Value-Add: Modern-day Transfer of Waste: Necessary Evil (Electron Road Transfer Facility, Durban)

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ABSTRACT
The purpose of this paper is to highlight the unique considerations and elements in establishing such a Facility as the Electron Road Transfer Station – such a design and construction of such a Facility is a NECESSARY EVIL in our modern society, as costs to handle, manage and transport waste are rapidly increasing.

The establishment of such a facility need not be a short term measure nor a medium term measure but rather a long term intervention, adaptable to changes in society and the way waste is to be managed today and in time to come.

In December 2010, DSW commissioned Jeffares & Green (Pty) Ltd to undertake the civil, structural, mechanical and electrical design and implementation of the proposed Electron Road Transfer Station (waste management facility).

The site is located north of Durban central area, nearby the Umgeni River, just south of Umgeni Road and just east of the N2 national road.

DSW operates a central landfill site called Bisasar Road Landfill Site. This site is nearing closure, after which waste collection vehicles will be required to travel further. Such a distance of travel financially warrants the provision of a waste transfer station, to reduce transport costs. This is the primary consideration for today, but cannot be the argument for "tomorrow".

DSW does currently operate other transfer stations in varying forms and sizes (capacities).

1. THE FACILITY

The transfer-of-waste component of an integrated Facility can be in various forms such as:

- Type of Refuse Transfer Stations:
  - Open Top-loaded Containers or Trailers
  - Stationary Compactors
  - Pre-Compaction Systems (*This Facility*)
  - Baler Systems,
  - Other.

- Some waste transfer systems:
  - Inter-modal Container Systems;
  - Direct (*This Facility*) versus Pre-Compaction Systems (slugs);
  - Live Floors (Impact Conveyors);
  - Hook-Lift Systems;
  - Road (*This Facility*) Versus Rail;
  - Pre-Treatment Equipment;
  - Open-Top-loaded Trailers with Walking Floors;
  - Baling of Waste;
  - Other.

This multi-purpose facility is one of the first large-scale Greenfield Waste Management Facilities which includes a Refuse Transfer Station (RTS) (1,200 tonnes/day) in South Africa. The purpose of the RTS is to reduce the impact of expensive transportation (and related congestion) of waste and to rather optimise such transportation operations, thus it directly reduces carbon emissions.

A key focus for this facility was to move waste management towards a more sustainable municipal service, one that meets new national waste regulatory requirements, reduces waste transportation costs, provides employment opportunities, allows waste to be effectively diverted from landfill (depending on management of the Facility) and can enhance the beneficial use of waste.

2. SCALE OF THE FACILITY

This project is one example of a cost-reducing strategy. This is a Waste Management Facility, incorporating a transfer station which is able to receive waste from local household waste collection vehicles, compact this waste into specially designed containers. Each container load can carry that of two local waste collection vehicles (at least). These containers (often two at a time) are then taken by lower-maintenance long haul vehicles to landfill. That means one single load by a vehicle with lower running costs, “replacing” (what would have been) a trip by at least four other higher-cost vehicles on the roads. This also helps avoid Congestion.

Figure 1 below shows a slave vehicle loading one closed-compaction container to be taken and loaded onto a trailer or even at the magazine (to be loaded with waste).

Figure 1: A "closed compaction container" being collected for possible transfer to landfill.

The Facility encompassed a focal transfer building (Refuse Transfer Station (RTS)) with ancillary operations, such as 3 off pit-weighbridge system and billing stations, training and education facilities for knowledge transfer and skill development, amongst other operations.

Some of the values below highlight the level of involvement in the construction of the Facility:

- Estimate over 5,000m^3 of concrete.
- Estimate over >24,000m^2 of formwork,
- 500 tons of steel,
- 13,000m^2 of brickwork (walls, columns)
- 6,100m^2 of roof covering,
- 5km of trenching & pipework,
- 17,000 Terraforce blocks,
- 10,500m^2 of concrete surface,
- 11,100m^2 of brick surfacing

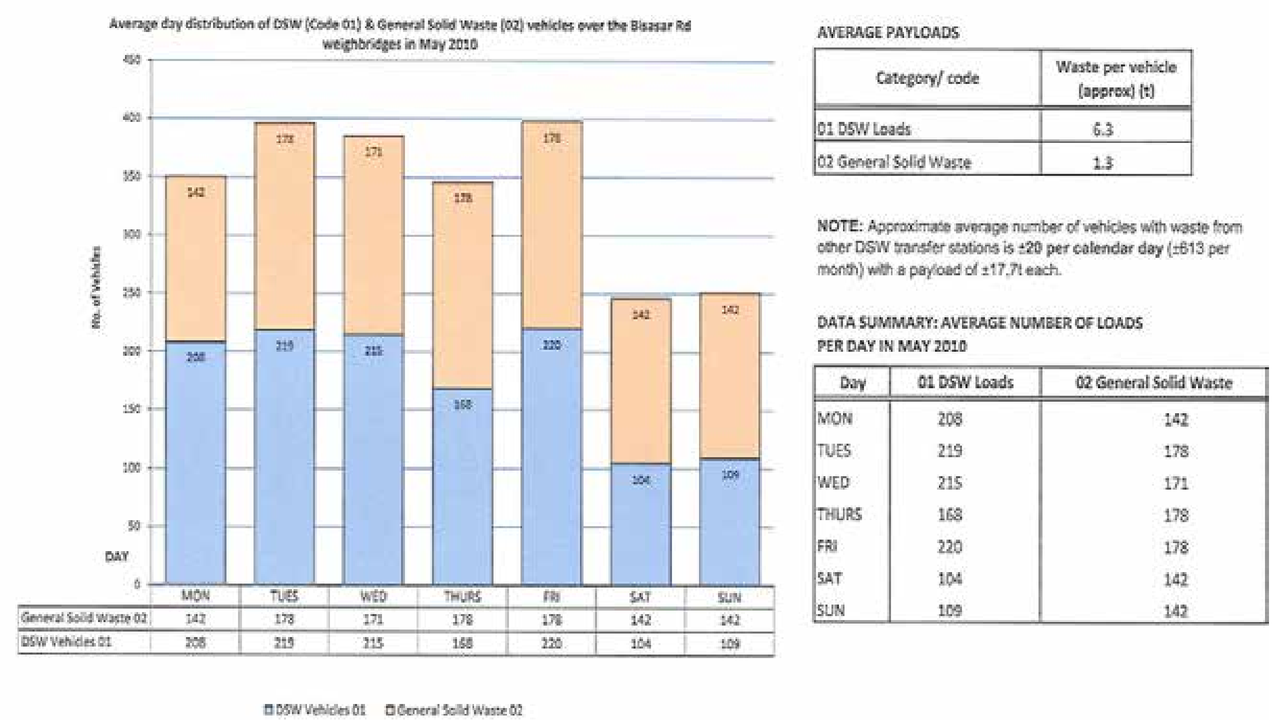
The involvement by a professional Team is extensive and broad. For this Contract:

- Over 25,000 hours of professional design and site work was used in completing the Facility.
- Over 402,000 man-hours was used to construct the facility. The Contract erred towards labour intensive construction methods to allow gain in experience and skills by work force.
- Design was done in compliance with current legislation and building codes.

3. COMPLEXITIES

The first major possible obstacle of any such facility is the allocation of erf size and shape of erf versus the required operation. This site was limited in both. The site is hexagonal and only 3,4 hectares in extent, which limits footprint size for the facility buildings, vehicle stacking and vehicle movements.

A key associated challenge is the accommodation of vehicle movements (vehicles delivering waste, vehicles handling containers and waste on the site, vehicles transferring the waste to other sites). The envisaged operation analysis is critical.



	MON	TUES	WED	THURS	FRI	SAT	SUN
General Solid Waste 02	142	178	171	178	178	142	142
DSW Vehicles 01	208	219	215	168	220	104	109

Category/ code	Waste per vehicle (approx) (t)
01 DSW Loads	6.3
02 General Solid Waste	1.3

Day	01 DSW Loads	02 General Solid Waste
MON	208	142
TUES	219	178
WED	215	171
THURS	168	178
FRI	220	178
SAT	104	142
SUN	109	142

Figure 2: Traffic Assessment Summary

Figure 2 above shows some data from the Traffic Impact Statement, as part of the project, to help identify stacking s\distances, vehicle numbers, etc.

Waste in itself is not consistent in nature. It is not consistent in character (moisture content, free liquids, bulk-mass items, level of organic waste, and amount of packaging waste) and a system was required to be able to process the varying characteristics of the waste. These elements alone need direct consideration when designing such a Facility.

	2007	2008	2009	2010	Total	Average pa
DSW Loads	417 266	409 782	432 175	411 929	1 671 153	417 788
General Solid Waste	67 090	75 737	69 507	66 493	278 827	69 707
Garden Refuse	39 920	34 651	35 274	36 621	146 466	36 617
Builder's Rubble	72 438	72 821	155 582	129 744	430 585	107 646
Mixed Loads	12 734	12 627	15 457	12 900	53 718	13 430
Sand & Cover Mat.	380 873	372 822	485 347	436 038	1 675 079	418 770
Tyres	1 777	1 102	684	505	4 068	1 017
Light Refuse	186	196	135	148	666	166
Other	53 970	42 817	21 988	15 958	134 734	33 683
Cover Mat.	93 514	23 250	4 821	2 220	123 805	30 951
Total Tonnage	**1 139 767**	**1 045 807**	**1 220 972**	**1 112 555**	**4 519 102**	**1 129 775**

Figure 3: Waste Characteristics and trend analysis

Some other key elements that needed attention:

- Pollution control, in detail, is required. This includes liquids squeezed or escaping from the waste-mass to special collection pits in the floors, or drainage from the compactor units.
- The height of the building and the timeframes which required special construction techniques, highlighted elsewhere in this motivation.
- The entire operation of this facility is dependent upon data, records and billing systems. This key control is done using special weighbridges of a particular length and width, with specialised drainage pits beneath (to control runoff of polluted stormwater). This data system, combined with data from the compaction units, provides critical information.

4. INNOVATION AND ORIGINALITY

No Facility can be replicated and each is designed to suit its own environment. The following items are some of the main elements that needed to be considered and evaluated in the design of the facility:

- Site extent was limited (3,4 hectares) so careful consideration was given to site layout, vehicle movement and building positions. Design elements were adopted from a facility in Hong Kong and made to suit the particular South African environment and labour situation.
- The first-time use of the modern-day compaction equipment and related side-pushers. These are specialised units from Germany, procured through a South African supplier and South African installer. See Figure 4 and Figure 5 below.
- Skills transfer and knowledge sharing. This was achieved through an allowance in the Contract between the Contractor and the Client to spend 6 months on site, shadowing the operator.
- By introducing side-pushers to the facility, the processing speed of the facility is massively enhanced and allows for the optimal use of the facility.

Figure 4: A main compactor ram unit which pushes waste into containers (containers are located outside the building). The compactor sits inside the building, on the floor beneath the offload platform (RTS floor).

Figure 5: One of the three compactors (photo is of the one “side-pusher”). Waste is collected in the large hopper "basket-type" unit above and a ram then pushes the waste into a container.

- A focal point of the project is the ±100m x 55m x 18m (length x width x height) refuse transfer station structure. The majority of the facility has no internal supports (columns) to allow for free movement of vehicles and fleet, which allows quicker movements, quicker turn-around times, and greater efficiencies. The ceiling also required a clearance height of 7,5m. See Figure 6 below for a photo of the completed internal Transfer Station floor.

Figure 6: Large open RTS floor for waste collection vehicles to carry out necessary pre-designed movements to offload waste into hoppers.

The RTS floor could not have any vertical supports (columns) as this would severely hinder traffic movement. The trusses and roofing span the entire width of the building, each truss specially designed.

- 80m long Bio-Swale and 3 off retention ponds were designed using the newly formulated SuDS system (Sustainable Urban Drainage Systems). See Figure 7 below. Provincial Government is now starting to recognise the new effective natural process for treatment of potentially polluted stormwater, by implementing this system for certain river catchments.

Figure 7: The newly constructed Bio-Swale with specially designed drainage system beneath and local vegetation for slow-treatment of runoff water. Slopes and grades are also designed to enhance sedimentation.

- New type of loading magazine that handles the roll-on, roll-off reinforced steel containers, was designed and constructed.
- Magazines allow for live-weighing of the containers so the operator of the facility can see immediately (before the containers are taken away) whether the containers have been optimally filled for transporting.
- The design of the building maximised natural light and natural airflow.
- Special attention was made to pollution prevention. The site now consists of a number of silt/ sand traps, oil traps and litter traps. This was done to allow key pollution prevention actions such as the capture of oils, litter, sand/ silt and to lower the COD (Chemical Oxygen Demand) of the effluent.
- Specialised control booths for optimal (natural visual) control of the Facility. The control booths also included glass flooring, for natural, unhindered view of the containers being loaded below.

Figure 8: View of one control booth and the open chute. (Waste collection vehicles would reverse up to the open chute and offload waste into the unit.)

Figure 9: Illustration of the glass flooring so the Operator can see the compaction containers below and have full control of the system.

5. SOCIAL AND COMMUNITY AND EMPOWERMENT:

The Construction Contract achieved over 15% of the construction value for its "Contract Participation Goal" which amounts to over R19 million spent on empowerment opportunities. This exceeded the required target.

The construction contract involved a budget for training and upliftment of less-skilled local residents and labour.

Over R73,000 was spent on direct dedicated training of less-skilled workers to enable better employment opportunities in the future, after this construction contract was complete.

The other benefit of this facility was employment creation. A range of new jobs will be created. The design of the Facility was to be more manual (labour) controlled rather than automated/mechanised controlled, where possible, as well as safe and logical.

6. GREENING INITIATIVES:

As part of the design of the Facility, certain "greening" was included in the design principles, such as:

- All external lights are on daylight switches,
- Maximised use of daylight on the apron floor,
- Stepped lighting inside the RTS building,
- Localised control of air conditioning units,
- Motion sensors on lights in offices/store,
- Use of recycled rubble for fill where possible,
- Litter and silt traps in catch pits,
- Rainwater harvesting to wash bays and floor washing (see Figure 10 below),
- Low flush toilets/hold flush,
- Low flow showerheads.
- The design of the entire Facility needed clear modelling of traffic movements, capacities and the structures themselves. This was accomplished by undertaking 3D-modelling.

Figure 10: Rainwater tanks. This required special attention to sizing of tanks, piping, overflow, pressure and pumps. This water allows the Municipality to avoid using domestic water for non-consumptive usage (floor washing, vehicle washing, container washing, etc.)

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