 896,000
Funding for Long-Haul Transport	NA	$ 1,452,000
3rd-Party Tipping Fee	NA	$ 800,000
Total Annual Funding	$ 2,699,634	$ 3,306,000
Weight basis of tipping fee (tonnes)	24,450	24,450
TOTAL TIP FEE	$110/tonne	$135/tonne

Table 3. Economic results for Johnson County (preliminary).

Item	*Option 1 – Expand Local Landfill to Dispose MSW Waste and Continue C&D Pit*	*Option 2 – Close Local MSW Landfill, Operate Local C&D Pit, and Long Haul MSW Waste*
Annual Debt Service for Initial Investment	$ 196,000	$ 137,000 (includes cost for closed existing landfill)
Future Cell Development Fund	$ 339,000	$ 17,000
Annual Funding for Closure	$ 54,000	NA
Annual Funding for Site Operations	$ 459,000	$ 444,000
Funding for Long-Haul Transport	NA	$ 190,000
3rd-Party Tipping Fee	NA	$ 200,000
Total Annual Funding	$ 1,048,000	$ 988,000
Weight basis of tipping fee (tonnes)	7,200	7,200
TOTAL TIP FEE	$146/tonne	$137/tonne

3.2 Other Considerations

Other factors that could be taken into account for the long-term waste management decisions

with regard to landfilling are the following:

- The business and operations afforded by the local landfill operation can result in significant economic activity in a rural area. When the waste is exported, the money is also exported.
- For a local government-operated facility the landfill equipment and staffing can compliment other local government services such as public works, parks, and recreational services.
- The carbon footprint associated with long-hauling waste is greater than keeping the waste local.
- The factors affecting the tipping fee price may be more stable for the local option compared to the long-haul option. Specifically, the future costs of transportation and 3rd-party disposal contracts may be more volatile than in-county management.
- Long-haul and 3rd-party disposal contracts may have volume-based pricing that reduces incentives and opportunities for recycling.

There seem to be very few alternative arguments supporting the long-haul option. It appears that the main benefits of the long-haul option are:

- Convenience and simplicity.
- Avoiding controversy if the local landfill is a nuisance.
- Possible cost advantage depending on the transportation costs.

4. CONCLUSIONS

A methodical approach can be used to evaluate comparative landfill management options. The two readily apparent options for this case history were (1) expand the existing landfill sites using modern environmental control technology, and (2) long-haul waste to a large regional facility that has the compliant infrastructure.

Full-cost accounting can be used to compare the relative costs of these two options on a per-tonne basis. The full-cost accounting starts at the point of receipt of wastes at the local facility, and carries them through post-closure care.

Local tipping fees may be higher than 3rd-party tipping fees at large regional facilities. However, the transfer and transport costs to ship the waste to a regional facility may result in a total cost that is close to or greater than the local tipping fee cost.

There are additional benefits to consider in keeping a local landfill rather than long-hauling waste, such as supporting the local economy and long-term price stability. These considerations can weight the decision in favor of maintaining a local facility.

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